

Nutrición Hospitalaria



ÓRGANO OFICIAL DE LA SOCIEDAD ESPAÑOLA DE NUTRICIÓN PARENTERAL Y ENTERAL

ÓRGANO OFICIAL DE LA SOCIEDAD ESPAÑOLA DE NUTRICIÓN

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Nutr Hosp. 2015;(6)31:2337-2991 • ISSN (Versión papel): 0212-1611 • ISSN (Versión electrónica): 1699-5198 • CODEN NUHOEQ • S.V.R. 318

Incluida en EMBASE (Excerpta Medica), MEDLINE (Index Medicus), Chemical Abstracts, Cinahl, Cochrane plus, Ebsco, Índice Médico Español, preIBCS, IBCS, MEDES, SENIOR, Scielo, Science Citation Index Expanded (SciSearch), Cancellit, Toxline, Health Planning Administration y REDALYC

ISSN 0212-1611



9 770212 161004

Nutrición Hospitalaria

IMPACT FACTOR 2013: 1,250 (JCR)

www.nutricionhospitalaria.com

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DE SOCIEDADES DE NUTRICIÓN, ALIMENTACIÓN Y DIETÉTICA**

N.º 6

Junio 2015 • Vol. 31
Periodicidad mensual

Edición y Administración
GRUPO AULA MÉDICA, S.L.

OFICINA
Isabel Colbrand, 10-12
Oficina 140 Planta 5.ª - 28050 Madrid
Tel.: 913 446 554 - Fax: 913 446 586
www.aulamedica.es

Dep. Legal: M-34.850-1982
Soporte válido: 19/05-R-CM
ISSN (Versión papel): 0212-1611
ISSN (Versión electrónica): 1699-5198

Suscripción y pedidos
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Director: J. M. Culebras Fernández.
Redactor Jefe: A. García de Lorenzo.

Esta publicación recoge revisiones y trabajos originales, experimentales o clínicos, relacionados con el vasto campo de la nutrición. Su número extraordinario, dedicado a la reunión o Congreso Nacional de la Sociedad Española de Nutrición Parenteral y Enteral, presenta en sus páginas los avances más importantes en este campo.

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NUTRICIÓN HOSPITALARIA, es la publicación científica oficial de la Sociedad Española de Nutrición Parenteral y Enteral (SENPE), de la Sociedad Española de Nutrición (SEN), de la Federación Latino Americana de Nutrición Parenteral y Enteral (FELANPE) y de la Federación Española de Sociedades de Nutrición, Alimentación y Dietética (FESNAD).

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Artículo especial

Malnutrition, pharmaconutrition and other considerations in AL amyloidosis, a rare disease with masquerading symptoms and usually delayed diagnosis

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Abstract

Amyloid Light-chain (AL) amyloidosis is a very rare disease. Nutritional and pharmaconutritional aspects are described. Nutrition repletion of malnourished AL patients is an essential strategy for improving treatment efficacy and clinical outcomes. Early diagnosis of AL amyloidosis is difficult to establish due to the fact that signs and symptoms appearing mimic other processes that delay the final correct histological diagnosis. Untreated patients with this disease have a dismal outcome, with a median survival of 10-14 months from diagnosis. The sooner the treatment is established the better the results are. Modern chemotherapeutic agents, based primarily in cyclophosphamide, bortetomid and dexametason, produce a rapid, deep, and durable response in the majority of patients. Autologous stem cell transplantation remains restricted to selected patients who are generally without advanced cardiac amyloidosis.

(Nutr Hosp. 2015;31:2337-2345)

DOI:10.3305/nh.2015.31.6.7851

Key words: AL amyloidosis. Cardiac amyloidosis.

MALNUTRICIÓN, FARMACONUTRICIÓN Y OTRAS CONSIDERACIONES EN AMILOIDOSIS AL, UNA ENFERMEDAD RARA CON SÍNTOMAS EQUÍVOCOS Y RETRASO HABITUAL EN EL DIAGNÓSTICO

Resumen

La amiloidosis de cadenas ligeras (amiloidosis AL) es una enfermedad muy rara. En este artículo se describen los aspectos nutritivos y farmaconutritivos de la enfermedad. La renutrición de los pacientes con amiloidosis malnutridos es una estrategia esencial para mejorar la eficacia del tratamiento y el resultado a largo plazo. El diagnóstico precoz de la amiloidosis AL es difícil, debido a que los signos y síntomas que aparecen emulan otras entidades morbosas y retrasan el correcto diagnóstico histológico final. Los pacientes no tratados tienen un porvenir oscuro, con una supervivencia media de entre 10 y 14 meses desde el diagnóstico. Cuanto antes se establezca el tratamiento, mejores son los resultados. Los agentes quimioterapéuticos modernos, en concreto ciclofosfamida, bortezomid y dexametasona, producen una respuesta rápida, importante y duradera en la mayoría de los pacientes. El trasplante de células autólogas debe restringirse a un grupo selecto de pacientes sin enfermedad cardíaca avanzada secundaria a la amiloidosis.

(Nutr Hosp. 2015;31:2337-2345)

DOI:10.3305/nh.2015.31.6.7851

Palabras clave: Amiloidosis AL. Amiloidosis cardíaca.

Introduction

Amyloid Light-chain (AL) amyloidosis is a very rare disease. Antibody-producing cells do not function properly and elaborate abnormal protein fibers made

of components of antibodies called light chains. These light chains come together to form amyloid deposits in multiple organs which can cause serious damage. AL amyloidosis must always be confirmed histologically. A biopsy specimen should stain positively with Congo red and demonstrate apple-green birefringence under polarized light.

Untreated patients with this disease have a dismal outcome, with a median survival of 10-14 months from diagnosis¹.

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Recibido: 24-VII-2014.

Aceptado: 11-II-2015.

Report of one case

Sixty seven year old white Caucasian male. No known allergies. No toxic habits. No familial history of hematological disorders.

Personal history

- Pharmacology treated arterial hypertension, since 8 years before.
- Mild hyperuricemia; no treatment necessary.
- Megacolon. Chronic constipation.
- Surgical operations: tonsillectomy at 30 y.o. Anal fissure 8 years ago. Right carpal tunnel syndrome surgically released in August 30/2013. Mild improvement.
- Present treatment: Dexametasone, aciclovir 800/day, seprim, lanzoprazol, amiodarone, sintrom, furosemid 20 mg/d, spironolactone and zolpiden. Green tea regularly.

Present disease

The patient suffers paresthesias in both hands since January 2013, being diagnosed bilateral carpal tunnel syndrome, with right predominance. Progressive dyspnea during the last six months with dry cough; (diastolic disfunction in EKG) and auricular flutter (Nov 2013). Blood pressure normalized, not needing pharmacological treatment any more. Weight loss of 8Kg, erectile malfunction, and voice changes. No orthostatic hypotension, ortopnea or nocturnal paroxysmal dyspnea. No diarrhea, (Chronic constipation).

Laboratory findings

Blood: creatinine 0.8 mg/dl; normal liver biology (included Alk. Phosphatase); total proteins 63g/L. Serum proteogram with small beta band (13%); albumin 37 g/L. Serum immune fixation: Bence Jones kappa type protein. Free serum light chains: 6800 mg/L, lambda 8,3mg/L; ratio 816. Normal blood coagulation (Quick time 90%) Urine analysis: proteins: 600 mg/24 hours composed of light chains. Urine immune fixation: Bence Jones kappa type. Medullar biopsy: 10-15% plasma cells (aberrant phenotype, kappa restriction). Negative red Congo stain. In FISH study, numerical and structural alteration of ATM gen (11q22) in 12% of analyzed cells (600). Abdominal fat biopsy: no evidence of abdominal amyloid deposits (a second abdominal biopsy performed three weeks later in another institution gave positive results). Rectal biopsy: Inflammatory changes and stromal changes, red Congo positive.

Cardiological study

Troponin I: 0.11 ng/mL (Normal values < 0.08) NT pro BNP: 3570 pg/ml (NV <125). EKG: sinusual arrhythmia, low voltage in extremities and poor voltage in precordial area.(Fig 1) Echocardiogram: Left ventricle with slight increase in septal width (13 mm) concentrically with back wall. Ejection Fraction (EF) 60%. Aortic, mitral and tricuspid valves slightly thickened. Slight biauricular dilatation. (Fig. 2).

Cardiac magnetic resonance (MR): concentric myocardial hypertrophy with septal predominance (14 mm). EF: 64%; slight biauricular dilatation; slight pericardial effusion, compatible with cardiac amyloidosis. (Figs. 3-5).

Several auricular fibrillating episodes needing electric cardiac cardio version in two occasions, (catheter ablation radiofrequency of the tricuspid cV isthm) and, finally, bicameral definitive pacemaker implanted (St

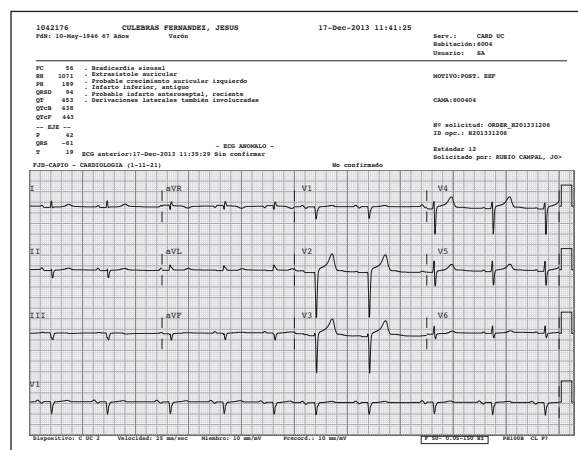


Fig. 1.—ECG shows low voltages in the QRS complexes and pseudo infarct; pattern typical of amyloidosis.

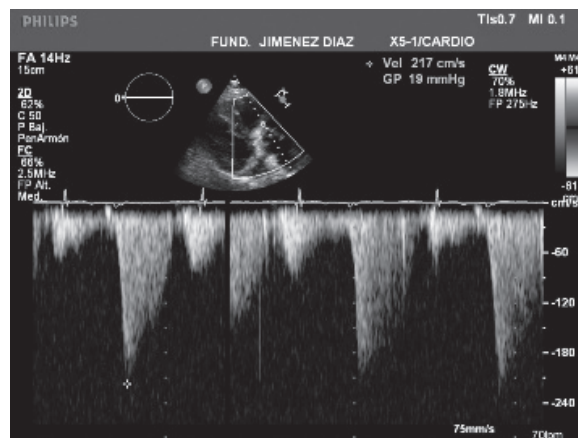


Fig. 2.—The echocardiogram showed moderate concentric hypertrophy (septum thickness 13 mm), pattern of diastolic dysfunction (pseudo normal wave pattern), and moderate biauricular enlargement. No evident granular sparkling of the myocardium was visible.

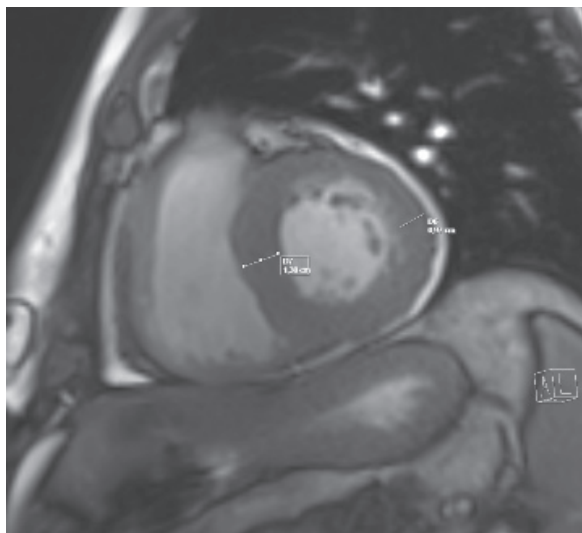
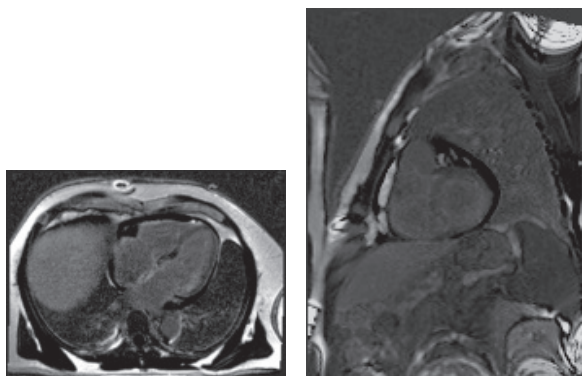


Fig. 3.—Magnetic Resonance Imaging. Short axis, basal and medial level, showing concentric hypertrophy (septum 13,8 mm) and minimal pericardial effusion.



Figs. 4a and b.—Late gadolinium enhancement (LGE), four chambers and short axis. Late gadolinium enhancement shows difficulties in finding the correct inversion time with characteristic global, subendocardial LGE with slight hypertrophy (maximum wall thickness in this case was 13.8 mm).

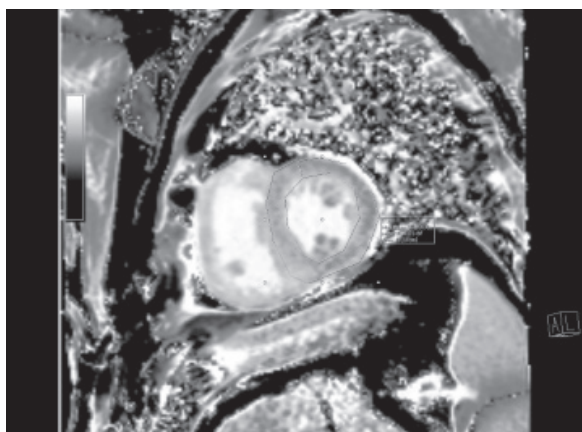


Fig. 5.—Short axis T1 mapping was performed without contrast administration. Myocardial T1 was significantly elevated compared to normal subjects.

Jude Accent DR MR en DDDr 70-120 lpm con AV 300 ms) in January 7, 2014.

At present the patient is receiving diuretic treatment, antiarrhythmic drug (amiodarone) and anticoagulants.

In Dec 2, 2013 chemotherapy treatment was started, with oral cyclophosphamide, (600 mg, days 1,8 and 15), subcutaneous Bortezomid (1.3 mg/m², days 1,4,8 and 11) and oral dexametasone (reduced doses from 40 to 20 mg, days 1,4,8 and 11) in cycles of 21 days (CyBorD). Patient completed six cycles. A significant reduction of circulating free kappa light chains was obtained with this treatment (159 mg/L) having acceptable tolerance.

Clinical exploration

Blood pressure: supine 119/79; sitting: 122/89; standing up: 115/77 mmHg. No blood diathesis. Normal tongue. No peripheral adenopathies. CVA: rhythmic tones (patient with pacemaker). No murmurs, Bimaleolar subedemas. Positive jugular ingurgitation 7-8 cm. Subcrepitant noise in left pulmonary base. Abdomen: globulous, painless, liver border palpated in deep inspiration.

Laboratory findings.

(Hospital Clinic I Provincial, Barcelona, December 17, 2013)

Normal biochemistry, included creatinine and alkaline phosphatase; slight hipertriglicemia. TGP 45 U/L. GGT 164U/L. Total proteins 62g/L. Serum proteogram without band. Seric immune fixation: restricted motility component constituted by IgC-kappa, monoclonal nature. Urinary protein: 141mg/24h. Urine immune fixation: restricted motility component detected, constituted by free kappa light chains; monoclonal nature. Troponin I: 0.081 ng/mL (Reference values <0.050). BNP 326 pg/mL (Ref. values 4-37) Normal hemogram, except for slight neutrofilic leucocitosis. GSR 8 mm/h. Quick time 29% (Treatment with warfarin; factor X: 19U/dL (Reference values 65-135) Negative serology for HIV, HBV and HCV. Normal thyroid profile. IgM dossification: <0.16 g/L (RV 0.36-2.61) IgA: normal, IgG 6.1 g/L (RV 6.8-15.3) Free kappa light chains in serum: 110 mg/L (RV 3.3-19.4), lambda: 2.94 mg/L (RV 5.71-26.3); ratio 37. PAAF of subcutaneous fat: amyloid deposits (Red Congo positive)

Complementary explorations

Echocardiogram: compatible with restrictive miocardiopathy. Moderately hypertrophic left ventricum (SIVtd 14 mm), non dilated; normal global motility. Ejection Fraction (EF) 65%. Diastolic function not evaluable due to bicameral pacemaker rhythm, but

with restrictive type alterations. Mild mitral insufficiency. Enlarged valves with normal motility. Mild aortic insufficiency, with normal opening. Slightly dilated right ventricle, not hypertrophied, with normal global motility. Slight tricuspid insufficiency. Enlarged veils with slightly restricted motility. Normal systolic pulmonary arterial pressure (estimated 32mmHg) Moderate right atrial dilatation and slight left atrial dilatation. Inferior vena cava slightly dilated with normal inspiratory collapse.

Pacemaker electrodes in right cavities. Slight pericardial effusion.

To summarize, this is a 67 y.o patient with recent diagnosis of light chain kappa amyloidosis, with cardiac (Functional class II, Mayo cardiac stage III) soft tissue (carpal tunnel syndrome) and digestive (Rectum positive Congo red) involvement. Following six cycles with CyBorD the response is excellent, with adequate tolerance. The patient had a "very good partial response". For this reason further treatment with six cycles with cyclophosphamide (650 mg/m² every 4 weeks) and prednisone (30 mg every other day) were conducted until September 2014. Intensification of the treatment with autologous stem cell transplantation (ASCT) and melfalan 200 mg was disregarded. Cardiac staging has been reevaluated by means of biomarkers in serum, echocardiogram and cardiac MR.

Early diagnosis of al amyloidosis

Early diagnosis of AL amyloidosis is difficult to establish due to the fact that signs and symptoms appearing mimic other processes that delay the final correct histological diagnosis. Every effort must be made towards early detection and diagnosis of AL amyloidosis. There is a direct correlation between early diagnosis and better clinical outcome.(Table I)

Pharmacological treatment

Pharmacological treatment of AL amyloidosis is based primarily in cyclophosphamide, bortezomib and dexamethasone. This combination (CyBorD) produces a rapid, deep, and durable response in the majority of patients with AL, even in the setting of cardiac and multiorgan impairment. Given the time delays of stem cell transplantation, CyBorD may be the fastest and most effective regimen to be reported².

Conventional chemotherapy and intensive treatment with stem cell transplantation

Several studies have shown the efficacy of high-dose dexamethasone-based regimens in inducing haematological responses and prolonging survival. Impressive efficacy, with > 60% haematological response, has

been reported with melphalan-dexamethasone regimens³ with median survival up to 5 years. In experienced centers, intensive treatment and ASCT obtains a similar haematological response rate⁴. ASCT remains restricted to selected patients who are generally without advanced cardiac amyloidosis. In 2007, a French multicentre randomized prospective trial showed that, compared with ASCT, melphalan-dexamethasone had similar efficacy with less toxicity, resulting in increased survival (22.2 months in the ASCT group and 56.9 months in the group with oral melphalan-dexamethasone; $P = 0.04$). A recent study by Cibeira et al⁵ showed that treatment of selected AL patients with high-dose melphalan and autologous stem cell transplantation resulted in a high organ response rate and long overall survival, even for those patients who did not achieve complete response.

Whereas ASCT is still commonly used in the USA in patients without severe disease, it is no longer used in most European countries, except Germany. Melphalan-dexamethasone has become the first-line treatment in France for the majority of patients³.

The proteasome inhibitor bortezomib, a relatively novel chemotherapeutic agent, is offering a much larger percentage of complete and partial remissions. Bortezomib with cyclophosphamide and dexamethasone is showing good tolerance and impressive response rates. This combination, due to its very rapid efficacy, is now the treatment of choice for primary AL amyloidosis

Warfarin anticoagulation

Unless major contraindications exist, the presence of atrial fibrillation in AL amyloidosis is a very strong indication for warfarin anticoagulation because of a very high rate of thromboembolic events. In severe cardiac amyloidosis, the atrium is infiltrated, and dysfunctional and atrial thrombi may be present even during sinus rhythm. It is therefore prudent to anticoagulate patients with AL amyloidosis even if they are in sinus rhythm if there is a small transmitral A wave seen on transthoracic echocardiography (< 20 cm/s)⁶.

Malnutrition in AL amyloidosis

Malnutrition is associated with changes in body composition, delayed wound healing, decreased functional capacity, impaired immune function, changes in the different organ systems and intolerance to medical treatment or surgical interventions⁷. Malnutrition leads to sarcopenia. The concept of sarcopenia implies loss of muscle mass and function. It is a condition that accompanies aging, although it not always has clinical consequences. It is produced by many factors: nervous system (loss of alpha motor units in the spinal cord), muscular (loss of muscle quality and mass), humoral

Table I <i>Clinical signs and symptoms that could have given the opportunity to make an earlier diagnosis</i>					
<i>Date</i>	<i>Symptoms</i>	<i>Consultant</i>	<i>Dyagnosis</i>	<i>Action</i>	<i>Comments</i>
Jan 6/2013	Mild finger paresthesias	Neurologist. Informal conversation	Distal paresthesias	Suggested large doses of Vit B (METANX)	<i>"There are more than 50 causes of distal paresthesias. DM, metabolic syndrome, hypothyroidism..."</i>
June 2013		Neurologist. Informal conversation	Bilateral finger paresthesias	None	<i>"Functional symptoms"</i>
August 2013	Bilateral finger paresthesias and loss of sensitivity	Electromyography	Bilateral medial impairment. Right sural impairment	Recommend carpal tunnel decompression	<i>"Very common at 67 years old"</i>
September 2013	Carpal tunnel syndrome	Plastic Surgery		Right carpal decompression	<i>Operation uneventful. "Symptoms take several months to subside."</i>
September 2013	Progressive muscle weakness. Lack of elasticity down slope	Informal conversation with colleagues	Overweight. Age 67	Loose weight	
October 2013	Dry cough	ENT	Mild gastro esophageal reflux.	Laryngoscopy	
November 2013	Progressive heart insufficiency, especially upslope	Cardiologist	Diastolic malfunction. Fevi 55% Low voltage		<i>Mild alterations normal at 67 y.o</i>
November 2013	Diastolic malfunction	Radiologist	TC and MR alterations, suggestive of amyloidosis. Light chain proteins in blood and urine	Fat biopsy. Rectal biopsy, Bone marrow biopsy, cardiac TC, cardiac MR, blood and urine analytics	<i>Check with Hematology</i>
November 2013	Amyloidosis?	Hematology	Histologically proven AL Amiloidosis	Start treatment CyBorD	

(decrease in anabolic hormones such as testosterone, estrogens, GH and increase of several interleukines), and life style (physical activity). The main clinical consequences of sarcopenia relate with functional independence. Thus, the sarcopenic patient has greater difficulty walking, or does it more slowly, climbing up stairs, or doing basic daily living activities. These difficulties increase the risk for falls and fractures. They also affect bone formation, glucose tolerance, and body temperature regulation. Besides, dependency is a mortality risk factor.

Malnourished patients are at risk of experiencing infectious and cardiorespiratory complications^{8,9}, increased morbidity and mortality and prolongation of hospital stay. Nutritional intervention is essential, including patients with good previous nutritional status,

since the worsening of nutritional status due to critical illness will be a determinant factor of poor subsequent outcome¹⁰.

AL amyloidosis is often diagnosed at an advanced stage, when treatment perspectives are limited or patients are less likely to tolerate chemotherapy. Nutrition status should be systematically evaluated in AL with simple and objective measurements. Malnutrition at diagnosis of AL amyloidosis is a frequent comorbidity and an independent predictor of mortality. The prognostic value of nutrition status becomes evident approximately 4-6 months after diagnosis, when treatment response can be expected. Future research may demonstrate that nutrition repletion of malnourished AL patients is an essential strategy, including those with good previous nutritional status, for improving

Table II
Timing between clinical suspicion, diagnosis and treatment in the clinical case described

<i>Date</i>	<i>Action</i>	<i>Comments</i>
Nov/21/2013	Echocardiogram Subcutaneous abdominal fat biopsy	Amyloidosis to be ruled out
Nov/27/2013	Blood and urine analysis, echocardiogram, rectal biopsy, bone marrow biopsy, heart MR, heart TC. Clinical consultation with Internal Medicine and with haematology	Clinical determinations to rule out amyloidosis
Nov 28/2013	Light chain elevated 6800 mg/L. Red Congo staining positive in rectal biopsy	Primary amyloidosis confirmed
Dec 2/2013	First cycle CyBorD started	First Cycle well tolerated and completed dec 12
Dec 23/2013	Second cycle CyBorD started	Second Cycle well tolerated and completed Jan 2, 2014
Jan 1/2014	Third CyBorD cycle started	

treatment efficacy and clinical outcomes¹¹. In AL amyloidosis, malnutrition at diagnosis is a frequent comorbidity that affects the prognosis independently of hematologic response to treatment and cardiac stage. Nutrition status should be systematically considered in future intervention trials in AL amyloidosis. Nutrition support trials are warranted.

Pharmaconutrition; functional food

It has been demonstrated, or at least suspected in many instances, that specific nutrients do play a role in nutritional metabolic support. Glutamine, arginine, ω -3 fatty acids, and RNA have shown beneficial effects postoperatively following abdominal surgery through the beneficial effect of pharmaconutrition in wound healing and in reduction in suture dehiscences. Given the essential action of micronutrients (vitamins, trace elements) in maintaining immune and antioxidant system function, their supply is necessary in any patient susceptible to these deficiencies, even if of subclinical type. In some instances certain micronutrients or antioxidants exert a proven or suggested specific effect and therefore should be recommended¹²

A food can be regarded as “functional” if it is satisfactorily demonstrated to affect beneficially one or

Table III
Differential diagnosis of amyloidosis

- Idiopathic peripheral neuropathy
- Bilateral distal progressive paresthesia
- Carpel tunnel syndrome
- Automatic nervous system involvement: syncope, erectile dysfunction, gastroparesis, and diarrhea. gastric-emptying disorder, pseudo-obstruction, voiding dysfunction
- Nephrotic-range proteinuria, with or without renal insufficiency
- Heart failure or fatigue secondary to restrictive cardiomyopathy
- Echo: mean wall thickness > 12 mm, no other cardiac cause
- Unexplained hepatomegaly
- unexplained voice changes (larynx)
- Soft-tissue involvement : tongue enlargement, submandibular swelling, recurrent periorbital purpura, amyloid lymphadenopathy, claudication of the limbs or jaw
- Clinical Arthropathy
- Myopathy by biopsy or pseudohypertrophy
- Lung: Interstitial radiographic pattern

more target functions in the body, beyond adequate nutritional effects, in a way which is relevant to either the state of well-being and health or the reduction of the risk of a disease. The beneficial effects could be either maintenance or promotion of a state of well-being or health and/or a reduction of the risk of a pathologic process or a disease.

Green tea contains an active polyphenol called Epigallocatechin Gallate (EGCG). Consumption of EGCG in patients with cardiac involvement with AL amyloidosis apparently causes a significant decrease in left ventricular wall thickness and mass, as well as an improvement in NYHA functional classification and left ventricular ejection fraction.

Green tea might be useful to diminish cardiac amyloid deposits and improve function in AL amyloidosis. The effects of dietary supplement with epigallocatechin gallate (EGCG) are currently in progress. The end point of these studies is to clarify if EGCG causes a significant decrease in left ventricular wall thickness and mass, as well as an improvement in NYHA functional classification and left ventricular ejection fraction.

A Phase II open-label randomized study of dietary supplement with epigallocatechin gallate (EGCG) to improve cardiac dysfunction in patients with AL amyloidosis is being conducted in Pavia, Italy. The

Table IV
Organs potentially involved in AL (primary) amyloidosis

- Heart
- Kidneys
- Liver
- GI system
- Nervous system

Table V
Hematologic (Immunochemical) Response Criteria

- **Complete response (CR)**
Serum and urine negative for a monoclonal protein by immunofixation
Free light chain ratio normal
Marrow < 5% plasma cells
- **Partial response (PR)**
Serum M component > 0.5 g/dL, a 50% reduction
Light chain in the urine with a visible peak and >100 mg/day and 50% reduction
Free light chain >10 mg/dL (100 mg/L) and 50% reduction
- **Progression From CR**
Any detectable monoclonal protein or abnormal free light chain ratio (light chain must double)
- **From PR or stable response,**
50% increase in serum M protein to > 0.5 g/dL or 50% increase in urine M protein to > 200 mg/day;
A visible peak must be present
Free light chain increase of 50% to >10 mg/dL (100 mg/L)
- **Stable**
No CR, no PR, no progression

recruitment period of this study is being conducted at this time. Therefore results will not be available until at least 2016¹³.

Cardiac complications of myocardial amyloid fibril deposition

An update in diagnosis and management of cardiac amyloidosis has been published by Mohty et al¹⁴. Symptoms are non-specific: dyspnoea due to heart failure, syncope, vertigo due to rhythm or conduction disorders and, rarely, chest pain. This is the reason why diagnosis is delayed (Tables I-IV). Cardiac involvement may have many serious consequences: severe congestive heart failure with initially preserved LVEF and decreased LV compliance due to amyloid deposit, and advanced diastolic dysfunction; decreased LVEF may follow diastolic dysfunction, leading to terminal and fatal heart failure; chronic elevated LV filling pressure leads to left atrial enlargement then to paroxysmal or persistent atrial fibrillation; atrial thrombi are frequent in cardiac amyloidosis, even in patients with sinus rhythm, and can cause systemic embolic events;

non-sustained or sustained ventricular arrhythmias are also potential complications of cardiac amyloidosis; conduction disturbances are prevented and treated by pacemaker implant; orthostatic hypotensive episodes are due to autonomic dysfunction and/or neurovegetative involvement or have a hypovolemic cause; severe dysautonomia can cause syncope and hypotensive cardiac treatment (angiotensin-converting enzyme inhibitors) should be avoided in these patients; autonomic dysfunction can be also expressed by the loss of heart variability; indeed, an SDNN < 50 ms on a 24-hour Holter ECG was found to be an independent predictor of short-term mortality in AL patients¹⁵; chest pain may occur in rare cases where amyloid deposits affect the microcoronary circulation, whereas the macrocoronary vessels are usually free of significant stenosis¹⁶.

EKG disturbances in AL amyloidosis

Electrocardiograms (ECGs) are abnormal in 90% of cases with cardiac involvement. The largest study that reported ECG findings consisted of 127 patients with AL and biopsy-proven cardiac involvement¹⁷. The study confirmed that the two most common abnormalities were low voltage QRS complex (defined as all limb leads < 5 mm in height) and a pseudo infarct pattern on the precordial leads which were seen in roughly 50% of the patients included. Right and left bundle branch block are uncommon. Other changes that may occur include conduction abnormalities (such as second and third degree atrioventricular block), more frequently atrial fibrillation¹⁸ and, rarely, ventricular tachycardia. A fragmented QRS (notches and RsR' pattern in the absence of QRS prolongation) is significantly more frequent in patients with cardiac amyloidosis¹⁹ (Fig. 2).

Cardiac supportive treatment

Apart from specific treatment of the underlying haematological disease, symptomatic treatment and supportive care are necessary in patients with organ failure. Most drugs commonly used for the treatment of congestive heart failure are inefficient or appear to be dangerous in patients with AL amyloidosis²⁰. Beta-blockers are deleterious because they decrease heart rate, which is the only mechanism that can maintain cardiac output in this disease; they may also aggravate autonomic dysfunction like angiotensin-converting enzyme inhibitors. Digitalis has been shown to accumulate in cardiac amyloid deposits. For this reason, digitalis is not recommended²¹.

Loop diuretics, given at high dosage in patients with severe fluid retention, are the mainstay of management. Amiodarone should be considered as first-line therapy for arrhythmia. Anticoagulation therapy is mandatory in patients with supraventricular arrhythmias.

mia but needs to be discussed in patients with sinus rhythm and severe contractile atrial dysfunction. Pacemaker implantation may be indicated in patients who develop symptoms of bradycardia or conduction disorders. A heart transplant should be considered in selected young patients with advanced amyloid cardiomyopathy free from other comorbidities^{22,23}.

Prognosis in AL amyloidosis

Survival depends mainly on the extension and severity of organ involvement, particularly the presence of amyloid heart disease, and on the haematological response to therapy. Prognosis is influenced relatively little by the underlying, usually non-proliferating, monoclonal plasma cells, even though bone marrow plasma cell infiltration higher than 10% has been associated with poorer outcome²⁴. (Table V).

Only 15 years ago, survival in AL amyloidosis was poor, with a median overall survival of 18 months²⁵. Since then, the disease prognosis has been transformed with the development of new strategies that efficiently suppress secretion of amyloid-forming LCs, giving a median survival of > 5 years. Early diagnosis is therefore a critical step to avoid irreversible damage, especially to the heart.

Final considerations and conclusions

AL amyloidosis is a rare disease with equivocal and masquerading symptoms. Delayed diagnosis is a major factor in poor prognosis. Every effort must be made to make the diagnosis earlier. Timely diagnosis is a great concern. Untreated patients with this disease have a dismal outcome, with a median survival of 10-14 months from diagnosis.

Amyloidosis should be ruled out in all patients suffering carpal tunnel syndrome. The societies of Neurology and Neurosurgery should establish this protocol mandatory. Monoclonal protein testing of the serum and urine is readily available and should be performed on all suspected cases. AL amyloidosis is the most common and dangerous form of amyloidosis and definitely should be ruled out. In addition to serum and urine protein electrophoresis and immunofixation, serum free light chain test can increase the sensitivity (especially in monoclonal light chain only cases) by 10%-15%.

AL amyloidosis must be ruled out also in diastolic insufficiency syndrome and in rapidly developing miocardiopathy. A patient with dyspnoea, unexplained fatigue and LV hypertrophy on TTE contrasting with the microvoltage of QRS amplitude should alert the clinician to an infiltrative process rather than a classical sarcomeric hypertrophic or hypertensive cardiomyopathy; in this case it is important to refer the patient to a specialist in internal medicine and/or a hematolo-

gist to perform more specific biological and/or genetic testing.

Extracardiac signs, in addition to unexplained LV thickening on echocardiography in the absence of increased voltage on ECG, favour amyloid cardiomyopathy.

The proteasome inhibitor bortezomib, a relatively novel chemotherapeutical agent, is offering a much larger percentage of complete and partial remissions. Bortezomib with cyclophosphamide and dexamethasone is showing good tolerance and impressive response rates. This combination, due to its very rapid efficacy, is now the treatment of choice for primary AL amyloidosis.

Apart from specific treatment of the underlying haematological disease, symptomatic treatment and supportive care are necessary in patients with organ failure.

Unlike other causes of heart failure, supportive treatment is usually very limited and can be dangerous. Despite important developments in chemotherapy for AL, the prognosis of patients with advanced cardiac involvement remains poor. Finally, a variety of novel specific therapies are on the horizon, which can inhibit new amyloid formation and enhance clearance of existing deposits. Patients should be instructed to control water intake, body weight and urine output on a daily basis in order to prevent overloads and subsequent cardiac insufficiency.

Due to the occurrence of severe cardiac complications, ASCT cannot be offered to all diagnosed patients. Aged patients, i.e. 65 years old or more, should be critically evaluated for transplantation. ASCT remains restricted to selected patients who are generally without advanced cardiac amyloidosis.

Beta-blockers and digitalis, commonly used for the treatment of congestive heart failure, are inefficient or appear to be dangerous in patients with AL and must not be used. Amiodarone should be considered as first-line therapy for arrhythmia.

Loop diuretics, given at high dosage in patients with severe fluid retention, are the mainstay of management. Patients should be instructed to control water intake, body weight and urine output on a daily basis in order to prevent overloads and subsequent cardiac insufficiency.

Anticoagulation therapy is mandatory in most AL amyloidosis.

Pacemaker implantation may be indicated in patients who develop symptoms of bradycardia or conduction disorders. A heart transplant should be considered in selected young patients with advanced amyloid cardiomyopathy, free from other co morbidities.

Acknowledgements

The authors appreciate the contributions and comments made by the hematologists Elena Prieto (Funda-

cion Jimenez Diaz , Madrid) Joan Blade (Hospital Clinic I Provincial, Barcelona), Teresa Cibeira (Hospital Clinic I Provincial, Barcelona) and Maria Victoria Mateos (Hospital Clinico Universitario, Salamanca)

Authors disclosure statement

The authors have no conflicts of interest.

References

1. Skinner M, Anderson J, Simms R, et al. Treatment of 100 patients with primary amyloidosis: a randomized trial of melphalan, prednisone, and colchicine vs colchicine only. *Am J Med.* 1996; 100(3):290-298.
2. Gatt ME and Palladini G. Light chain amyloidosis 2012: a new era. *British Journal of Haematology*, 2013, 160, 582-598.
3. Jaccard A, Moreau P, Leblond V, et al. High-dose melphalan versus melphalan plus dexamethasone for AL amyloidosis. *N Engl J Med* 2007;357:1083-93.
4. Sancharawala V. Role of high-dose melphalan and autologous peripheral blood stem cell transplantation in AL amyloidosis. *Am J Blood Res* 2012;2:9-17.
5. Cibeira MT, Sancharawala V, Seldin DC, Quillen K, Berk JL, Dember LM, et al. Outcome of AL amyloidosis after high-dose melphalan and autologous stem cell transplantation: long-term results in a series of 421 patients. *Blood* 2011; 118: 4346-4352.
6. Rodney H. Falk. Diagnosis and management of the cardiac amyloidoses. *Circulation.* 2005;112:2047-2060.
7. Culebras-Fernández JM, de Paz-Arias R, Jorquera-Plaza F, García de Lorenzo A. Nutrition in the surgical patient: immunonutrition. *Nutr Hosp* 2001 May-Jun;16(3):67-77.
8. De Luis DA, Culebras JM, Aller R, Eiros-Bouza JM. Surgical infection and malnutrition. *Nutr Hosp.* 2014 Sep 1;30(3):509-13.
9. Culebras JM. Malnutrition in the twenty-first century: an epidemic affecting surgical outcome. *Surg Infect* 2013 Jun;14(3):237-43.
10. Culebras JM, Martín-Peña G, García-de-Lorenzo A, Zarazaga A, Rodríguez-Montes JA. Practical aspects of peripheral parenteral nutrition. *Curr Opin Clin Nutr Metab Care.* 2004 May;7(3):303-7.
11. Caccialanza R, Palladini G, Klersy C, Cereda E, Bonardi C, Cameletti B et al. Malnutrition at diagnosis predicts mortality in patients with systemic immunoglobulin light-chain amyloidosis independently of cardiac stage and response to treatment. *JPEN J Parenter Enteral Nutr.* 2014 Sep;38(7):891-4.
12. Sanchez Álvarez, C.; Zabarte Martínez de Aguirre, M.; Bordeje Laguna, L. Guidelines for specialized nutritional and metabolic support in the critically-ill patient: Update. Consensus SEMICYUC-SENPE: Gastrointestinal Surgery. *Nutr Hosp* 2011 Nov;26 Suppl 2:41-5.
13. Epigallocatechingallate (EGCG) in Cardiac AL Amyloidosis (EpiCardiAL). CLINICAL TRIAL RECORDS, NIH <http://www.clinicaltrials.gov/ct2/show/NCT01511263?term=NC-T01511263&rank=1>
14. Mohty D, Damy T, Cosnay P, Echahidi N, Casset-Senon D, Viot P et al. Cardiac amyloidosis: Updates in diagnosis and management. *Archives of Cardiovascular Disease* (2013) 106, 528-540.
15. Reyners AK, Hazenberg BP, Reitsma WD, et al. Heart rate variability as a predictor of mortality in patients with AA and AL amyloidosis. *Eur Heart J* 2002;23:157-61.
16. Tsai SB, Seldin DC, Wu H, et al. Myocardial infarction with “clean coronaries” caused by amyloid light-chain AL amyloidosis: a case report and literature review. *Amyloid* 2011;18:160-4.
17. Murtagh B, Hammill SC, Gertz MA, et al. Electrocardiographic findings in primary systemic amyloidosis and biopsy-proven cardiac involvement. *Am J Cardiol* 2005;95:535-7.
18. Feng D, Edwards WD, Oh JK, et al. Intracardiac thrombosis and embolism in patients with cardiac amyloidosis. *Circulation* 2007;116:2420-6.
19. Perlino S, Salinaro F, Cappelli F, et al. Prognostic value of fragmented QRS in cardiac AL amyloidosis. *Int J Cardiol* 2012.
20. Bouhour JB, Haddak M, Lefevre M. Risks of beta-blockers and calcium inhibitors in amyloid cardiopathy. *Presse Med* 1986;15:981.
21. Rubinow A, Skinner M, Cohen AS. Digoxin sensitivity in amyloid cardiomyopathy. *Circulation* 1981;63:1285-8.
22. Mignot A, Varnous S, Redonnet M, et al. Heart transplantation in systemic (AL) amyloidosis: a retrospective study of eight French patients. *Arch Cardiovasc Dis* 2008;101:523-32.
23. Sattianayagam PT, Gibbs SD, Pinney JH, et al. Solid organ transplantation in AL amyloidosis. *Am J Transplant* 2010;10:2124-31.
24. Hasserjian RP, Goodman HJ, Lachmann HJ, et al. Bone marrow findings correlate with clinical outcome in systemic AL amyloidosis patients. *Histopathology* 2007;50:567-73.
25. Kyle RA, Gertz MA, Greipp PR, et al. A trial of three regimens for primary amyloidosis: colchicine alone, melphalan and prednisone, and melphalan, prednisone, and colchicine. *N Engl J Med* 1997;336:1202-7).



Revisión

Nutritional implications for the patient undergoing extracorporeal membrane oxygenation

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Abstract

Extracorporeal membrane oxygenation (ECMO) for cardiovascular collapse or catastrophic respiratory failure in the critically ill patient imposes a multidisciplinary approach. Nutritional support is one of the issues that must be faced, as this population presents a state of increased metabolic activity, elevated catabolism of protein and rapid accumulating energy deficiency. Provision of adequate nutritional therapy is hard to achieve due to different factors. This article provides a brief overview of the current literature regarding nutritional support during ECMO in adult patients, as no current guidelines address this issue.

(Nutr Hosp. 2015;31:2346-2351)

DOI:10.3305/nh.2015.31.6.8661

Key words: *Extracorporeal membrane life support. ECMO. Nutrition therapy. Nutritional support.*

ASPECTOS NUTRICIONALES DEL PACIENTE SOMETIDO A ECMO (EXTRACORPOREAL MEMBRANE OXYGENATION)

Resumen

La oxigenación por membrana extracorpórea (OMEC) en casos de colapso cardiovascular o falla respiratoria catastrófica en pacientes críticos impone un planteamiento multidisciplinar. El soporte nutricional es uno de los problemas a afrontar, ya que esta población presenta un estado de actividad metabólica aumentada, un elevado catabolismo proteico, y una deficiencia de energía de rápida acumulación. Es difícil conseguir una provisión de terapia nutricional adecuada debido a distintos factores. Este artículo ofrece una breve presentación de la bibliografía actual relativa al soporte nutricional durante la OMEC en pacientes adultos, ya que actualmente no contamos con directrices que aborden este tema.

(Nutr Hosp. 2015;31:2346-2351)

DOI:10.3305/nh.2015.31.6.8661

Palabras clave: *Soporte vital con membrana extracorpórea. OMEC. Terapia nutricional. Soporte nutricional.*

Abbreviations

ECMO: Extracorporeal membrane oxygenation.
VV: Venovenous ECMO.
VA: Venoarterial ECMO.
ICU: Intensive care unit.
EN: Enteral nutrition.
PN: Parenteral nutrition.
CRP: C-reactive protein.

Introduction

Extracorporeal membrane oxygenation (ECMO) is a mechanical system that provides respiratory and/or hemodynamic support to patients who are in imminent risk of death due to respiratory or cardiac failure¹. Venovenous (VV) ECMO is usually used in catastrophic respiratory failure while venoarterial (VA) ECMO is used in cardiovascular collapse. Usually the predicted survival for these patients is less than 20%.

Critically ill patients requiring vital organ support in the ICU are usually unable to meet nutrient needs orally for a long period. They generally develop a state of increased metabolic activity accompanied by elevated catabolism of protein, insulin resistance, and negative nitrogen balance in the body. If such patients are not provided with macronutrients in the form of enteral nutrition (EN) or parenteral nutrition (PN), they accumulate an energy deficiency that rapidly contri-

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Recibido: 2-II-2015.
1.ª Revisión: 17-II-2015.
Aceptado: 3-III-2015.

butes to lean-tissue wasting, which is associated with adverse outcomes².

Provision of adequate nutritional support on these patients can be hard to achieve due to hemodynamic alterations and the need for high doses of vasoactive drugs, deep sedation, and occasionally, high doses of steroids. As a result, gastric emptying is impaired, beginning with enteral nutrition that is delayed, and the calorie/protein target is poorly reached³.

Clinical guidelines are developed for the nutrition therapy of neonates supported with ECMO⁴, but no guidelines have been established for adults. The enteral route is preferred in critical patients and should be considered in this specific population. Few personal experiences have been published in literature (as retrospective analysis from case series)⁵⁻¹⁰, showing that EN is possible in ECMO patients, always under certain considerations and specific medical supervision. Supplemental PN, particularly if given early or/and when significant intolerance to EN is maintained, is another strategy to be considered¹¹.

To achieve better long-term outcomes in ECMO patients, an interdisciplinary approach that includes a nutrition support team may be desirable. This team work should develop a local protocol and a nutrition strategy customized for each ECMO patient. Regular meetings to discuss nutrition status and goal achievement should also be performed in the ICU setting.

Clinical Studies on Adults

There is limited published data on nutritional support in ECMO and the exact effect of this device on human gut function is unknown, as it has only been studied on porcine models showing increased risk for gut barrier dysfunction and bacterial translocation¹².

Anderson et al¹³ first presented a series of 24 adult trauma patients with respiratory failure supported on either VV or VA ECMO in which EN was attempted but not tolerated. Kolla et al published their experience with 100 adult ECMO patients with respiratory failure. Nutrition management with enteral delivery was included in their protocol as the first choice for nutritional support, but the authors did not describe their tolerance, caloric target or complications on their study¹⁴.

More recent small retrospective series indicate that EN in patients receiving ECMO is not only possible, but safe. A case series of 27 patients with respiratory failure supported by VV ECMO was reported by Scott et al⁶. Ninety-six (96%) of the patients received EN, or in combination with PN, started within 24 to 36 hours. Eighteen patients received EN as their only source of nutrition, and 8 patients combined EN with PN to meet nutritional requirements according to their protocol for non-ECMO critical patients. A commercial oligomeric non-enhanced formula was used in the first 16 patients, and for the other 11 patients an arginine- and glutamine-enhanced immune-modifying formula was used.

Target caloric goals were 25 kcal/kg/day with protein targeted at 1.2 to 1.5 gr/kg/day. They did not compare outcomes between both groups. Most of the patients received prokinetic agents within 48 hrs (erythromycin). No patient developed intestinal ischemia, gastrointestinal bleeding, or other complications related to early feeding. Ferrie et al reported their retrospective experience on 86 patients using ECMO, 55 patients with respiratory failure requiring VV ECMO and 31 for cardiac indication with VA ECMO⁸. EN began on all patients at a mean time of 13.1 hours after UCI admission reaching goal rate on day 2.6. Only two patients failed to reach goal feed rate, requiring exclusive PN. Of the patients presenting intolerance, 20 of 33 were managed with prokinetic medications, while 18 required combination with PN to reach target nutritional requirements. All were fed using an existing local protocol emphasizing early nasogastric enteral feeding with caloric targets estimated with the Schofield equation¹⁵, (with stress factor 1.1 to 1.2) and protein at least 1.2 gr/kg/day. There was no difference between ECMO models in incidence of feeding intolerance ($p=0.40$).

In another retrospective study with 48 patients receiving ECMO (35 VA and 13 VV ECMO), Lukas et al⁹ demonstrated a mean nutritional goal achievement of only 55% of their nutritional targets, 50% for VA ECMO patients, and 67% for VV ECMO patients, (which almost reached statistical significance), estimated with the Schofield equation with a stress factor of 1.2-1.5. Protein targets were in the range of 1.2-1.5 g/kg/day except the patient that received continuous renal replacement therapy, when the range was increased to 1.5-2.0 g/kg/day. This study was performed in a single mixed ICU of medical/surgical/trauma critical patients and heart/lung transplant patients. There were no differences in achieving better nutritional adequacy between survivors and non-survivors (52% v 61%; $P=0.345$). Nutritional support was provided mostly in the form of EN, with a moderate number of patients requiring PN.

A prospective observational study performed in a cardiac surgical ICU investigated whether early EN in adults receiving VA ECMO was tolerated. Nutritional support was provided using their ICU nutrition protocol. Energy goals were calculated with 25 kcal/kg/day to be reached over 4 days. Nutrition tolerance was defined as the ratio of effective delivered nutrition to caloric goal. More than 70% of nutrition tolerance was achieved within the first week. All patients were maintained on EN only and no adverse events were noticed¹⁰.

Factors Associated With Safety Outcomes

Hemodynamic Stability

The hemodynamically unstable patient represents a therapeutic challenge in terms of nutritional management¹⁶. Hemodynamic failure usually leads to a hypotensive state, where blood is generally shunted from

the gut and other peripheral organs to the central circulation of the heart and brain. This situation can critically compromise the splanchnic perfusion. According to this scenario, adequate blood irrigation and motility of the gastrointestinal tract are prerequisite to initiate any enteral delivery¹⁷.

ECMO initiation usually accomplishes an oxygenation and hemodynamic unloading which has a direct effect on VA ECMO improving blood gases and lowering intrathoracic pressures in VV support. All this provides a better circulatory status by lowering the risk of gastrointestinal hypo perfusion and other complications such as mesenteric ischemia, depressed peristalsis, abdominal distention, and diarrhea¹⁸.

Initial Nutritional Assessment

Nutritional assessment should always be included in the patient evaluation. The first step is to define the degree of malnutrition and estimate the severity of illness, the metabolic state, the catabolism and the inflammatory stress. No single method is universally accepted. For nutritional assessment, we used the *Subjective Global Assessment* (SGA)¹⁹ which assesses nutritional status based on features of the history and physical examination. Ratings are most affected by loss of subcutaneous tissue, muscle wasting, and weight loss. Five features of the history were elicited: weight loss in the previous six months expressed as both kilograms and proportionate loss, the history of dietary intake in relation to a patient's usual pattern, the presence of significant gastrointestinal symptoms (anorexia, nausea, vomiting, diarrhea), the patient's functional capacity or energy level (bedridden to full capacity), and the disease and its relation to nutritional requirements. Physical examination includes loss of subcutaneous fat, muscle wasting (quadriceps, deltoids), ankle edema, sacral edema and ascites. According to the SGA criteria, the patient is categorized into three groups: class A (well nourished); class B, (moderately malnourished); and class C (severely malnourished). When the patient is severely malnourished and very ill, lean-tissue wasting is a contributing factor to adverse outcomes and it is recommended to start nutrition support²⁰.

In terms of anthropometric parameters such as body weight and body mass index (BMI), a retrospective analysis of the international Extracorporeal Life Support Organization (ELSO) registry (n=1,334 adults) did not show increased risk of death for patients in the higher quartile of body weight in respiratory failure. They did not consider BMI or nutrition status as risk factors to be analyzed²¹. Another study from 140 ECMO treated acute respiratory distress syndrome patients admitted in three French ICUs showed that a higher BMI is independently associated with better survival by 6 months post ICU discharge²². Therefore, high body weight or BMI should not be regarded as a

contraindication to initiation of ECMO in patients with respiratory distress. This differed, however, from the patients requiring ECMO for cardiogenic shock, where higher weight is described as a worsening factor by the Survival After Veno-arterial ECMO (SAVE) score, from a multivariate analysis of VA cases²³. BMI was not available for their set of data.

Adequate energy administration is essential to maintain metabolic needs, minimize catabolism, promote cardiac cachexia recovery and wound healing. In general, calculation of energy requirements can be estimated by indirect calorimetry (gold standard) or by a predictive equation²⁴. The technique of indirect calorimetry is based on measurement of oxygen (O₂) consumption and carbon dioxide (CO₂) production. This is not possible on patients supported by ECMO because the CO₂ is removed across the extracorporeal membrane and cannot be identified by the calorimeter. Estimation of energy needs can be based on weight in kilograms for critically ill patients. ICU patients should receive 25 kcal/kg/day increasing to target over the next 2–3 days^{25,26}. For weight determination, dry body weight (edema free) should be used²⁷. Estimated energy for the obese patient (BMI >30) can be estimated as 22–25 kcal/kg/day of ideal body weight²⁶.

Protein catabolism and increased protein turnover are major elements of the metabolic response to illness and injury. In general, the recommended daily protein administration to achieve increased protein synthesis and minimize muscle wasting in ill patients can be from 1.3 to 1.5 g/kg/day, and adjusted for each patient's individual condition, impacted by severity of illness, inflammatory response, surgery, and infection. Higher amounts are needed for patients with renal replacement therapy. When PN is indicated in ICU patients, supplementation with glutamine continues to be associated to a significant reduction on hospital mortality and ICU length of stay²⁸. Because this amino acid is conditionally essential in catabolic and stress state, supplementation with doses from 0.2 to 0.4 g/kg/day of L-glutamine can be used, but there is no study in ECMO. The minimal amount of carbohydrate required is 2 gr/kg of glucose per day. Hyperglycemia (glucose >10 mmol/L) contributes to death in the critically ill patient and should also be avoided to prevent infectious complications^{25,26}.

Fluid and sodium administration should be discussed with the ECMO team. Sodium restriction may be necessary to improve fluid balance, minimize fluid weight gain, and optimize diuretic therapy on some patients²⁷.

Nutritional management on ECMO patients should be similar to other critically ill patients with respect to timing of initiation and route of EN. Use of early EN within the first 24–48 hours of ICU admission it is recommended when possible and continued to achieve goals over the next 48–72 hrs. Patients receiving less than their targeted enteral feeding after 2 days should

be considered for supplementary PN^{25,26}. The most appropriate route of EN is a controversial area. Even though small-bowel feeding may decrease the risk of gastro esophageal reflux, recent meta-analyses comparing gastric versus small-bowel feeding have not found significantly different incidences of pneumonia, ICU length of stay, or mortality^{29,30}. Some benefits from using gastric feeding in this group of patients include easy tube placement at the moment of connecting to ECMO and early feeding initiation.

Monitoring Nutritional Parameters

Careful monitoring of nutritional support is essential and involves many parameters. Tables I and II provide a checklist that can be used when starting and following nutritional management. The response to nutrition therapy is related to many factors, especially the severity of the inflammatory status. C-reactive protein (CRP) is an index of the inflammatory response, and therefore, the metabolic and catabolic response decreases as the CRP declines. Transthyretin (Pre-albumin) is a negative acute-phase reactant and, with an adequate nutritional support, should rise as CRP falls³¹.

Blood Volume and Fluid Status

Fluid management is very challenging during the resuscitation phase with fluid overload^{32,33}. Once the patient is supported by ECMO, VV and VA ECMO are very different in its impact on the patients physiology and fluid status. In VV ECMO, blood is drained from and returned into the venous system in-series with the natural circulation. Because the same amount of blood is continuously drawn and replaced into circulation, no changes on preload status occur. In VA ECMO, the extracorporeal circuit is parallel to native circulation, dramatically decreasing the right heart preload and increasing left ventricle afterload³⁴.

There is no data regarding the exact additional fluid in adult ECMO patients. In pediatric population, Swanniker et al reported worse survival in patients who did not decrease their fluid overload over dry weight. Survivors decreased by 4-9% body weight while non-survivors increased by 25-35% ($p=0.001$)³⁵. This can be related to the exposure of blood to a non biologic surface circuit. As a consequence, a complex inflammatory response is initiated leading to capillary leakage similar to a systemic inflammatory response syndrome³⁶. All this data indicates that fluid overload is, at least, a common associated problem.

Reaching nutritional goals may also be related to fluid status. In fact, patients with higher positive fluid balances have shown less achievement of nutritional target compared to patients with low or negative fluid balance⁸. Therefore, management of

Table I

Initial laboratory evaluation: Chemistry studies.

- **Comprehensive metabolic profile:**
Albumin; Pre-albumin; total proteins; CRP, Electrolytes Na; K; Cl;
BUN; Cr
AST; ALT
Ionized Calcium; Mg; Phosphate
Triglycerides.
- **Hematology:**
Hgb; Hct; WBC; lymphocyte count, Platelets.
- **Other Nutritional Studies:**
Vitamin B12; 25 OH-Calciferol; Folic Acid, Twenty-four hour urinary nitrogen excretion.

Abbreviations: CRP: C-Reactive Protein, Na: Sodium, K: Potassium, Cl: Chloride, BUN: Blood Urea Nitrogen, Cr: Creatinine, AST: Aspartate aminotransferase, ALT: Alanine Aminotransferase, Mg: Magnesium, Hgb: Hemoglobin, Hct: Hematocrit, WBC: White Blood Cells, 25 OH-Calciferol: 25-hydroxycholecalciferol

Table II

Follow-up Studies during Nutrition Support

- **Daily until stable (or when PN is required), then PRN:**
BUN, Cr, Na, K, Cl, Ionized Ca, Mg, Phosphate.
- **Weekly during nutrition support:**
Triglycerides, Pre-albumin, CRP.
- **PRN based on nutritional assessment:**
Vitamin levels, TSH, Iron study.

Abbreviations: BUN: Blood Urea Nitrogen, Cr: Creatinine, Na: Sodium, K: Potassium, Cl: Chloride, Mg: Magnesium, CRP: C-Reactive Protein, TSH: Thyroid Stimulating Hormone

diuresis or hemofiltration to achieve dry weight, and maintenance of intravascular volume are contributing factors for better results³⁷. On the other hand, the effect of the extra fluid volume leads to a restriction of other fluid inputs, including nutrition. With this restriction for the nutritional management, the choice of enteral formula can be restricted to the available concentrated products, not always being the better choice in terms of toleration. Sometimes the enteral formula has to be delivered at a rate below the target. The data on using an immune-enhancing formula on critically ill patients are conflicting and open to considerable debate. Fiber enriched formulae can be well tolerated¹⁶.

A special situation is when the patients hematocrit is too low, requiring frequent blood transfusions. The secondary increased likelihood of antibody sensitization can be a potential barrier for patients waiting for a heart and/or lung transplant because the time being bridged to transplant may be a long period under immunomodulatory agents. The resulting accumulation of these drugs dramatically increases protein catabolism negatively affecting the patient's nutritional status³⁸.

Use of Prokinetics

EN is often discontinued in patients who present large gastric residual volumes. Using prokinetic medications such as metoclopramide or erythromycin has been advocated to improve gastric emptying on patients in ECMO patients. Erythromycin seems to be more effective than metoclopramide on critical illness³⁹, but the efficiency and comparison of both prokinetic agents on patients undergoing ECMO have not been performed.

Use of vasoactive agents

Hypotension and sepsis in critically ill patients may warrant the use of vasopressors (eg. dobutamine, epinephrine, norepinephrine, milrinone, vasopressin) to maintain adequate hemodynamic parameters. The use of inotropic agents (eg. dobutamine, milrinone) should not discourage the clinician from initiating EN in patients with no other contraindication, because this drug increases cardiac output and consequently perfusion to the gut is improved⁴⁰. All vasopressors produce vasoconstriction, and therefore each agent has a potential to affect gastrointestinal motility and perfusion. There are deeper decreases on splanchnic blood flow and oxygen uptake after epinephrine use in shock patients when compared with dobutamine and norepinephrine, suggesting undesirable effects on splanchnic perfusion⁴¹. Theoretically, dopamine should have moderate to no negative effects on gut perfusion at a low dose, ($<5 \mu\text{g/kg/min}$) which primarily increases mesenteric perfusion, whereas at a higher dose its vasoconstricting properties are enhanced by α -adrenergic activity, and a conservative approach should be taken⁴². Risk for undesirable events and intolerance to EN require close monitoring in patients receiving vasoactive drugs, especially in certain doses. We have to consider that there are intra- and inter-individual variability in drug pharmacokinetics, making dosing based on body weight not predictable for blood concentrations⁴³.

Anticoagulation Management

Patients on ECMO need anticoagulation as part of the patient and circuit management. In fact, bleeding and thrombosis are frequent complications with severe impact on prognosis. Infusion of unfractionated heparin is the most commonly used drug⁴⁴. Active bleeding and bleeding risk can be contraindications for using or replacing the enteral feeding tube, requiring PN support²⁵.

Conclusion

Nutritional support is currently considered an integral part of ICU management, and all sources to in-

crease energy delivered and nutritional status should be implemented for patients during extracorporeal life support⁴⁵. Nutritional therapy for adults receiving ECMO has not been well documented in literature. The enteral route is proposed as the preferred source of nutritional delivery. However there are concerns in patients with circulatory failure on VA ECMO or those who require vasoactive drugs, especially due to the risk for developing bowel ischemia.

In this article we reviewed key considerations for nutritional management during ECMO and presented our local protocol. Until specific guidelines are available for this population, it seems that the guidelines for the assessment of nutritional therapy in the critically ill adult, and the collective multicenter experience on ECMO patients, are the best resource of information for the clinician who is caring for the nutritional management of a patient requiring this device.

We declare no acknowledgments or financial support

Relevant Authors' information

Dr. Rodrigo Diaz is past president of the international Extracorporeal Life Support Organization (ELSO), Latin American Chapter

Declaration

Authors disclose any financial or non-financial competing interests.

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1) have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) have been involved in drafting the manuscript or revising it critically for important intellectual content; 3) have given final approval of the version to be published; and 4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

References

1. Del Sorbo L, Cype M, Fan E. (2014) Extracorporeal life support for adults with severe acute respiratory failure. *Lancet Respir Med* 2, 154-164.

2. Alberda C, Gramlich L, Jones N et al. (2009) The relationship between nutritional intake and clinical outcomes in critically ill patients: results of an international multicenter observational study. *Intensive Care Med* 35, 1728-1737.
3. Marik P, Zolaga G. (2001) Early enteral nutrition in acutely ill patients: A systematic review. *Crit Care Med* 29, 2264-2270.
4. Jaksic T, Hull MA, Modi BP et al. (2010) American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) Board of Directors. A.S.P.E.N. Clinical guidelines: nutrition support of neonates supported with extracorporeal membrane oxygenation. *JPEN* 34, 247-253.
5. Ulerich L. (2014) Nutrition implications and challenges of the transplant patient undergoing extracorporeal membrane oxygenation therapy. *Nutr Clin Pract* 29, 201-206.
6. Scott LK, Boudreaux K, Thalje F et al. (2004) Early enteral feedings in adults receiving venovenous extracorporeal membrane oxygenation. *JPEN* 28, 295-300.
7. Umezawa LD, Flordelis JL, Pérez-Vela JL, et al. (2013) Nutrition support during extracorporeal membrane oxygenation (ECMO) in adults. *Intensive Care Med* 39, 2240.
8. Ferrie S, Herkes R, Forrest P. (2013) Nutrition support during extracorporeal membrane oxygenation (ECMO) in adults: a retrospective audit of 86 patients. *Intensive Care Med* 39, 1989-1994.
9. Lukas G, Davies AR, Hilton AK et al. (2010) Nutritional support in adult patients receiving extracorporeal membrane oxygenation. *Crit Care Resusc* 12, 230-234.
10. Umezawa LD, Flordelis JL, Pérez-Vela JL et al. (2014) Early Enteral Nutrition in Adults Receiving Venovenous Extracorporeal Membrane Oxygenation: An Observational Case Series. *JPEN* (Epublication ahead of print version).
11. Casaer MP, Mesotten D, Hermans G et al. (2011) Early versus late parenteral nutrition in critically ill adults. *N Engl J Med* 365, 506-517.
12. Kurundar AR, Killingsworth CR, McIlwain RB. (2010) Extracorporeal Membrane Oxygenation Causes Loss of Intestinal Epithelial Barrier in the Newborn Piglet. *Ped Res* 68, 128-133.
13. Anderson HL, Shapiro MB, Delius RE et al. (1994) Extracorporeal life support for respiratory failure after multiple trauma. *J Trauma* 37, 266-272.
14. Kolla S, Awad SS, Rich PB et al. (1997) Extracorporeal life support for 100 adult patients with severe respiratory failure. *Ann Surg* 226, 544-564.
15. Schofield WN. (2006) Predicting basal metabolic rate, new standards and review of previous work. *Hum Nutr Clin Nutr* 39, 5-41.
16. Casaer MP, Van den Berghe G. (2014) Nutrition in the acute phase of critical illness. *N Engl J Med* 370, 1227-1236.
17. Yang S, Wu X, Yu W et al. (2014) Early enteral nutrition in critically ill patients with hemodynamic instability: an evidence-based review and practical advice. *Nutr Clin Pract* 29, 90-96.
18. Scaravilli V, Zanella A, Sangalli F et al. (2014) Basic Aspects of Physiology During ECMO. In *ECMO Extracorporeal Life Support in Adults*, 1st ed, pp:19-36 [Sangalli F, editor]. Milan: Springer.
19. Detsky A, McLaughlin J, Jeffrey P et al. (1987) What is Subjective Global Assessment of Nutritional Status? *JPEN* 11, 8-13.
20. de Ulíbarri Pérez JJ, Fernández G, Rodríguez Salvañés F, et al. (2014) Nutritional screening: control of clinical undernutrition with analytical parameters. *Nutr Hosp* 29: 797-811.
21. Al-Soufi S, Buscher H, Nguyen ND et al. (2013) Lack of association between body weight and mortality in patients on veno-venous extracorporeal membrane oxygenation. *Intensive Care Med* 39, 1995-2002.
22. Schmidt M, Zogheib E, Rozé H et al. (2013) The PRESERVE mortality risk score and analysis of long-term outcomes after extracorporeal membrane oxygenation for severe acute respiratory distress syndrome. *Intensive Care Med* 39, 1704-1713.
23. ELSO and Department of Intensive Care at The Alfred Hospital Melbourne (2014). Survival after Veno Arterial ECMO Score. <http://save-score.org> (accessed October 2014)
24. Hwang TL, Huang SL, Chen MF. (1993) The use of indirect calorimetry in critically ill patients. The relationship of measured energy expenditure to injury severity score, septic severity score, and APACHE II score. *J Trauma* 34, 247-251.
25. Singer P, Berger M, Van den Berghe G. (2009) ESPEN Guidelines on parenteral Nutrition: Intensive Care. *Clinical Nutrition* 28, 387-400.
26. Heyland D, Dhaliwal R, Drover J. (2003) Canadian Clinical Practice Guidelines for Nutrition Support in Mechanically Ventilated, Critically Ill Adult Patients. *JPEN* 27, 355-373.
27. Berger MM, Chiolerio RL. (2009) Enteral nutrition and cardiovascular failure: from myths to clinical practice. *JPEN* 33, 702-709.
28. Wischmeyer PE, Dhaliwal R, McCall M et al. (2014) Parenteral glutamine supplementation in critical illness: a systematic review. *Crit Care* 18, R76.
29. Ho KM, Dobb GJ, Webb SA. (2006) A comparison of early gastric and post-pyloric feeding in critically ill patients: a meta-analysis. *Intensive Care Med* 32, 639-649.
30. Marik P, Zaloga G. (2003) Gastric versus post-pyloric feeding: a systematic review. *Crit Care* 7, R46-R51.
31. Dennis RA, Johnson LE, Roberson PK et al. (2008) Changes in prealbumin, nutrient intake, and systemic inflammation in elderly recuperative care patients. *J Am Geriatr Soc* 56, 1270-1275.
32. Bagshaw S, Brophy P, Cruz D et al. (2008) Fluid balance as a biomarker: impact of fluid overload on outcome in critically ill patients with acute kidney injury. *Critical Care* 12, 169.
33. Alsous F, Khamies M, DeGirolamo A et al. (2000) Negative fluid balance predicts survival in patients with septic shock: a retrospective pilot study. *Chest* 117, 1749-1754.
34. Diaz R. (2011) ECMO and ECMO mobile: mechanical cardiopulmonary support. *Rev. Méd. Clín Condes* 22, 377-387.
35. Swaniker F, Kolla S, Moler F (2000) Extracorporeal Life Support Outcome for 128 Pediatric Patients With Respiratory Failure. *Journal of Pediatric Surgery* 35, 197-202.
36. Annich GM, Cornell T, Massicotte P et al. (2012) Blood Biomaterial Surface Interaction During ECLS in ECMO. In *ECMO: Extracorporeal Cardiopulmonary Support in Critical Care*. 4th ed, pp: 75-82 [Annich GM, editor] Michigan.
37. Hwang TL, Lue MC, Nee YJ et al. (1994) The incidence of diarrhea in patients with hypoalbuminemia due to acute or chronic malnutrition during enteral feeding. *Am J Gastroenterol* 89, 376-378.
38. Aggarwal A, Kumar A, Gregory MP et al. (2013) Nutrition assessment in advanced heart failure patients evaluated for ventricular assist devices or cardiac transplantation. *Nutr Clin Pract* 28, 112-119.
39. Nguyen NQ, Chapman MJ, Fraser RJ et al. (2007) Erythromycin is more effective than metoclopramide in the treatment of feed intolerance in critical illness. *Crit Care Med* 35, 483-489.
40. Wells DL. (2012) Provision of enteral nutrition during vasopressor therapy for hemodynamic instability: an evidence-based review. *Nutr Clin Pract* 27, 521-526.
41. Meier-Hellmann A, Reinhart K, Bredle DL et al. Epinephrine impairs splanchnic perfusion in septic shock. *Crit Care Med* 25, 399-404.
42. Thoren A, Elam M, Ricksten SE. (2000) Differential effects of dopamine, doxamine, and jejunal mucosal perfusion early after cardiac surgery. *Crit Care Med* 28, 2338-2343.
43. MacGregor DA, Smith TE, Prielipp RC et al. (2000) Pharmacokinetics of dopamine in healthy male subjects. *Anesthesiology* 92, 338-346.
44. Haft J, Bartlett R, Parsons P, Wilson K: Extracorporeal membrane oxygenation (ECMO). <http://www.uptodate.com/contents/extracorporeal-membrane-oxygenation-ecmo-in-adults> (accessed October 2014)
45. Kagan I, Singer P. (2013) Nutritional Imbalances during Extracorporeal Life Support. *World Rev Nutr Diet* 105, 154-159.



Revisión

Inflamación y obesidad (lipoinflamación)

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Resumen

La obesidad es una enfermedad crónica de origen multifactorial con una elevada prevalencia a nivel mundial que se asocia a complicaciones potencialmente graves y que precisa de un enfoque multidisciplinar por su gran repercusión clínica y elevado coste sanitario. La evidencia más reciente apunta que comparte con otras patologías comunes y de complejo abordaje terapéutico la existencia de un estado de inflamación crónica de bajo grado que perpetúa la enfermedad y se asocia a múltiples complicaciones. El interés actual de la lipoinflamación o inflamación crónica asociada a la obesidad deriva del conocimiento de las alteraciones y remodelado que se produce en el tejido adiposo, con la participación de múltiples factores y elementos implicados en todo el proceso. Investigaciones recientes subrayan la importancia de algunas de estas moléculas, denominadas mediadores especializados en la resolución, como posible dianas terapéuticas para el tratamiento de la obesidad.

En este artículo se revisa la evidencia publicada acerca de los mecanismos que regulan el proceso de remodelado del tejido adiposo y el estado de lipoinflamación en la obesidad así como en los mediadores implicados directamente en la aparición y resolución del proceso inflamatorio.

(Nutr Hosp. 2015;31:2352-2358)

DOI:10.3305/nh.2015.31.6.8829

Palabras clave: Obesidad. Citoquinas. Adipocitos. Macrófagos. Mediadores especializados en la resolución.

INFLAMMATION AND OBESITY (LIPOINFLAMMATION)

Abstract

Obesity is a chronic disease with multiple origins. It is a widespread global phenomenon carrying potentially serious complications which requires a multidisciplinary approach due to the significant clinical repercussions and elevated health costs associated with the disease. The most recent evidence indicates that it shares a common characteristic with other prevalent, difficult-to-treat pathologies: chronic, low-grade inflammation which perpetuates the disease and is associated with multiple complications. The current interest in lipoinflammation or chronic inflammation associated with obesity derives from an understanding of the alterations and remodelling that occurs in the adipose tissue, with the participation of multiple factors and elements throughout the process. Recent research highlights the importance of some of these molecules, called pro-resolving mediators, as possible therapeutic targets in the treatment of obesity.

This article reviews the evidence published on the mechanisms that regulate the adipose tissue remodelling process and lipoinflammation both in obesity and in the mediators that are directly involved in the appearance and resolution of the inflammatory process.

(Nutr Hosp. 2015;31:2352-2358)

DOI:10.3305/nh.2015.31.6.8829

Key words: Obesity. Cytokines. Adipocytes. Macrophages. Pro-resolving mediators.

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Recibido: 12-II-15.

Aceptado: 8-III-15.

Introducción

En la actualidad la obesidad es considerada una enfermedad crónica, multifactorial, resultado de la interacción entre carga genética y ambiente que afecta a un gran porcentaje de la población de todas las edades, sexos y condiciones sociales. Se define como una acumulación anormal o excesiva de tejido adiposo que puede ser perjudicial para la salud (>25% en hombres y >33% en mujeres)¹.

El tejido adiposo es un tejido endocrino complejo metabólicamente muy activo entre cuyas funciones destacan: I) el mantenimiento del balance energético; II) la termorregulación; III) el metabolismo de lípidos y glucosa; IV) la modulación de la función hormonal y reproductiva, V) la regulación de la presión arterial y VI) de la coagulación sanguínea. Además, éste desempeña un papel fundamental sobre las cascadas inflamatorias, procoagulantes, antifibrinolíticas y vasoactivas, lo que sugiere una influencia directa sobre el proceso inflamatorio^{2,3}.

Concretamente, en condiciones de obesidad se ha demostrado que en aproximadamente un 70-80% de los individuos se produce un remodelado del tejido adiposo (*"adipose tissue remodeling"*) tanto a nivel estructural como funcional que provoca una reacción inflamatoria. Cuando la resolución de la inflamación aguda no se resuelve correctamente se desencadena un estado inflamatorio crónico de bajo grado a nivel local con repercusiones sistémicas conocida como lipoinflamación (*"metabolic-triggered inflammation"*, *"metainflammation"*, o *"adipose tissue inflammation"*)⁴. El resto de individuos que no presentan evidencia de signos de lipoinflamación son denominados con el término "obesos metabólicamente sanos", para referirse a que no presentan ninguna de las alteraciones metabólicas típicas de los individuos obesos aunque el riesgo de morbi-mortalidad en relación con la *diabetes mellitus tipo 2* (DM 2) y la enfermedad cardiovascular (ECV) es el mismo que en el resto de obesos⁵.

De este modo, la inflamación crónica ha surgido como uno de los mecanismos fisiológicos clave que relaciona la obesidad con la resistencia a la insulina y la DM 2, además de estar íntimamente asociada con el desarrollo de otras patologías graves como la esteatohepatitis no alcohólica y las enfermedades cardiovasculares⁶⁻⁸. También cabe destacar que otras patologías muy prevalentes entre la población general tales como la enfermedad inflamatoria intestinal, el asma, la artritis reumatoide y la enfermedad periodontal están también asociadas a un estado de inflamación crónica⁹⁻¹².

En este artículo se revisan los mecanismos que regulan el remodelado del tejido adiposo y la lipoinflamación en la obesidad.

Lipoinflamación

El tejido adiposo está compuesto por adipocitos, preadipocitos, células endoteliales, pericitos, fibro-

blastos, mastocitos, y células inmunitarias (macrófagos y linfocitos T). Éste ejerce sus funciones autocrinas, endocrinas y paracrinas sobre el resto de órganos a través de la secreción de una gran variedad de enzimas, factores de crecimiento, hormonas y también citoquinas o interleucinas, proteínas responsables de la comunicación intercelular, que inducen la activación de receptores específicos de membrana, funciones de proliferación y diferenciación celular, quimiotaxis, crecimiento y modulación de la secreción de inmunoglobulinas. Las citoquinas implicadas en la modulación de las respuestas fisiológicas a cargo del tejido adiposo se denominan adipocitoquinas^{13,14}. Leptina, adiponectina, resistina, factor de necrosis tumoral alfa (TNF α), interleucina-6 (IL-6), proteína quimioatrayente de monocitos 1 (MCP-1) e inhibidor del activador del plasminógeno (PAI-1) son algunas de las adipocitoquinas más importantes^{15,16}.

Cuando existe un balance positivo de energía, el excedente energético se acumula en el tejido adiposo subcutáneo. Éste va aumentando por hiperplasia, es decir, a partir de la proliferación y diferenciación de los pre-adipocitos. Cuando el tejido adiposo subcutáneo es incapaz de almacenar apropiadamente el exceso de energía o se ha rebasado el umbral de almacenamiento, aumentan los depósitos de grasa visceral, que al tener menor capacidad adipogénica crecen por hipertrofia, es decir, por aumento del tamaño de los adipocitos.

Por tanto, en condiciones de obesidad el aumento por hiperplasia y principalmente por hipertrofia de los adipocitos se ha asociado a la disregulación del tejido adiposo que conlleva un remodelado de su estructura y posterior inflamación con repercusiones tanto a nivel local como sistémico.

Cabe destacar que hasta el momento se han descrito varios procesos directamente relacionados con la hipertrofia de los adipocitos. Estudios en animales y también en humanos han demostrado que en las primeras etapas de expansión del tejido adiposo por hipertrofia aparecen zonas de hipoxia, es decir, tejido adiposo pobremente oxigenado. Se ha observado que en estas zonas de tejido adiposo obeso la secreción de adipocitoquinas pro-inflamatorias tales como factor inhibidor de la migración de macrófagos (MIF), matriz de metaloproteinasas (MMP2 y MMP9), IL-6, PAI-1, factor de crecimiento endotelial vascular (VEGF) y leptina están regulados al alza por el incremento de la hipoxia^{17,18}. Paralelamente, la escasez de oxígeno provoca la muerte celular de los adipocitos más periféricos que se traduce en un aumento de la reacción inflamatoria.

Asimismo, aunque el adipocito es el elemento clave de los cambios y remodelado del tejido adiposo, los macrófagos presentes en el tejido adiposo obeso desempeñan también un papel fundamental. Éstos muestran una notable heterogeneidad en sus actividades y funciones, que permiten diferenciarlos en dos clases basadas en la expresión de antígenos específicos debido principalmente a los complejos cambios metabó-

licos e inmunológicos¹⁹. En estados de sobrealimentación y obesidad se ha descrito el fenómeno de “cambio fenotípico” (phenotypic switch) definido como una transformación en el estado de polarización de los macrófagos, es decir, la transformación de un estado anti-inflamatorio M2 a la forma predominante durante el balance negativo de energía, a una forma M1 más pro-inflamatoria^{20,21}. Varios estudios demuestran que el tejido adiposo en la obesidad presenta una infiltración masiva de macrófagos M1 secundaria al incremento de la secreción de la proteína quimioatrayente de macrófagos (MCP-1) que juega un papel crucial en la respuesta inflamatoria en obesidad, siendo el factor nuclear potenciador de las cadenas ligeras kappa de las células B activadas (NF-kB), uno de los mayores inductores de la expresión de esta adipocina²¹⁻²³. Como consecuencia, la proporción de macrófagos del tejido adiposo aumenta del 10% al 40% del total de las células presentes²⁴. A su vez, los macrófagos infiltrados son responsables de la secreción de sustancias pro-inflamatorias y concretamente de más del 50% del TNF- α desde el tejido adiposo. El TNF- α tiene un importante papel en la resistencia a la insulina, ya que inhibe la acción de la insulina en los adipocitos a través de inhibidores en la vía de señalización de esta hormona y también está relacionado con la resistencia insulínica periférica. Por tanto, la población de macrófagos M1 domina en el tejido adiposo obeso expresando una serie de factores pro-inflamatorios y demuestra una correlación positiva con la resistencia a la insulina²⁵. Si bien estos mecanismos de reclutamiento de macrófagos e infiltración del tejido adiposo pueden actuar de forma independiente, el metabolismo y las vías inflamatorias están íntimamente conectados.

Se ha establecido que la intercomunicación entre macrófagos y adipocitos constituyen un hecho indiscutible en el desarrollo de obesidad. En este contexto, se ha observado que los macrófagos contribuyen al desarrollo de resistencia insulínica en pacientes obesos, mientras que una pérdida de peso reduce la infiltración de macrófagos y la expresión de factores relacionados con inflamación en el tejido adiposo²⁶.

La hipoxia en el tejido adiposo, la muerte celular de los adipocitos periféricos, la infiltración de células inmunes y la transformación de los macrófagos M2 (secretadores de adipocitoquinas anti-inflamatorias) a macrófagos M1 (secretadores de adipocitoquinas pro-inflamatorias) e infiltración de estos últimos en el tejido adiposo, la angiogénesis y la sobreproducción de matriz extracelular producen una disregulación de la homeostasis debido al aumento de la secreción de adipocitoquinas pro-inflamatorias principalmente IL-6, IL-10 y TNF- α , así como el descenso de adipocitoquinas anti-inflamatorias tales como la adiponectina que suprime la síntesis de varias citoquinas pro-inflamatorias, como TNF- α e interferón gamma (IFN- γ). Esta disregulación se debe a la inhibición que ejerce la adiponectina sobre la activación del NF-kB, principal regulador de la transcripción de citoquinas²⁷.

Resolución de la lipoinflamación

La inflamación aguda es una respuesta inespecífica frente a las agresiones del medio generada por agentes inflamatorios. La respuesta inflamatoria ocurre en tejidos conectivos vascularizados con el objetivo de aislar y destruir al agente dañino, así como reparar y recuperar la lesión asociada. Este proceso dinámico se caracteriza principalmente por cambios en el flujo sanguíneo, aumento en la permeabilidad de los vasos sanguíneos y migración de líquidos, proteínas y células inmunes²⁸.

Del mismo modo, la finalización de la respuesta inflamatoria, conocida como resolución de la inflamación es también un proceso activo y complejo. Está regulado por mediadores lipídicos derivados del metabolismo de los ácidos grasos polinsaturados (AGPI) esenciales, mediadores bioquímicos y receptores de las vías de señalización. A estas moléculas que han demostrado potentes efectos anti-inflamatorios y pro-resolución de la inflamación se les denomina “mediadores especializados en la resolución” (specialized pro-resolving mediator-SPM)²⁹.

Los AGPI omega 6 y omega 3 son los precursores de las principales moléculas pro-inflamatorias y anti-inflamatorias involucrados en el proceso de la inflamación y su resolución, respectivamente. Por una parte el ácido linoleico (LA) y el ácido araquidónico (AA) derivados de los AGPI omega 6 generan prostaglandinas, tromboxanos y prostaciclina, todos ellos con una acción pro-inflamatoria, por otra los principales derivados de los AGPI omega 3 son anti-inflamatorios. El ácido alfa-linolénico (ALA), un nutriente esencial que no puede sintetizarse en el organismo, es el precursor del ácido eicosapentaenoico (EPA) y del ácido docosahexaenoico (DHA). Éstos dos últimos dan lugar a tres familias de mediadores locales que facilitan la resolución de la inflamación: resolvinas D1 y resolvinas D2 (derivadas del DHA), resolvinas E (derivadas del EPA), protectinas y maresinas (derivadas del DHA)^{30,31}. En lo que respecta a la resolución de la inflamación tienen especial importancia los siguientes eicosanoides: lipoxinas (derivada de AA) y resolvinas, protectinas y maresinas. Más concretamente las lipoxinas intervienen en la resolución de la inflamación impidiendo el flujo de neutrófilos al foco inflamatorio, las resolvinas son potentes inmunomoduladores enteroespecíficos involucrados en la regulación de la quimiotaxis de los neutrófilos, mejoran la fagocitosis y disminuyen la producción de citoquinas inflamatorias y las protectinas estimulan las vías de anti-inflamación y pro-resolución³².

En términos generales, los AGPI omega 3 deben sus funciones anti-inflamatorias a su capacidad para suprimir la expresión de citoquinas inducidas por los macrófagos a través de antagonizar la vía del NF-kB, a la activación del complejo enzimático proteína quinasa activada por AMP (AMPK) y la mejoría en la expresión de sirtuina 1 (SIRT1) en los macrófagos con lo

que se produce la desacetilación de la subunidad 65 del NF-kB y anula su señal permitiendo la supresión de la expresión de los genes pro-inflamatorios; la capacidad de inhibir competitivamente la conversión de AA a mediadores lipídicos pro-inflamatorios; actuando como ligando del receptor de peroxisoma-proliferador- activado (γ -PPAR), una señal anti-inflamatoria; y por la activación de un receptor acoplado a la proteína G (GPR120) que atenúa la producción de TNF- α , IL-6 y MCP-1³³⁻³⁵.

Concretamente, el DHA ha demostrado tanto en individuos obesos como en animales ser una terapia segura y eficaz además de una estrategia preventiva contra las complicaciones relacionadas con la obesidad^{26,36}. En relación a ello se ha postulado que el DHA presenta una capacidad para inhibir la expresión de citoquinas macrofágicas y de inhibición de la actividad del NF-kB superior al EPA. Además en humanos se han asociado elevadas concentraciones plasmáticas de DHA con una disminución del índice de resistencia insulínica (HOMA-IR) que se traduce en una baja sensibilidad a la insulina, fenómeno que no se ha objetivado con el EPA³⁷. Además, el DHA mimetiza el efecto del SIRT1 para desacetilar el NF-kB. Ambos, DHA (a concentración micromolar) y resolvina D1 (a concentración nanomolar) disminuyen la activación de los macrófagos M1 y facilitan la polarización de éstos hacia M2, un elemento clave en el proceso de resolución de la inflamación³⁸.

La proporción de eicosanoides producidos depende de la cantidad de sustrato disponible lo que influye en que la respuesta sea pro-inflamatoria o anti-inflamatoria, es decir, que el aporte de EPA y DHA compite con el contenido de AA reduciendo esta respuesta inflamatoria y dando lugar a la producción de SPM (Specialized Pro-resolving Mediators). Por tanto, la composición en AGPI de la dieta desempeña un rol fundamental en la modulación de las funciones inmunes y procesos inflamatorios y más concretamente en la resolución de la inflamación³⁹.

Consecuencias de la lipoinflamación

La lipoinflamación es un proceso sistémico en el que intervienen varios mecanismos relacionados entre ellos que favorecen y perpetúan la obesidad. Se ha establecido que existe un vínculo entre un estado de lipoinflamación crónico de bajo grado, el desarrollo de resistencia a la insulina y la aparición de comorbilidades⁴⁰. En todo ello la activación crónica de las vías pro-inflamatorias actúa como uno de los principales mecanismos responsables⁴¹⁻⁴⁴.

La resistencia a la insulina se caracteriza por el mantenimiento de elevadas concentraciones plasmáticas de insulina o hiperinsulinemia. La insulina es una hormona polipeptídica con una importante función reguladora sobre el metabolismo que a nivel del sistema nervioso central (SNC) se caracteriza por producir

sensación de saciedad, aumentar el gasto energético y regular la acción de la leptina. La insulina al unirse a su receptor heterotetramérico transmembrana, caracterizado por compartir idéntica estructura en el SNC, músculo, hígado y tejido adiposo, promueve la activación de su parte catalítica. Se produce la autofosforilación del receptor que le permitirá unirse a otros sustratos intracelulares que darán continuidad a la señal. De este modo se activan dos vías. En la primera, los residuos de tirosina fosforilados captan y fosforilan las proteínas de la familia del sustrato del receptor de insulina (IRS) que promueve la unión y activación del fosfoinositol 3-quinasa (PI-3K) y conecta la señal de la insulina al control del ritmo de los disparos neuronales. En cambio, la segunda vía depende de la activación de una proteína citosólica con actividad tirosinasa, janus quinasa-2 (JAK-2). Tras fosforilar la JAK-2 se recluta y fosforila el transductor de señal y activador de la transcripción 3 (STAT-3) que conecta la señal de insulina a la transcripción de los genes de los neurotransmisores implicados en el control del hambre y la termogénesis. La transcripción génica de la insulina a través del STAT-3 únicamente se produce en presencia de leptina.

La leptina es una hormona reguladora del apetito producida fundamentalmente en el tejido adiposo blanco, y en menor medida en la placenta, estómago y células inmunes. Ejerce su función en el núcleo arcuato del hipotálamo sobre dos tipos de poblaciones neuronales que producen péptidos orexigénicos tales como neuropéptido Y (NPY) y neuropéptido Agouti (AgRp) y péptidos anorexigénicos como proopiomelanocortina (POMC), principal precursor del alfa-melanocito estimulador (alfa-MSH) y el transcrito relacionado con la cocaína y la anfetamina (CART)⁴⁵.

El receptor de leptina pertenece a la familia de receptores de la clase I de citoquinas que no posee una actividad catalítica intrínseca por lo que está ligada a la enzima JAK-2. La unión de la leptina con su receptor promueve la captación de otra unidad del receptor adyacente y la formación de una estructura dimérica. Ello induce la actividad catalítica de la enzima JAK-2 asociada que se autofosforila en distintos residuos de tirosina activándose y a su vez fosforilando y activando la otra molécula de JAK-2 ligada a un segundo receptor. La fosforilación en residuos de tirosina crea 3 sitios activos que dan continuidad a la señal de leptina: Destacan por su importancia, el primer sitio que promueve el reclutamiento y la fosforilación los IRS y éstos activan al PI-3K que controla el ritmo de los disparos neuronales de los neurotransmisores. Y también el tercero que promueve el reclutamiento y fosforilación de fundamentalmente el STAT-3, responsable de conducir la señal generada por la leptina al núcleo donde coordina la transcripción de los genes neurotransmisores que se encargan de la señal de la hormona. Por tanto, el STAT-3 es la molécula de señalización más importante con respecto al efecto anorexigénico de la leptina al regular la actividad transcripcional de distin-

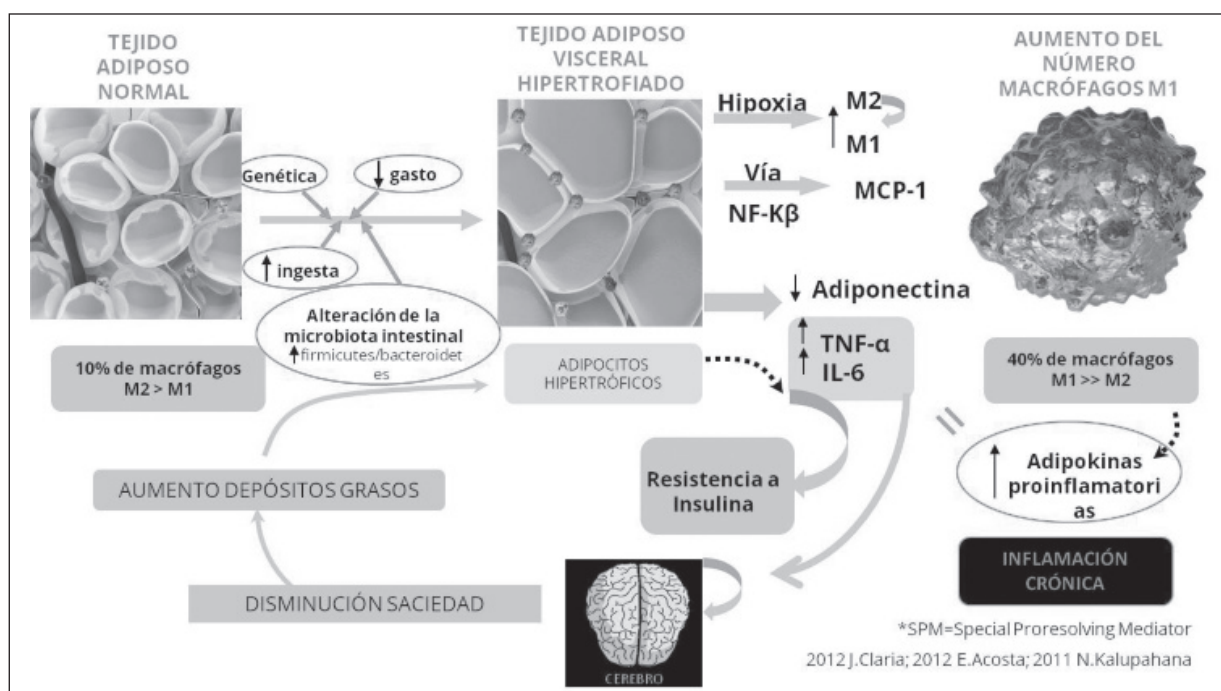


Fig. 1.—Vía metabólica de la lipoinflamación. Circuito de reentrada obesidad-lipoinflamación.

tos genes incluyendo el POMC, el NPY, el AgRP y el supresor de la señalización de citoquinas-3 (SOCS3). Al aumentar el SOCS3, éste se une al complejo receptor de leptina-JAK-2 e inhibe la señal de leptina. Por tanto, es una molécula que produce una retroalimentación negativa⁴⁶⁻⁵⁰.

Así en el hipotálamo la vía JAK-2/STAT-3 es controlada en primer lugar por la leptina sufriendo una modulación incrementada por la insulina. En la vía IRS/PI-3K el efecto de la insulina predomina sobre la leptina, pero ésta tiene un efecto potenciador^{51,52}.

Por tanto, existe indiscutiblemente un “cross-talk” en los mecanismos de comunicación entre las vías de señalización de leptina e insulina. Ambas hormonas, tanto la leptina como la insulina desempeñan acciones claves en la modulación de la saciedad⁵³.

La resistencia a la insulina y en consecuencia la hiperinsulinemia resultante, somete a los tejidos a una inadecuada acción lipogénica que favorece la obesidad abdominal, la producción a nivel hepático de triglicéridos, la liberación de lipoproteína de muy baja densidad o VLDL (*very low-density lipoprotein*) y por consiguiente al desarrollo de dislipidemia. La resistencia a la insulina también aumenta el riesgo de arteriosclerosis mediante la suma de factores de riesgo cardiovascular, alteraciones endoteliales, procesos inflamatorios y de coagulación^{54,55}.

A su vez las citoquinas pro-inflamatorias como TNF-α e IL-6, favorecen el aumento del depósito de lípidos debido a que la hiperinsulinemia disminuye la sensibilidad de los receptores insulínicos. A nivel del SNC, estas citoquinas interfieren también en las seña-

les a nivel del SNC que regulan el apetito⁵⁶, con lo que desaparece la sensación de saciedad persistiendo la hiperfagia que conduce a un aumento de los depósitos de grasa, lo cual favorece la hipertrofia de los adipocitos perpetuando el ciclo obesidad-lipoinflamación-aumento del apetito.

Como consecuencia final, la lipoinflamación puede favorecer la persistencia y aumento de la obesidad debido a que favorece el depósito de lípidos como consecuencia de la mala utilización de los carbohidratos que serán derivados en mayor proporción al hígado convirtiéndose en grasa⁵⁷ y disminuye la saciedad lo que favorece la sobreingesta^{50,56}.

Por tanto, se podría afirmar que la lipoinflamación, no sólo es consecuencia de la obesidad, sino que también podría estar implicada en su mantenimiento, favoreciendo el aumento progresivo de peso y generando así un circuito de reentrada (Figura 1).

En condiciones de obesidad se produce un estado de inflamación en el tejido adiposo, este proceso implica hipertrofia de adipocitos e infiltración del tejido adiposo por macrófagos de predominio M1 o pro-inflamatorios, disminución de adiponectina, IL-10, SPM y secreción aumentada de adipocinas pro-inflamatorias (TNF-alfa, IL-6, MCP, PCR). Las dietas muy bajas en calorías (*very low calorie diet-VLCD*) con un aporte energético menor a los requerimientos totales del individuo (<800 kcal/día) producen una disminución de peso principalmente por la reducción de los depósitos grasos del organismo. Bajo estas condiciones se produce un incremento en la secreción de adiponectina y disminución de la PCR con persisten-

cia de niveles disminuidos de SPM, TNF-alfa y IL-6. Es decir, el tejido adiposo persiste infiltrado de macrófagos con predominio de M1 o pro-inflamatorios sobre M2 o anti-inflamatorios. Por tanto, el proceso inflamatorio de bajo grado no se resuelve totalmente. En cambio se ha postulado que las dietas suplementadas con DHA, producen además de un aumento en la secreción de adiponectina y de SPM, así como una disminución del tamaño los adipocitos y de la secreción de AA. Simultáneamente, los SPM producen un incremento de la IL-10 e inhibición del NF-Kbeta, con lo que se inhibe completamente la producción de TNF-alfa y de IL-6 por los adipocitos y macrófagos. Globalmente, todo ello da lugar a la resolución de la lipoinflamación^{38,58}.

Conclusiones

Cuando la resolución de la inflamación aguda no se resuelve se desencadena un estado inflamatorio crónico de bajo grado. La lipoinflamación o inflamación crónica asociada a la obesidad y sus múltiples repercusiones sistémicas se caracterizan por la producción aumentada de adipocitoquinas pro-inflamatorias, la activación persistente de vías inflamatorias y el déficit de mediadores especializados en la resolución. Recientes investigaciones apuntan que una dieta suplementada con DHA, principal precursor de los mediadores especializados en la resolución de la inflamación, como una posible diana terapéutica para la obesidad.

Referencias

- Organización Mundial de la Salud (OMS). Obesidad y sobrepeso. Nota descriptiva N°311. Mayo de 2014. <http://www.who.int/mediacentre/factsheets/fs311/es/>. Consultado el 15/09/2014.
- Rodríguez-Rodríguez E, Perea JM, López-Sobaler AM, Ortega RM. Obesity, insulin resistance and increase in adipokines levels: importance of the diet and physical activity. *Nutr Hosp* 2009; 24 (4): 415-421.
- Flores-Lázaro JR, Rodríguez-Martínez E, Rivas-Arancibia S. Metabolic consequences of the functional alterations of adipose tissue in obese patients. *Rev Med Hosp Gen Méx* 2011; 74 (3): 157-165.
- Clària J, Dalli J, Yacoubian S, Gao F, Serhan CN. Resolvin D1 and resolvin D2 govern local inflammatory tone in obese fat. *J Immuno* 2012; 189 (5): 2597-2605.
- Barbarroja N et al. The obese healthy paradox: is inflammation the answer? *Biochem J* 2010; 430 (1): 141-149.
- Hotamisligil, GS. Inflammation and metabolic disorders. *Nature* 2006; 14; 444 (7121): 860-867.
- Guilherme A, Virbasius JV, Puri V, Czech MP. Adipocyte dysfunction linking obesity to insulin resistance and type 2 diabetes. *Nat Rev Mol Cell Biol* 2008; 9 (5): 367-377.
- Shoelson SE, Herrero L, Naaz A. Obesity, inflammation, and insulin resistance. *Gastroenterology* 2007; 132 (6): 2169-2180. Review.
- Ardila CM. Resolvin E1 promueve resolución de la inflamación en enfermedad periodontal. *Av Periodon Implantol* 2012; 24 (2): 71-75.
- Ouchi N, Parker JL, Lugus JJ, Walsh K. Adipokines in inflammation and metabolic disease. *Nat Rev Immunol* 2011; 11 (2): 85-97.
- Bastarrachea RA, López-Alvarenga JC, Bolado-García VE, Téllez-Mendoza J, Laviada-Molinad H, Comuzzie AG. Macrófagos, inflamación, tejido adiposo, obesidad y resistencia a la insulina. *Gac Méd Méx* 2007; 143 (6): 505-512.
- Zulet MA, Puchau B, Navarro C, Martí A, Martínez JA. Biomarcadores del estado inflamatorio: nexo de unión con la obesidad y complicaciones asociadas. *Nutr Hosp* 2007; 22 (5): 511-527.
- Kim S, Moustaid-Moussa N. Secretory, endocrine and autocrine/paracrine function of the adipocyte. *J Nutr* 2000; 130: S3110-115.
- Ibrahim MM. Subcutaneous and visceral adipose tissue: structural and functional differences. *Obes Rev* 2010; 11: 11-18.
- De Luis DA, González Sagrado M, Conde R, Aller R, Izaola O, Castro MJ. Circulating adipocytokines in morbid obese patients, relation with cardiovascular risk factors and anthropometric parameters. *Nutr Hosp*. 2011;26(1):91-6.
- De Luis DA, Aller R, Izaola O, Ovalle HF. The serum profile of adipokines in naïve patients with diabetes mellitus type 2 and obesity. *J Clin Lab Anal*. 2011;25(6):409-13.
- Sun K, Kusminski CM, Scherer PE. Adipose tissue remodeling and obesity. *J Clin Invest* 2011; 121 (6): 2094-2101.
- Hosogai N, Fukuhara A, Oshima K, Miyata Y, Tanaka S, Segawa K, Furukawa S, Tochino Y, Komuro R, Matsuda M, Shimomura I. Adipose tissue hypoxia in obesity and its impact on adipocytokine dysregulation. *Diabetes* 2007; 56 (4): 901-911.
- Suganami T, Tanaka M, Ogawa Y. Adipose tissue inflammation and ectopic lipid accumulation. *Endocr J* 2012; 59 (10): 849-57.
- Lumeng CN, Bodzin JL, Saltiel AR. Obesity induces a phenotypic switch in adipose tissue macrophage polarization. *J Clin Invest* 2007; 117 (1): 175-184.
- Lumeng CN, DelProposto JB, Westcott DJ, Saltiel AR. Phenotypic switching of adipose tissue macrophages with obesity is generated by spatiotemporal differences in macrophage subtypes. *Diabetes* 2008; 57: 3239-3246.
- Zeyda M, Farmer D, Todoric J, Aszmann O, Speiser M, Gyori G, Zlabinger GJ, Stulnig TM. Human adipose tissue macrophages are of an anti-inflammatory phenotype but capable of excessive pro-inflammatory mediator production. *Int J Obes (Lond)* 2007; 31: 1420-1428.
- Prieur X, Mok CY, Velagapudi VR, Núñez V, Fuentes L, Montaner D, Ishikawa K, Camacho A, Barbarroja N, O'Rahilly S, Sethi JK, Dopazo J, Orešić M, Ricote M, Vidal-Puig A. Differential lipid partitioning between adipocytes and tissue macrophages modulates macrophage lipotoxicity and M2/M1 polarization in obese mice. *Diabetes* 2011; 60: 797-809.
- Weisberg SP, McCann D, Desai M, Rosenbaum M, Leibel RL, Ferrante AW Jr. Obesity is associated with macrophage accumulation in adipose tissue. *J Clin Invest* 2003; 112: 1796-1808.
- Heilbronn LK, Campbell LV. Adipose tissue macrophages, low grade inflammation and insulin resistance in human obesity. *Curr Pharm Des* 2008; 14 (12): 1225-1230.
- Kalupahana NS, Claycombe KJ, Moustaid-Moussa N. (n-3) Fatty acids alleviate adipose tissue inflammation and insulin resistance: mechanistic insights. *Adv Nutr* 2011; 2 (4): 304-316.
- Tilg H, Moschen AR. Adipocytokines: mediators linking adipose tissue, inflammation and immunity. *Nat Rev Immunol* 2006; 6 (10): 772-783.
- Robbins SL, Cotran RS. Patología estructural y funcional. 3ª edición, Editorial Interamericana, Capítulo 2, pág. 39.
- Serhan CN, Brain SD, Buckley CD, Gilroy DW, Haslett C, O'Neill LAJ, Perretti M, Rossi AG, Wallace JL. Resolution of inflammation: state of the art, definitions and terms. *FASEB J* 2007; 21: 325-332.
- Serhan CN. Resolution phase of inflammation: novel endogenous anti-inflammatory and proresolving lipid mediators and pathways. *Annu Rev Immunol* 2007; 25: 101-137.
- Serhan CN, Yang R, Martinod K, Kasuga K, Pillai PS, Porter

- TF, Oh SF, Spite M. Maresins: novel macrophage mediators with potent antiinflammatory and proresolving actions. *J Exp Med* 2009; 16 (1):15-23.
32. Schwab JM, Chiang N, Arita M, Serhan CN. Resolvin E1 and protectin D1 activate inflammation-resolution programmes. *Nature* 2007; 447 (7146): 869-874.
 33. Xue B, Yang Z, Wang X, Shi H. Omega-3 polyunsaturated fatty acids antagonize macrophage inflammation via activation of AMPK/SIRT1 pathway. *PLoS One* 2012; 7 (10): e45990.
 34. Hirabara SM, Gorjão R, Vinolo MA, Rodrigues AC, Nachbar RT, Curi R. Molecular targets related to inflammation and insulin resistance and potential interventions. *Journal of Biomedicine and Biotechnology* 2012; 2012: 379024.
 35. Siriwardhana N, Kalupahana NS, Cekanova M, LeMieux M, Greer B, Moustaid-Moussa N. Modulation of adipose tissue inflammation by bioactive food compounds. *J Nutr Biochem* 2013; 24(4):613-623.
 36. Carpentier YA, Portois L, Malaisse WJ. n-3 fatty acids and the metabolic syndrome. *Am J Clin Nutr*. 2006;83(6 Suppl):1499S-1504S.
 37. Oliver E, McGillicuddy FC, Harford KA, Reynolds CM, Phillips CM, Ferguson JF, Roche HM. Docosahexaenoic acid attenuates macrophage-induced inflammation and improves insulin sensitivity in adipocytes-specific differential effects between LC n-3 PUFA. *Journal of Nutritional Biochemistry* 2012; 23: 1192-1200.
 38. Titos E, Rius B, González-Pérez A, López-Vicario C, Morán-Salvador E, Martínez-Clemente M, Arroyo V, Clària J. Resolvin D1 and its precursor docosahexaenoic acid promote resolution of adipose tissue inflammation by eliciting macrophage polarization toward an M2-like phenotype. *J Immunol* 2011; 187 (10): 5408-5418.
 39. Munro IA, Garg ML. Dietary supplementation with long chain omega-3 polyunsaturated fatty acids and weight loss in obese adults. *Obes Res Clin Pract* 2013; 7 (3): e173-181.
 40. De Luis DA, Sagrado MG, Conde R, Aller R, Izaola O, de la Fuente B, Castrillón JL, Romero E. Relation of resistin levels with cardiovascular risk factors, insulin resistance and inflammation in naïve diabetes obese patients. *Diabetes Res Clin Pract*. 2010;89(2):110-4.
 41. Wang Z, Nakayama T. Inflammation, a link between obesity and cardiovascular disease. *Mediators Inflamm*. 2010; 2010: 535918.
 42. Barbarroja N et al. The obese healthy paradox: is inflammation the answer? *Biochem J* 2010; 430 (1): 141-149.
 43. Acosta E. Obesidad, tejido adiposo y resistencia a la insulina. *Acta Bioquím Clin Latinoam* 2012; 46 (2): 183-194.
 44. Greenberg AS, Obin MS. Obesity and the role of adipose tissue in inflammation and metabolism. *Am J Clin Nutr*. 2006; 83 (2): 461S-465S.
 45. Broberger C. Brain regulation of food intake and appetite: molecules and networks. *J Intern Med* 2005;258 (4): 301-327.
 46. Björbaek C, Uotani S, da Silva B, Flier JS. Divergent signaling capacities of the long and short isoforms of the leptin receptor. *J Biol Chem* 1997; 272 (51): 32686-32695.
 47. Jung CH, Kim MS. Molecular mechanisms of central leptin resistance in obesity. *Arch Pharm Res* 2013; 36 (2): 201-207.
 48. Zabeau L, Lavens D, Peelman F, Eyckerman S, Vandekerckhove J, Tavernier J.. The ins and outs of leptin receptor activation. *FEBS Lett* 2003; 546 (1): 45-50.
 49. Münzberg H, Myers MG Jr. Molecular and anatomical determinants of central leptin resistance. *Nat Neurosci* 2005; 8 (5): 566-570.
 50. Kellner M, Koch M, Metzinger E, Mushack J, Capp E, Häring HU. Leptin activates PI3 Kinase in C2C12 myotubes via janus kinase-2 (JAK-2) and insulin receptor substrate-2 (IRS-2) dependent pathways. *Diabetologia* 1997;40 (11):1358-1362.
 51. Cintra DE, Ropelle ER, Pauli JR. Regulación central de la ingestión alimentaria y el gasto energético: acciones moleculares de la insulina, la leptina y el ejercicio físico. *Rev Neurol* 2007; 45 (11): 672-682.
 52. Carvalho JB, Ribeiro EB, Folli F, Velloso LA, Saad MJ. Interaction between leptin and insulin signaling pathways differentially affects JAK-STAT and PI3-Kinase-mediated signaling in rat liver. *Biol Chem* 2003 ;384 (1):151-159.
 53. Carvalho JB, Torsoni MA, Ueno M, Amaral ME, Araújo EP, Velloso LA, Gontijo JA, Saad MJ. Cross-talk between the insulin and leptin signaling systems in rat hypothalamus. *Obes Res* 2005; 13 (1): 48-57.
 54. de Luis DA, Aller R, Izaola O, Conde R, Gonzalez Sagrado M. The ratio of adiponectin to HOMA as an index of metabolic syndrome in obese women. *Ann Nutr Metab*. 2011;58(4):301-6.
 55. De Luis DA, González Sagrado M, Conde R, Aller R, Izaola O. Resistin levels and inflammatory markers in patients with morbid obesity. *Nutr Hosp*. 2010;25(4):630-4.
 56. Pimentel GD, Ganeshan K, Carvalho JB. Hypothalamic inflammation and the central nervous system control of energy homeostasis. *Mol Cell Endocrinol*. 2014;397(1-2):15-22.
 57. Paoli A, Rubini A, Volek JS, Grimaldi KA. Beyond weight loss: a review of the therapeutic uses of very-low-carbohydrate (ketogenic) diets. *Eur J Clin Nutr*. 2013;67(8):789-96.
 58. González-Pérez A, Clària J. Resolution of adipose tissue inflammation. *Scientific World Journal*. 2010 May 4;10:832-56.



Revisión

Revisión de las patologías relacionadas con la ingesta de gluten

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Resumen

Los cereales han sido considerados un alimento fundamental de la dieta. A través del desarrollo de la cocina, el ser humano ha producido alimentos ricos en gluten, con el fin de aprovechar al máximo las propiedades nutricionales de este alimento. De tal manera que el trigo se ha convertido en uno de los elementos centrales de la dieta mediterránea. Entre las patologías relacionadas con la ingesta de gluten, contenido principalmente en el trigo, la cebada y el centeno, la enfermedad celíaca (EC) es la más conocida. La EC es una condición inflamatoria crónica que afecta al tracto gastrointestinal y que se desarrolla en sujetos genéticamente predispuestos. La manifestación más común es la malabsorción de nutrientes. Otra patología condicionada por esta proteína es la alergia al trigo (AT), que constituye una reacción inmunológica adversa al gluten mediada por la inmunoglobulina E. Recientemente está aumentando la sensibilidad al gluten no celíaca (SGNC), definida como la aparición de una variedad de manifestaciones relacionadas con la ingestión de gluten, en pacientes en los que la enfermedad celíaca y la alergia al trigo han sido excluidas. En este artículo se describen estas tres entidades con sus mecanismos patogénicos y las diferentes manifestaciones clínicas.

(Nutr Hosp. 2015;31:2359-2371)

DOI:10.3305/nh.2015.31.6.8984

Palabras clave: *Gluten. Enfermedad celíaca. Sensibilidad al gluten no celíaca. Alergia al trigo.*

A REVIEW OF DISEASES RELATED TO THE INTAKE OF GLUTEN.

Abstract

Cereals are considered a basic food. Through the development of cooking, the human being has produced high-gluten-content food, so that it could make the most of its nutritional properties. Wheat is becoming one of the key elements of the Mediterranean diet. Amongst gluten-intake-related pathologies- gluten is present mainly in wheat, barley and rye- celiac disease (CD) is the most well-known. CD is a chronic inflammatory condition which affects gastrointestinal tract which develops in genetically predisposed individuals. The most common manifestation of CD is nutrients malabsorption. This protein trigger other pathology, wheat allergy (WA), which is an adverse immunological effect to gluten due to E immunoglobulin. A recent increased in non celiac gluten sensitivity (NCGS) has also been noticed, defined as the emergence of a range of gluten-intake related symptoms in patients for which celiac disease and wheat allergy have been ruled out. This article discusses these three conditions with their pathogenic mechanisms and the different clinic manifestations.

(Nutr Hosp. 2015;31:2359-2371)

DOI:10.3305/nh.2015.31.6.8984

Key words: *Gluten. Celiac disease. Non celiac gluten sensitivity. Wheat allergy.*

Introducción

Los cereales constituyen una de las principales fuentes de proteínas para la nutrición humana. El gluten, estrictamente hablando, se puede definir como la masa que queda tras eliminar los componentes solubles en agua de la harina de trigo. El producto resultante tiene un contenido del 75-85% de proteínas y del 15-25% de lípidos e hidratos de carbono insolubles. Sin embargo,

cuando comúnmente hablamos de gluten, nos referimos exclusivamente a la fracción proteica que es insoluble tanto en agua como en soluciones salinas diluidas. Este producto engloba dos tipos de proteínas presentes en la mayoría de los cereales: las prolaminas (solubles en etanol) y las gluteninas (parcialmente solubles en soluciones ácidas o alcalinas diluidas).¹ Las prolaminas del trigo se denominan *gliadinas*, del centeno *secalinas* y de la cebada *horleinas*. Las prolaminas y las gluteninas son las proteínas que confieren las propiedades de elasticidad y viscosidad características del gluten, razón por la que es utilizado frecuentemente por la industria alimentaria.

El trigo es el cereal más utilizado por lo que la gliadina es la prolamina más importante. La gliadina al

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Recibido: 18-III-15.
Aceptado: 22-IV-15.

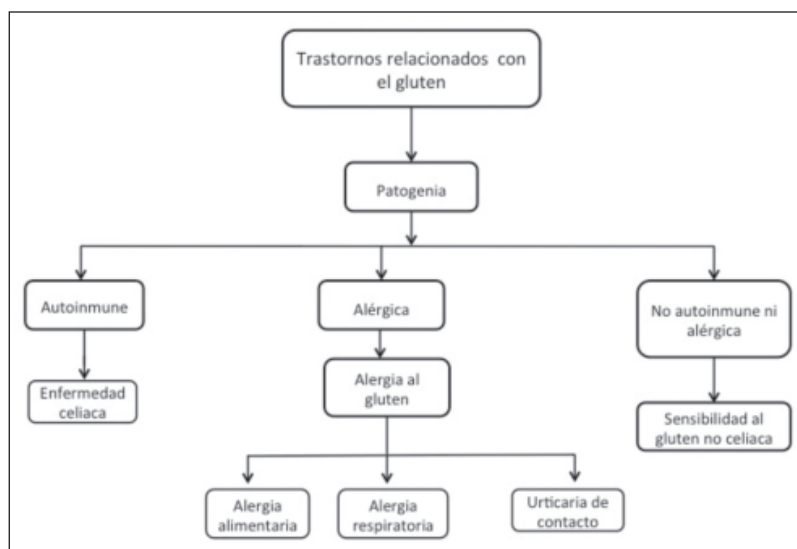


Fig. 1.—Principales trastornos relacionados con el gluten.

separarse por técnicas electroforéticas se obtiene cuatro fracciones de peso molecular entre 20 y 75 kDa conocidas como α , β , γ y ω -gliadinas². Todas ellas son tóxicas para los pacientes celíacos, demostrando in-vitro la acción tóxica de las moléculas de la gliadina no digerida en la mucosa intestinal. Estas moléculas originan lesiones epiteliales a través del reclutamiento de linfocitos intraepiteliales³.

Diversos estudios han demostrado que la gliadina pierde su efecto tóxico si es deaminada mediante ebullición durante 45 minutos en una solución normal de ácido clorhídrico. Durante este proceso se produce la transformación del 90% del aminoácido glutamina en ácido glutámico y amoníaco por la fragmentación reductora de los enlaces peptídicos. La toxicidad de la gliadina por lo tanto puede ser debido a la presencia de péptidos de glutamina, mientras que la fracción lipídica del trigo puede ser inofensivo⁴. Mediante ultrafiltración y la digestión trípica de la gliadina se demuestra que los péptidos tóxicos tienen un peso molecular entre 820 y 928 y que se compone de 6-7 aminoácidos⁵.

El componente de gliadina, que es rico en prolina y glutamina no puede ser degradado por las enzimas intestinales y desencadena una reacción inmune en individuos genéticamente predispuestos. Aunque cada tipo de trigo contiene diferente número de componentes de gliadina, la toxicidad de cada componente es desconocida. De hecho, cada proteína de gluten de los diferentes tipos de trigo puede tener un perfil de toxicidad único y secuencias estimuladoras de células T diferentes. Se ha postulado que las variedades antiguas de trigo, como la escanda y espelta, puede ser mejor tolerado por las personas con trastornos relacionados con el gluten que las cepas actuales (*Triticum aestivum*) utilizados en la producción de alimentos⁶⁻⁸.

Hoy en día, el trigo sigue siendo una de las fuentes de alimentos más importantes en el mundo que contribuyen al 50% de las calorías en los países indus-

trializados y en desarrollo. El consumo mundial ha aumentado más rápidamente que cualquier otro cereal. Estos cambios son impulsados por un aumento de la renta disponible, la urbanización y las corporaciones transnacionales de la alimentación, así como las técnicas de venta y comercialización⁹. El consumo anual de harina de trigo, per cápita, se estima en 132,5 libras por persona en los EE.UU.¹⁰. El aumento de la prevalencia de los trastornos relacionados con el gluten, y su existencia histórica, sugiere la creciente necesidad de explorar los granos con menores propiedades alérgicas y que pueden ser mejor tolerados. Entre los trastornos relacionados con el gluten se encuentran tres entidades diferentes que se tienen inicialmente un diferente mecanismo etiopatogénico (figura 1). En la siguiente revisión profundizamos en las características epidemiológicas, clínicas, principales diferencias fisiopatológicas de cada una de las entidades, así como una aproximación hacia las estrategias diagnósticas necesarias.

Enfermedad celíaca

Concepto y epidemiología

La enfermedad celíaca (EC) es una enteropatía de base inmune, que afecta a sujetos genéticamente predispuestos debida a una intolerancia permanente al gluten contenido en la dieta¹¹⁻¹³. Otras definiciones actuales la orientan no solo como una enfermedad con base intestinal sino como una enfermedad sistémica que puede afectar a otros órganos fuera del intestino delgado que es la diana principal¹⁴.

La EC presenta una prevalencia en torno al 1% de la población¹⁵. Sin embargo, únicamente están diagnosticados 1 de cada 7-10 del total de los afectados, constituyendo lo que se ha denominado “iceberg celíaco”

¹⁶. La EC es más frecuente en mujeres que en hombres con una diferencia de 4:1¹⁷. Tiene un patrón de presentación bimodal con dos picos de incidencia en la edad, entre 1-3 años en niños y 30-50 años en adultos. En los niños predominan los síntomas típicos de la EC (diarrea, distensión abdominal y retraso del crecimiento), superiores títulos serológicos y una mayor severidad de las lesiones histológicas; en contraposición en los adultos destaca la presencia de formas clínicas oligosintomáticas con una menor repercusión serológica e histológica¹⁸⁻²⁰.

Además, esta patología tiene una fuerte asociación genética. El genotipado HLA DQ2 lo presentan el 90 % de los pacientes con EC, mientras el 5 % de los celíacos muestran el haplotipo HLA-DQ8^{6, 21}. La importancia del componente genético de CC se destaca además por el aumento de la prevalencia observada en los familiares de primer grado de los pacientes con EC entre 10%-25 %²². De esta forma la estrategia de cribado de la EC guiada por la presencia de un genotipado HLA compatible con la patología permite la identificación de un mayor porcentaje de sujetos con lesiones histológicas intestinales dentro del espectro de la enteropatía sensible a gluten²². La importancia de este componente genético radica en su elevado valor predictor negativo, de tal manera que en ausencia de una genética de riesgo para la EC permite excluir el diagnóstico de esta patología. Sin embargo, el 30% de la población general lleva los haplotipos HLA DQ2 o DQ8; no obstante, sólo el 3 % desarrollará la enfermedad²³.

Etiopatogenia

La EC se manifiesta en sujetos genéticamente predispuestos como una respuesta inmune frente al gluten ingerido. Esta respuesta inmune contiene una parte innata (efecto “tóxico” directo del gluten sobre el epitelio) y otra adaptativa o específica (a través de los linfocitos T CD4+ de la lámina propia o tejido subyacente) y las dos parecen ser las responsables del daño histológico en la mucosa intestinal²⁴.

Algunos fragmentos del gluten, como la α -gliadina, inducen una respuesta inmunológica innata, tóxica e inmediata, no relacionada con los linfocitos T ni con la presentación antigénica HLA-DQ2/8^{25, 26}. Como consecuencia, se desencadena un estrés oxidativo, mediado principalmente por la formación de óxido nítrico, que origina la inducción de iNOS (óxido nítrico sintetasa) en los enterocitos²⁷⁻³⁰ lo que provoca la expresión en estas mismas células de ligandos como MICA³¹. La gliadina, también es capaz de debilitar las uniones intercelulares situadas entre los enterocitos^{32, 33}. Sin embargo, el principal mecanismo depende de la liberación de IL15 por parte de estos enterocitos en situación de estrés³⁴. Esta citoquina induce en los linfocitos intraepiteliales la expresión de NKG2D^{35, 36} capaz de interactuar con su ligando, la molécula MICA

de los enterocitos perpetuando el daño intestinal. La unión entre NKG2D y MICA induce apoptosis de los enterocitos, llevando a la desaparición de las microvellosidades y aplanamiento del epitelio intestinal. Con ello se activan fenómenos de citotoxicidad en el epitelio, que junto con el debilitamiento de las uniones intercelulares, contribuye a un aumento de la permeabilidad intestinal y el paso del gluten hasta la lámina propia, donde se desencadena la respuesta adaptativa.

La respuesta inmune adaptativa está mediada por linfocitos T específicos, previa presentación antigénica por las células presentadoras de antígenos (CPAs) portadoras de elementos de restricción HLA-DQ2/DQ8. Los macrófagos (20%) y sobre todo las células dendríticas (CDs) (80%), son las principales CPAs de la lámina propia y están incrementadas en la lesión celíaca en actividad³⁷. Estas CPAs son a su vez activadas como consecuencia de la inducción de IL-15 derivada de la respuesta innata³⁸⁻⁴⁰. Los linfocitos TCD4+ de la lámina propia reconocen fragmentos de gluten, como α -gliadina, presentados en el contexto de moléculas HLA-DQ2 o DQ8^{37, 41}, y tras ser modificados por la enzima transglutaminasa 2 (tTG2)^{42, 43}. Por tanto, el efecto final estará mediado por linfocitos T CD4+, responsables de una respuesta dominada por citoquinas proinflamatorias como IFN γ , TNF α , IL18, IL15... y un descenso proporcional de citoquinas reguladoras o anti-inflamatorias (IL10 y TGF β)^{44, 45}. Este perfil pro-inflamatorio será el implicado en última instancia en los mecanismos de remodelación tisular como la hiperplasia de las criptas típica de la EC, la atrofia de las vellosidades intestinales y la activación de linfocitos B que estimulan la producción de anticuerpos⁴⁶. En resumen, se puede afirmar que la gliadina tiene un efecto dual en el intestino de los pacientes celíacos, siendo imprescindible la activación de la respuesta inmunológica innata para que se desencadene la respuesta adaptativa en individuos susceptibles⁴⁷.

No todos los individuos con genética de riesgo que ingieren gluten desencadenan la enfermedad. Por esta razón puede que otros factores ambientales, además del gluten, estén implicados en el desencadenamiento o aparición de la EC. La introducción de alimentos que contienen gluten antes de los 6 meses provoca un incremento de la incidencia de la enfermedad^{49, 50}. Pero también iniciar el consumo de alimentos que contienen gluten después de los 2 años origina un aumento de la incidencia, por pérdida de la tolerancia inmunitaria a los antígenos del gluten. Distintas infecciones por microorganismos entéricos como adenovirus enterocitario humano 12 o *Cándida albicans* pueden estar implicadas en la patogenia de la respuesta inmune por similitud de antígenos de los agentes patógenos con los antígenos del gluten. En la actualidad se han llevado a cabo numerosos estudios que comparan la microbiota intestinal de individuos sanos con respecto a la microbiota intestinal de celíacos para comprobar esta hipótesis. Autores españoles como la Dra. Yolanda Sanz han publicado numerosos trabajos donde se observan estas

Tabla I
Criterios diagnósticos de la enfermedad celiaca propuestos por la ESPGHAN

Criterios diagnósticos de la EC de la ESPGHAN

1. Historia y presentación clínica compatible con enfermedad celiaca.
2. Test serológicos compatibles con enfermedad celiaca. Unos anticuerpos antitransglutaminasa 10 veces superiores al valor de referencia y anticuerpos antiendomiso positivos.
3. Genotipado de riesgo para la enteropatía sensible a gluten.
4. Histología compatible con enfermedad celiaca. La biopsia intestinal no es necesario de realizar en todos los niños, solo en aquellos en los que las determinaciones serológicas no sean concluyentes.
5. Evidencia de una respuesta clínica, histológica y serológica a la dieta sin gluten.
6. Sujeto mayor de dos años.
7. Exclusión de otras condiciones que imitan a la EC.

Tabla II
Criterios propuestos por Catassi y Fasano para el diagnóstico de enfermedad celiaca

1. Síntomas típicos de enfermedad celiaca.
2. Anticuerpos de clase IgA específicos de EC a títulos altos (de tipo IgG en caso de déficit de IgA).
3. Genotipo HLA DQ2 o DQ8.
4. Enteropatía compatible con EC en la biopsia duodenal.
5. Respuesta a la dieta sin gluten.

diferencias en la microbiota y su posible participación en la patogenia de la enfermedad⁵¹⁻⁵³.

Otros autores como Caminero⁵⁴, Wacklin⁵⁵, Tjellström⁵⁶ y Sollid⁵⁷ detectaron diferencias en la microbiota intestinal y en la actividad trófica fecal y actividad glutenásica de sujetos sanos y enfermos celiacos^{54, 58}. Estas diferencias invitan a pensar en los microorganismos como posibles agentes relacionados con la etiología de la EC, aunque no están todavía bien definidos los mecanismos implicados^{59, 60}.

Clínica

Esta enfermedad se caracteriza por la afectación de segmentos proximales del intestino delgado provocando malabsorción y déficit de hierro, ácido fólico, calcio y vitaminas liposolubles. La diarrea se debe en la mayoría de las ocasiones a la progresión de la en-

fermedad hasta el intestino delgado distal⁶¹. De esta manera, si sólo está afectado el intestino proximal no desencadena la diarrea porque los segmentos más distales pueden compensar la absorción de productos derivados de la digestión de los hidratos de carbono y grasas¹⁶.

En los niños la enfermedad celiaca generalmente se manifiesta en forma de diarrea crónica, acompañada de distensión abdominal, y retraso de crecimiento, lo que constituyen la denominada *forma clásica* o triada característica⁶². Otros síntomas que también aparecen con cierta frecuencia en la infancia son la anorexia, pérdida de peso, los vómitos, la irritabilidad e incluso el estreñimiento. Cuando la enfermedad aparece más tardíamente, en niños mayores o en la adolescencia, puede haber manifestaciones extraintestinales⁶³, tales como cefaleas, anemia⁶⁴ y síntomas neurológicos⁶⁵, entre otros síntomas.

En adultos se presenta con una frecuencia 2-3 veces mayor en las mujeres que en los varones⁶⁶. También la prevalencia de enfermedades autoinmunes es más frecuente en las mujeres, así como la anemia ferropénica y la osteoporosis, que son procesos frecuentemente asociados con la celiaquía. Las formas de presentación en el adulto son muy variadas y menos características, por lo que se denominan *formas atípicas*⁶⁷ u oligosintomáticas. La diarrea aparece en el adulto en menos del 50% de los pacientes y la pérdida de peso es poco llamativa, de hecho hasta un 30% de los pacientes presenta sobrepeso en el momento del diagnóstico⁶⁸.

Diagnóstico

Actualmente el “gold estandar” para el diagnóstico de la EC es la biopsia duodenal. Los procedimientos serológicos permiten identificar a los sujetos que pueden beneficiarse de la biopsia duodenal. Actualmente las pruebas serológicas utilizadas son los anticuerpos antitransglutaminasa (tTG), antiendomiso (EMA), y los péptidos de gliadina deaminados (DGP). Se utilizan los anticuerpos IgA e IgG para permitir diagnosticar la enfermedad en el déficit selectivo de Ig A. Los EMA y tTG ofrecen una sensibilidad y especificidad mayor del 95%. Sin embargo se utilizan preferentemente los tTG al ser más rentable desde el punto de vista económico. Las pruebas genéticas para los marcadores de susceptibilidad HLA están disponibles, pero limitados a determinar si un paciente presenta un mayor riesgo de desarrollar la enfermedad. Dado su elevado valor predictivo negativo nos permiten descartar la presencia de la EC.

El estudio histológico de la biopsia duodenal se realiza según la clasificación de Marsh-Oberhuber⁶⁹. Permite diferenciar diferentes lesiones desde incremento de los linfocitos intraepiteliales hasta atrofia intestinal establecida. Es necesaria la obtención de 4-6 biopsias de 2-3ª porción duodenal y una biopsia de bulbo duodenal.

En 2012 la Sociedad Europea de Gastroenterología y Nutrición Pediátrica (ESPGHAN) estableció los criterios diagnósticos de la EC en la edad pediátrica que puede evitar en algunos casos la realización de biopsia duodenal. Estos criterios están resumidos en la tabla I.

Carlo Catassi¹¹ publicó recientemente su regla 4 de 5, de acuerdo con la última revisión de la ESPGHAN. Estos postulados intentan optimizar el diagnóstico de la EC. Indican que para conseguir el diagnóstico de la enfermedad celiaca es preciso presentar cuatro de las siguientes características presentadas en la tabla II (en ausencia de genotipado de riesgo es suficiente cumplir 3 de ellas).

Sensibilidad al gluten no celiaca (SGNC)

Concepto y epidemiología

Las definiciones de Oslo para la enfermedad celiaca o conceptos relacionados establece la sensibilidad al gluten no celiaca como una entidad caracterizada por una o más variedades inmunológicas, morfológicas o de manifestaciones sintomáticas desencadenadas por la ingesta de gluten y una vez excluida la EC⁷⁰. Los pacientes con sensibilidad al gluten no tienen la enfermedad celiaca, pero sí experimentan síntomas al comer alimentos que contienen gluten. Las características clínicas de la sensibilidad al gluten incluyen síntomas intestinales, comúnmente mal diagnosticados como SII, y manifestaciones extraintestinales, que se producen poco después del consumo de gluten y desaparecen rápidamente una vez que el paciente está en una dieta libre de gluten⁷¹.

A diferencia de la EC, la SGNC puede mostrar signos de una respuesta inmune innata activada, pero sin datos de enteropatía, elevaciones en tTG, EMA o anticuerpos DGP, y el aumento de permeabilidad de la mucosa característica de EC. Recientemente, Biesiekierski et al⁷², en un estudio doble ciego aleatorizado, mostró que en los pacientes con Síndrome de Intestino Irritable (SII) que mejoraban la distensión abdominal y el dolor con la dieta sin gluten (DSG), apareciendo nuevamente los síntomas al reintroducir el gluten en la dieta. No está claro en este momento qué componentes de granos puede desencadenar síntomas en individuos con sensibilidad al gluten y si algunas poblaciones de pacientes tienen pequeños cambios morfológicos intestinales sutiles. Aunque actualmente no hay un estándar de diagnóstico enfoque de SGNC, la evaluación sistemática debe llevarse a cabo incluyendo exclusión de EC y otros trastornos inflamatorios.

Aunque la epidemiología de la SGNC está lejos de ser establecido, su presunta prevalencia es mayor que la de la enfermedad celiaca, aproximadamente del 6%⁷³. Aunque puede ocurrir a cualquier edad, la sensibilidad al gluten parece ser más frecuente en los adultos que en los niños, con una edad media de aparición de 40 años (rango 17-63 años). Además al igual

que los trastornos funcionales del intestino, es más frecuente en mujeres que en hombres (relación hombre-mujer de 1: 2,5)⁷⁴.

Etiopatogenia

El mecanismo de acción por el cual el gluten desencadena los síntomas gastrointestinales de los pacientes con sensibilidad al gluten es todavía incierto. Probablemente sea debido a la combinación de diferentes vías de actuación y no se conocen completamente como se producen.

Aunque tanto la inmunidad innata y adaptativa tienen un papel central en el desarrollo de la EC, la SGNC parece estar asociada principalmente con la activación de la respuesta inmune innata²⁴. La expresión del marcador de inmunidad innata Toll-like receptor (TLR) 2 se incrementa considerablemente en la mucosa intestinal de los pacientes con SGNC en comparación con los pacientes que tienen la EC y control de los individuos. Por otra parte, los pacientes con sensibilidad al gluten tuvieron mayor expresión de TLR1 y TLR4 a nivel de la mucosa que los pacientes con celiacía o sujetos control. Además, los marcadores de la respuesta inmune adaptativa, incluyendo IL-6, T-helper-1 de citocinas IFN- γ , IL-17 e IL-21, se encuentran aumentados en la enfermedad celiaca, pero no en la SGNC^{75, 76}. Otro hallazgo interesante que diferencia ambas entidades se refiere a la expresión de la mucosa de genes asociados con células T reguladoras (Treg). Se encontró que la expresión del marcador de las Treg FOXP3 estaba disminuida en pacientes con SGNC en comparación con los que tenían la EC⁷⁶.

Otro factor que es probable que esté involucrado en la patogenia de la SGNC se refiere a los cambios ocasionados en la barrera epitelial de la mucosa del intestino delgado. En la EC se produce una pérdida de la función de barrera intestinal, que representa un mecanismo clave para el desarrollo de la autoinmunidad permitiendo el paso de antígenos a través del epitelio intestinal. Sin embargo, en el estudio de Sapone et al. se observa que los pacientes con SGNC no tenían cambios en la permeabilidad de la mucosa intestinal tal como se evaluó mediante la prueba de lactulosa manitol⁷⁶. No obstante, cabe señalar que la prueba de lactulosa manitol podría no ser lo suficientemente confiable para identificar anomalías sutiles de la función de barrera intestinal en pacientes con sensibilidad al gluten. De igual manera, Biesiekierski et al.⁷², utilizando la prueba de absorción de azúcar doble, no encontró ninguna diferencia significativa en la función de la barrera intestinal de dos grupos tratados al azar de los pacientes con SGNC (uno de ellos recibió gluten, el otro placebo). Sin embargo, Sapone observó a través del análisis mediante PCR de los componentes de "tight junction", denominados claudins (CLDN), que los tight junction 1 y la ocludina tenían un aumento de la expresión de RNAm de CLDN4 en las biopsias

Tabla III <i>Principales síntomas relacionados con la SGNC</i>	
Síntomas	Prevalencia
Distensión abdominal	72%
Dolor abdominal	77%
Diarrea	40%
Estreñimiento	18%
Eczema y/o rash	33%
Cefaléa	32%
Confusión mental	42%
Fatiga	36%
Depresión o ansiedad	15%
Parestesias de piernas, brazos o dedos	17%
Dolores musculares o articulares	28%

duodenales en pacientes con sensibilidad al gluten frente aquellos con EC. El incremento de expresión de CLDN4 es indicativo de una reducción de la permeabilidad intestinal, lo que sugiere que los pacientes con sensibilidad al gluten tienen un menor paso antigénico dado el incremento de la función de la barrera intestinal⁷⁶. Sin embargo, son necesarios más estudios para confirmar este resultado y poder establecer si la función de barrera del epitelio de la mucosa está aumentado en pacientes con SGNC.

Un mecanismo potencial por el cual el gluten puede originar síntomas, sería el debido a la fermentación intestinal de pépticos de gluten de difícil absorción⁷⁷.⁷⁸. El gluten es un compuesto proteico cuya digestión enzimática completa es compleja, por lo tanto es posible que la fermentación del gluten ocasione un aumento del gas intestinal debido a la producción de gases derivados del sulfato. Por ello, podría desencadenar flatulencias y la distensión de una víscera hueca como es el tracto intestinal o colon. Los derivados sulfúricos que se producen pueden potencialmente alterar la sensibilidad visceral^{79, 80}.

Además, el gluten puede originar la activación del sistema colinérgico a nivel gastrointestinal. Las neuronas aferentes de la submucosa y del plexo mientérico son de tipo colinérgico tanto en humanos como en roedores^{81, 82}. La activación de las neuronas colinérgicas ha sido demostrada en modelos animales con murinos que reproducían la sensibilidad al gluten⁸³. El gluten originaba un incremento de la contractibilidad de la musculatura lisa e indirectamente aumentaba el contenido de agua a nivel de la luz intestinal. Además,

Tabla IV <i>Criterios diagnósticos de la sensibilidad al gluten no celiaca</i>	
Criterios diagnósticos de la EC de la ESPGHAN	
La ingesta de gluten ocasiona la aparición precoz de los síntomas intestinales y extraintestinales	
Los síntomas desaparecen rápidamente tras la retirada de gluten de la dieta	
La reintroducción de gluten provoca de nuevo la sintomatología	
La Ig E específica para el gluten o el trigo y el skin prick test son negativos	
Los anticuerpos anti-tTG, anti-EMA y anti-DGP son negativos	
Los anticuerpos anti gliadina pueden ser positivos en el 40- 50% de los pacientes	
La mucosa duodenal permanece normal o con leve aumento de los linfocitos intraepiteliales	
HLA DQ 2 o HLA DQ8 se encuentran positivos en el 40% de los pacientes	

podría desencadenar la secreción directa o indirecta de neurotransmisores que originan en último término un aumento de la permeabilidad intestinal, con incremento de los basófilos activados sensibles al gluten a nivel intestinal⁸⁴. También ha sido comprobado que en pacientes con enfermedad celiaca evolucionada pueden existir alteraciones en el sistema simpático y/o parasimpático así como alteraciones de tipo dismotilidad^{85, 86}.

Las células enterocromafines en el epitelio intestinal liberan serotonina que activa las neuronas aferentes de la submucosa y del plexo mientérico⁸⁷. En procesos inflamatorios como la colitis ulcerosa se puede producir una reducción de la expresión de los transportadores que captan serotonina (SERT)⁸⁸. Varios estudios en pacientes con SII han detectado cambios inflamatorios mínimos que engloban sobre todo linfocitos CD3+, células mastocíticas y una expresión reducida de los SERT⁸⁹. Un exceso de producción de serotonina en respuesta a una comida rica en carbohidratos puede ser un mecanismo desencadenante de síntomas dispépticos en la enfermedad celiaca⁹⁰. Una actividad prolongada serotoninérgica debido a una reducción de los SERT puede incrementar la liberación de acetilcolina y activar, por lo tanto, los reflejos peristálticos y secretores, los cuales pueden afectar la función intestinal y la producción de síntomas. Un incremento en la producción de acetilcolina (ACh) secundario a la ingesta de gluten podría ser un mecanismo que explicara la producción de síntomas tipo intestino irritable en pacientes con “sensibilidad al gluten”. Es necesario reproducir estos estudios en pacientes con “sensibilidad al gluten” sin

Tabla V
Comparación de las características de las patologías ocasionadas por el gluten

	<i>Enfermedad celiaca</i>	<i>Sensibilidad al gluten no celiaca</i>	<i>Alergia al trigo</i>
Prevalencia	1%	6%	10%
Comienzo de los síntomas	De semanas a años	De horas a días	De minutos a horas
Fisiopatología	Autoinmune (inmunidad innata y adaptativa)	Inmunomediado (inmunidad innata)	Alérgico
Mejor test diagnóstico inicial	Anti-tTG	Diagnóstico de exclusión	Skin prick test
Mejor test para confirmar la enfermedad	Biopsia duodenal	No necesario	Prueba de provocación oral

EC. Aunque no bien caracterizado aún, está claro que existe un eje immuno-neuroendocrino a nivel intestinal, existiendo relación entre linfocitos de mucosa, células enterocromafines y plexos mientéricos.

Por último, el gluten puede desencadenar síntomas a partir de los productos de su digestión parcial. Se ha demostrado que *in vitro*, péptidos derivados gliadina o sin relación con la gliadina, pueden inducir un daño intestinal y cambios en las células epiteliales a través de mecanismos no mediados por el sistema HLA. Por ejemplo, péptidos derivados de la gliadina pueden incrementar la permeabilidad intestinal y alterar la expresión de proteínas de los componentes de las uniones intercelulares de los enterocitos (tight junction)³³, inducir la apoptosis celular^{91, 92} e incrementar el estrés oxidativo. En un estudio clásico de van Elburg⁹³, ya establece que los péptidos de gliadina aumentan la permeabilidad intestinal en los familiares de primer grado de los pacientes celiacos. Estos resultados corroboran de forma global la hipótesis de que la gliadina puede inducir cambios mucosos mínimos que se manifiestan como alteraciones en la permeabilidad intestinal y activan el sistema inmune innato. Además, los derivados no relacionados con la gliadina, son pobremente absorbidos a lo largo del intestino delgado y pueden provocar síntomas funcionales^{78, 94}.

Clínica

La SGNC se caracteriza por síntomas que generalmente ocurren poco después de la ingesta de gluten, desapareciendo o mejorando (en cuestión de horas o pocos días) tras la retirada del gluten y recidiva con la exposición al gluten. La presentación clínica de esta patología es una combinación de síntomas típicos del SII como el dolor abdominal, alteraciones del hábito intestinal, (diarrea o estreñimiento), distensión abdominal y diversas manifestaciones sistémicas tales como la cefalea, fatiga, dolores musculares o articulares, o

entumecimiento de extremidades, dermatitis (eccema o erupción en la piel), la depresión y la anemia, en la tabla III se presentan las principales manifestaciones clínicas de esta enfermedad⁷⁴. En el ensayo clínico doble ciego, aleatorizado, controlado con placebo aparecen con mayor frecuencia en el grupo que consume gluten frente a los pacientes tratados con placebo (68% vs 40%), lo que sugiere una vínculo entre la ingesta de gluten y la generación de los síntomas. Aunque la frecuencia de síntomas del SII como intestinal es mayor que el de las manifestaciones extraintestinales, todos los pacientes suelen mostrar dos o más síntomas extraintestinales, siendo el más común de fatiga (36%) y confusión mental (42%), este último definido como una sensación de letargo que ocurre después de comer alimentos que contienen gluten⁹⁵.

Al contrario de lo que sucede en la EC, la SGNC no parece presentar una mayor asociación con enfermedades autoinmunes. Volta et al estudiaron la presencia de SGNC en un grupo de 78 familiares de primer grado de pacientes celiacos, observando esta entidad en 10 de ellos (12,8%). Sin embargo, ninguno de los familiares desarrolló una diabetes mellitus y solo 1(1,3%) presentó una tiroiditis autoinmune. Respecto al riesgo de aparición de complicaciones a largo plazo como el linfoma intestinal u otras neoplasias gastrointestinales no se ha descrito ningún caso, aunque aún está por determinar en un mayor número de individuos.

Diagnóstico

En ausencia de un biomarcador específico, el diagnóstico de la sensibilidad al gluten se basa en la evaluación precisa de las características clínicas, junto con la exclusión de la alergia al trigo y la enfermedad celíaca (tabla IV). La retirada del gluten se asocia con una mejora dramática o incluso la desaparición de los síntomas intestinales y extraintestinales⁹⁶. Tras la reintroducción

Tabla VI

Diferencias en las pruebas diagnósticas utilizadas para el diagnóstico de los trastornos relacionados con el gluten

Marcador	Enfermedad celiaca	Sensibilidad al gluten no celiaca	Alergia al trigo
Anti-AGA	Positivo	Positivo en el 40-50% de los pacientes	Negativo
Anti-DGP	Positivo	Negativo	Negativo
Anti-tTG	Positivo	Negativo	Negativo
Anti-EMA	Positivo	Negativo	Negativo
Ig E antigluten o antitrigo	Negativo	Negativo	Positivo
Biopsia de intestino delgado	Atrofia vellositaria	Normal	Normal

de gluten se observa una recurrencia de los síntomas. Se debe realizar un test indicativo para poder determinar la sensibilidad al gluten que evalúe el cese de los síntomas o la recurrencia de los mismos según la ausencia o presencia de gluten en la dieta⁷⁵. Sin embargo, como un efecto placebo producido por la retirada del gluten no se puede excluir, estudios doble ciego de exposición controlados con placebo se esperan para confirmar el diagnóstico de la sensibilidad al gluten. En la tabla V se presenta la comparación de las principales características de los trastornos provocados por el gluten.

Otro requisito fundamental para el diagnóstico de esta patología es la ausencia positividad de los tTG, EMA y DGP. No obstante, en el análisis serológico de los pacientes con SGNC se ha encontrado una alta prevalencia (40-50%) de anticuerpos anti gliadina (AGA) sin permitir el diagnóstico de la EC⁷⁴. La positividad de los AGA casi siempre se limita a la clase IgG, mientras que sólo ocasionalmente afecta a la clase IgA. En contraste con lo que sucede en la EC, en donde IgG AGA siguen siendo positivas en la mitad de los pacientes después de la retirada del gluten, IgG AGA desaparecen en la mayoría de los pacientes con SGNC tras 6 meses con DSG⁹⁷. Es tentador especular la existencia de una memoria inmunológica en curso podría ser operativa selectivamente en la enfermedad celíaca, pero no en la sensibilidad al gluten. En la tabla VI puede observarse la diferencia entre los principales marcadores serológicos y biopsia duodenal entre las diferentes entidades provocadas por el gluten.

Se debe obtener una biopsia intestinal en todos los pacientes con sospecha de SGNC mientras están consumiendo una dieta que contiene gluten, para excluir la presencia de la EC. Alrededor del 60% de los pacientes con sensibilidad al gluten tienen una mucosa intestinal normal (Marsh 0). El 40% restante de los pacientes tienen un leve aumento en el número de los linfocitos intraepiteliales (enteritis linfocítica o grado I de la clasificación de Marsh⁹⁸). Sin embargo, las lesiones de grado I se producen en una amplia gama de patologías, no solo en trastornos relacionados con el

gluten como infecciones intestinales (bacterianas, virales y parasitarias), enfermedad inflamatoria intestinal, la infección por *Helicobacter pylori*, la intolerancia a la lactosa, alergias a los alimentos, consumo de AINES y la inmunodeficiencia variable común. En la enteritis linfocítica puede ayudar a diferenciar ambas entidades la presencia de linfocitos $\gamma\delta$ mediante citometría de flujo⁹⁹, el depósito subepitelial de anticuerpos anti-transglutaminasa Ig A en la biopsia duodenal mediante inmunofluorescencia o la detección mediante inmunohistoquímica del marcador FOXP3 en los linfocitos de la lámina propia¹⁰⁰.

En la EC el 99% de los pacientes presentan los haplotipos HLA-DQ2 y / o HLA-DQ8. Sin embargo este genotipado lo manifiestan el 40% de los sujetos con SGNC⁷⁴. Esta cifra es mucho menor que la encontrada en los pacientes con EC y es comparable a la población general (30%)¹⁰⁰. De tal manera, parece que la sensibilidad al gluten no está relacionada con el patrón genético presente en la mayoría de pacientes con EC.

Alergia al trigo

Concepto y epidemiología

La alergia al trigo (AT) se define como una reacción inmunológica adversa al trigo¹⁰¹. El trigo es uno de los ocho alérgenos alimentarios mediados por IgE más comunes en los EE.UU.¹⁰². A nivel mundial, AT afecta a entre el 0,5% y el 9% de la población¹⁰³. La respuesta clínica a la sensibilización de trigo varía en función de la forma de exposición y la respuesta inmune provocada¹⁰².

Etiopatogenia

La AT constituye una alergia alimentaria o reacciones de hipersensibilidad alimentaria que se produce por un desequilibrio entre una reacción alérgica y los mecanismos de tolerancia. Estas reacciones se origi-

nan mediante un mecanismo inmunológico y comprenden las formas mediadas por Inmunoglobulina E (IgE) y las mediadas por inmunocomplejos o respuesta inmune celular¹⁰⁴.

En condiciones fisiológicas, los alérgenos alimenticios intactos o digeridos parcialmente, atraviesan la mucosa intestinal y encuentran el tejido linfoide asociado al intestino. Esta red inmunitaria, extremadamente desarrollada, protege contra los agentes patógenos ingeridos y previene las reacciones inmunes por antígenos nutricionales. En ausencia de respuesta inmunológica los antígenos alimenticios que han atravesado la mucosa intestinal es la tolerancia oral¹⁰⁵.

Sin embargo en la AT sucede una sensibilización alérgica ligada a la Ig E; inicialmente sucede el paso del trigo a lo largo de la mucosa intestinal, que origina la presentación de los antígenos por las células presentadoras de antígenos. Estas provocan la activación de los linfocitos T con predominio de respuesta inmune Th2. Se origina una cooperación entre los linfocitos T y B, que inducen la síntesis de Ig E específicas al trigo y produciendo la activación de los eosinófilos. Posteriormente se fija las IG E específicas a los mastocitos de los órganos diana (piel, bronquios, intestino delgado...). Finalmente, tras un segundo contacto con el alérgeno se induce la liberación de los mediadores mastocitarios (histamina, Factor activador de plaquetas, serotonina, proteasas neutras, heparina, ácido hialurónico y diversas prostaglandinas, leucotrienos y citoquinas) que son el origen de los diversos signos clínicos¹⁰⁵.

Clínica

La ingestión de trigo puede producir la aparición inmediata o retardada de manifestaciones cutáneas, gastrointestinales o síntomas respiratorios clásicamente asociada con la alergia alimentaria¹⁰². Además, la sensibilización al trigo puede causar anafilaxis dependiente de los alimentos inducida por el ejercicio (ADAIE), urticaria de contacto, asma del panadero, o rinitis. ADAIE se define como una reacción alérgica inducida durante varias horas por la combinación de un producto alimenticio infractor, en este caso el trigo, y el ejercicio físico subsiguiente.

Los síntomas van desde urticaria hasta angioedema y shock¹⁰³. El asma ocupacional o específicamente, el asma del panadero, es una respuesta mediada por IgE a las subunidades inhibidores de trigo amilasa / tripsina en las personas que trabajan con harina de trigo como resultado de dificultad respiratoria y la rinitis¹⁰⁶.

El curso natural de AT difiere entre niños y adultos. AG es más común en niños con una prevalencia del 0,4% -1% en los EE.UU.¹⁰⁷. Generalmente, se presenta con síntomas inmediatos de urticaria, obstrucción bronquial, náuseas o molestias gastrointestinales. Hipersensibilidad tardía puede presentar 24 horas después de la ingestión de las quejas gastrointestinales,

prurito o erupción eccematosa¹⁰⁸. La mayoría de los niños alérgicos de trigo también sufren de dermatitis atópica y otras alergias alimentarias. Un estudio en sujetos en edad pediátrica demostró que la resolución de AT se produjo en el 29% de los niños de cuatro años de edad, el 56% de los niños de ocho años de edad, y el 65% de los niños de doce años¹⁰⁷. Sin embargo, los adultos son menos propensos a presentar síntomas de alergia a los alimentos clásica debido a trigo ingerido¹⁰⁹. Lo más probable, los adultos pueden presentar ADAIE o síntomas relacionados con la inhalación de productos de trigo¹¹⁰.

Diagnóstico

La precisión diagnóstica de las pruebas de diagnósticas de AT en niños y adultos es imperfecta. Las pruebas disponibles actuales incluyen la detección de IgE específica de trigo sérica (RAST), pruebas de punción cutánea (skin prick test), Patch testing y pruebas de exposición oral al alérgeno. Majamaa et al¹¹¹ compararon estas pruebas en 39 niños menores de 2 años de edad con sospecha de AT. De los 22 niños que dieron positivo para la AT a través de la provocación oral, el 23% desarrolló una reacción de tipo inmediato. Los 77% desarrollaron reacciones de aparición tardía restantes tales como eczema o diarrea. En los pacientes que dieron positivo a la provocación oral, el 20% dio positivo a través de la prueba RAST, el 23% dio positivo a través skin prick test y el 86% dio positivo a través de Patch testing. A pesar de Patch testing siendo la medida más sensible en este grupo de edad, la especificidad es del 35%, bastante inferior a la especificidad de skin prick test y RAST, que era del 93% y 100%, respectivamente¹¹¹.

Los adultos son menos propensos que los niños para presentar síntomas típicos de la AT tras la ingesta de gluten, sin embargo el diagnóstico sigue siendo igualmente problemático¹⁰⁹. Scibilia et al¹⁰⁹ realizaron un estudio doble ciego controlado con placebo en 27 adultos y encontró que el 48% de los pacientes daba positivo para la AG. En los pacientes que dieron positivo, el 46% dio positivo mediante el skin prick test y el 85% a través de la prueba de RAST. La especificidad de estas pruebas eran 41% para skin prick test y el 27% para RAST¹⁰⁹. Por lo tanto, aunque el trigo es un alérgeno común en niños y adultos, en la actualidad las pruebas disponibles no son totalmente satisfactorias. La exposición oral a los alimentos con el alérgeno puede ser la técnica diagnóstica más eficaz¹⁰.

Conclusiones

Los trastornos relacionados con el gluten son patologías cada vez más frecuentes que afectan actualmente a nuestra sociedad y presentan una elevada prevalencia. Tienen características específicas que

permiten diferenciarlas y que se resumen en la tabla V¹⁰⁰. Actualmente disponemos de diferentes pruebas diagnósticas que ayudan a la correcta clasificación de los sujetos en este espectro de patologías relacionadas con el gluten como se representa en la tabla IV⁷⁴.

El tratamiento común de estas patologías consiste en la exclusión de los alimentos que contienen gluten de la dieta. Esta dieta debe ser estricta en el caso de la enfermedad celiaca y de la alergia al trigo por las consecuencias derivadas de la activación del sistema inmune y de los mecanismos relacionados con la alergia que pueden originar complicaciones graves en algunos casos¹¹². En los pacientes con sensibilidad al gluten no celiaca se recomienda también la restricción del gluten en la dieta para conseguir un alivio sintomático. Sin embargo, algunos de estos sujetos toleran pequeñas cantidades de gluten en la dieta y no van a tener por ello consecuencias de gravedad salvo la aparición de alguna de la sintomatología que llevó al diagnóstico⁹⁵.

Aunque la restricción del gluten de la dieta pueda parecer una medida sencilla, para los pacientes afectados por estas patologías supone un cambio importante en su alimentación y una atención especial a la contaminación cruzada que puede haber entre los diferentes alimentos. El aumento en la prevalencia de estas entidades ha provocado un aumento paralelo en la producción de alimentos sin gluten, así como la concienciación de la sociedad hacia esta dieta, lo que finalmente puede ayudar a su cumplimiento.

Agradecimientos

Este estudio ha sido financiado en parte con una beca del Instituto de Salud Carlos III, Fondo de Investigación Sanitaria (Ref. PI13/01133), cofinanciado por FEDER (Fondo Europeo de Desarrollo Regional).

Referencias

1. Pompa M, Giuliani MM, Palermo C, Agriesti F, Centonze D, Flagella Z. Comparative Analysis of Gluten Proteins in Three Durum Wheat Cultivars by a Proteomic Approach. *J Agric Food Chem* 2013.
2. He J, Penson S, Powers SJ, Hawes C, Shewry PR, Tosi P. Spatial patterns of gluten protein and polymer distribution in wheat grain. *J Agric Food Chem* 2013;61:6207-15.
3. Bernardo D, Garrote JA, Nadal I, Leon AJ, Calvo C, Fernandez-Salazar L, et al. Is it true that coeliacs do not digest gliadin? Degradation pattern of gliadin in coeliac disease small intestinal mucosa. *Gut* 2009;58:886-7.
4. Weijers HA, va de KJ. Some biochemical investigations into the cause of wheat sensitivity in celiac disease. *Gastroenterology* 1960;38:587-91.
5. van RJ, Haex AJ, Seeder WA, de J. Clinical and biochemical analysis of gluten toxicity. *I. Experientia* 1960;16:209.
6. Barada K, Abu Daya H, Rostami K, Catassi C. Celiac disease in the developing world. *Gastrointestinal endoscopy clinics of North America* 2012;22:773-96.

7. Spaenij-Dekking L, Kooy-Winkelaar Y, van Veelen P, Drijfhout JW, Jonker H, van Soest L, et al. Natural variation in toxicity of wheat: potential for selection of nontoxic varieties for celiac disease patients. *Gastroenterology* 2005;129:797-806.
8. Nakamura A, Tanabe S, Watanabe J, Makino T. Primary screening of relatively less allergenic wheat varieties. *Journal of nutritional science and vitaminology* 2005;51:204-6.
9. Kearney J. Food consumption trends and drivers. *Philosophical transactions of the Royal Society of London Series B, Biological sciences* 2010;365:2793-807.
10. Leonard MM, Vasagar B. US perspective on gluten-related diseases. *Clinical and experimental gastroenterology* 2014;7:25-37.
11. Fasano A, Catassi C. Clinical practice. Celiac disease. *The New England journal of medicine* 2012;367:2419-26.
12. Green PH, Cellier C. Celiac disease. *The New England journal of medicine* 2007;357:1731-43.
13. Di Sabatino A, Corazza GR. Coeliac disease. *Lancet* 2009;373:1480-93.
14. Tavakkoli A, DiGiacomo D, Green PH, Lebowohl B. Vitamin D status and concomitant autoimmunity in celiac disease. *J Clin Gastroenterol* 2013;47:515-9.
15. Ludvigsson JF, Rubio-Tapia A, van Dyke CT, Melton LJ, 3rd, Zinsmeister AR, Lahr BD, et al. Increasing incidence of celiac disease in a North American population. *The American journal of gastroenterology* 2013;108:818-24.
16. Rodrigo L, Garrote JA, Vivas S. [Celiac disease]. *Medicina clinica* 2008;131:264-70.
17. Kratzer W, Kibele M, Akinli A, Porzner M, Boehm BO, Koenig W, et al. Prevalence of celiac disease in Germany: a prospective follow-up study. *World journal of gastroenterology: WJG* 2013;19:2612-20.
18. Vivas S, Ruiz de Morales JM, Fernandez M, Hernando M, Herrero B, Casqueiro J, et al. Age-related clinical, serological, and histopathological features of celiac disease. *The American journal of gastroenterology* 2008;103:2360-5; quiz 6.
19. Vivas S, Ruiz de Morales JG, Riestra S, Arias L, Fuentes D, Alvarez N, et al. Duodenal biopsy may be avoided when high transglutaminase antibody titers are present. *World journal of gastroenterology: WJG* 2009;15:4775-80.
20. Vivas S, Ruiz de Morales JM, Martinez J, Gonzalez MC, Martin S, Martin J, et al. Human recombinant anti-transglutaminase antibody testing is useful in the diagnosis of silent coeliac disease in a selected group of at-risk patients. *European journal of gastroenterology & hepatology* 2003;15:479-83.
21. Gujral N, Freeman HJ, Thomson AB. Celiac disease: prevalence, diagnosis, pathogenesis and treatment. *World journal of gastroenterology: WJG* 2012;18:6036-59.
22. Vaquero L, Caminero A, Nunez A, Hernando M, Iglesias C, Casqueiro J, et al. Coeliac disease screening in first-degree relatives on the basis of biopsy and genetic risk. *European journal of gastroenterology & hepatology* 2014;26:263-7.
23. Ahn R, Ding YC, Murray J, Fasano A, Green PH, Neuhausen SL, et al. Association analysis of the extended MHC region in celiac disease implicates multiple independent susceptibility loci. *PloS one* 2012;7:e36926.
24. Schuppan D, Junker Y, Barisani D. Celiac disease: from pathogenesis to novel therapies. *Gastroenterology* 2009;137:1912-33.
25. Maiuri L, Ciacci C, Ricciardelli I, Vacca L, Raia V, Auricchio S, et al. Association between innate response to gliadin and activation of pathogenic T cells in coeliac disease. *Lancet* 2003;362:30-7.
26. Maiuri L, Ciacci C, Ricciardelli I, Vacca L, Raia V, Rispo A, et al. Unexpected role of surface transglutaminase type II in celiac disease. *Gastroenterology* 2005;129:1400-13.
27. Beckett CG, Dell'Olio D, Shidrawi RG, Rosen-Bronson S, Ciclitira PJ. Gluten-induced nitric oxide and pro-inflammatory cytokine release by cultured coeliac small intestinal biopsies. *Eur J Gastroenterol Hepatol* 1999;11:529-35.

28. Murray IA, Daniels I, Coupland K, Smith JA, Long RG. Increased activity and expression of iNOS in human duodenal enterocytes from patients with celiac disease. *Am J Physiol Gastrointest Liver Physiol* 2002;283:G319-26.
29. Daniels I, Cavill D, Murray IA, Long RG. Elevated expression of iNOS mRNA and protein in coeliac disease. *Clin Chim Acta* 2005;356:134-42.
30. De Stefano D, Maiuri MC, Iovine B, Ialenti A, Bevilacqua MA, Carnuccio R. The role of NF-kappaB, IRF-1, and STAT-1alpha transcription factors in the iNOS gene induction by gliadin and IFN-gamma in RAW 264.7 macrophages. *Journal of molecular medicine* 2006;84:65-74.
31. Martin-Pagola A, Perez-Nanclares G, Ortiz L, Vitoria JC, Hualde I, Zaballa R, et al. MICA response to gliadin in intestinal mucosa from celiac patients. *Immunogenetics* 2004;56:549-54.
32. Clemente MG, De Virgiliis S, Kang JS, Macatagney R, Musu MP, Di Pierro MR, et al. Early effects of gliadin on enterocyte intracellular signalling involved in intestinal barrier function. *Gut* 2003;52:218-23.
33. Sander GR, Cummins AG, Henshall T, Powell BC. Rapid disruption of intestinal barrier function by gliadin involves altered expression of apical junctional proteins. *FEBS Lett* 2005;579:4851-5.
34. Di Sabatino A, Ciccocioppo R, Cupelli F, Cinque B, Millimaggi D, Clarkson MM, et al. Epithelium derived interleukin 15 regulates intraepithelial lymphocyte Th1 cytokine production, cytotoxicity, and survival in coeliac disease. *Gut* 2006;55:469-77.
35. Meresse B, Chen Z, Ciszewski C, Tretiakova M, Bhagat G, Krausz TN, et al. Coordinated induction by IL15 of a TCR-independent NKG2D signaling pathway converts CTL into lymphokine-activated killer cells in celiac disease. *Immunity* 2004;21:357-66.
36. Hue S, Mention JJ, Monteiro RC, Zhang S, Cellier C, Schmitz J, et al. A direct role for NKG2D/MICA interaction in villous atrophy during celiac disease. *Immunity* 2004;21:367-77.
37. Raki M, Tollefsen S, Molberg O, Lundin KE, Sollid LM, Jahnsen FL. A unique dendritic cell subset accumulates in the celiac lesion and efficiently activates gluten-reactive T cells. *Gastroenterology* 2006;131:428-38.
38. Yoshimura S, Bondeson J, Brennan FM, Foxwell BM, Feldmann M. Role of NFkappaB in antigen presentation and development of regulatory T cells elucidated by treatment of dendritic cells with the proteasome inhibitor PSI. *Eur J Immunol* 2001;31:1883-93.
39. Ouaz F, Arron J, Zheng Y, Choi Y, Beg AA. Dendritic cell development and survival require distinct NF-kappaB subunits. *Immunity* 2002;16:257-70.
40. Ohteki T, Tada H, Ishida K, Sato T, Maki C, Yamada T, et al. Essential roles of DC-derived IL-15 as a mediator of inflammatory responses in vivo. *J Exp Med* 2006;203:2329-38.
41. Mowat AM. Anatomical basis of tolerance and immunity to intestinal antigens. *Nature reviews Immunology* 2003;3:331-41.
42. Anderson RP, Degano P, Godkin AJ, Jewell DP, Hill AV. In vivo antigen challenge in celiac disease identifies a single transglutaminase-modified peptide as the dominant A-gliadin T-cell epitope. *Nat Med* 2000;6:337-42.
43. Arentz-Hansen H, McAdam SN, Molberg O, Fleckenstein B, Lundin KE, Jorgensen TJ, et al. Celiac lesion T cells recognize epitopes that cluster in regions of gliadins rich in proline residues. *Gastroenterology* 2002;123:803-9.
44. Nilsen EM, Jahnsen FL, Lundin KE, Johansen FE, Fausa O, Sollid LM, et al. Gluten induces an intestinal cytokine response strongly dominated by interferon gamma in patients with celiac disease. *Gastroenterology* 1998;115:551-63.
45. Leon AJ, Garrote JA, Blanco-Quiros A, Calvo C, Fernandez-Salazar L, Del Villar A, et al. Interleukin 18 maintains a long-standing inflammation in coeliac disease patients. *Clin Exp Immunol* 2006;146:479-85.
46. MacDonald TT, Bajaj-Elliott M, Pender SL. T cells orchestrate intestinal mucosal shape and integrity. *Immunology today* 1999;20:505-10.
47. Jabri B, Sollid LM. Mechanisms of disease: immunopathogenesis of celiac disease. *Nat Clin Pract Gastroenterol Hepatol* 2006;3:516-25.
48. Ivarsson A, Myleus A, Norstrom F, van der Pals M, Rosen A, Hogberg L, et al. Prevalence of childhood celiac disease and changes in infant feeding. *Pediatrics* 2013;131:e687-94.
49. Vriezinga SL, Mearin ML. [Gluten tolerance as a result of earlier exposure?]. *Nederlands tijdschrift voor geneeskunde* 2013;157:A6349.
50. Ludvigsson JF, Fasano A. Timing of introduction of gluten and celiac disease risk. *Ann Nutr Metab* 2012;60 Suppl 2:22-9.
51. Pozo-Rubio T, de Palma G, Mujico JR, Olivares M, Marcos A, Acuna MD, et al. Influence of early environmental factors on lymphocyte subsets and gut microbiota in infants at risk of celiac disease; the PROFICEL study. *Nutr Hosp* 2013;28:464-73.
52. Laparra JM, Olivares M, Sanz Y. Oral administration of *Bifidobacterium longum* CECT 7347 ameliorates gliadin-induced alterations in liver iron mobilisation. *Br J Nutr* 2013;1-9.
53. Pozo-Rubio T, Olivares M, Nova E, De Palma G, Mujico JR, Ferrer MD, et al. Immune development and intestinal microbiota in celiac disease. *Clin Dev Immunol* 2012;2012:654143.
54. Caminero A, Nistal E, Arias L, Vivas S, Comino I, Real A, et al. A gluten metabolism study in healthy individuals shows the presence of faecal glutenase activity. *European journal of nutrition* 2012;51:293-9.
55. Wacklin P, Kaukinen K, Tuovinen E, Collin P, Lindfors K, Partanen J, et al. The duodenal microbiota composition of adult celiac disease patients is associated with the clinical manifestation of the disease. *Inflammatory bowel diseases* 2013;19:934-41.
56. Tjellstrom B, Stenhammar L, Hogberg L, Falth-Magnusson K, Magnusson KE, Midtvedt T, et al. Gut microflora associated characteristics in children with celiac disease. *Am J Gastroenterol* 2005;100:2784-8.
57. Sollid LM, Gray GM. A role for bacteria in celiac disease? *Am J Gastroenterol* 2004;99:905-6.
58. Caminero A, Herran AR, Nistal E, Perez-Andres J, Vaquero L, Vivas S, et al. Diversity of the cultivable human gut microbiome involved in gluten metabolism: isolation of microorganisms with potential interest for coeliac disease. *FEMS microbiology ecology* 2014;88:309-19.
59. Nistal E, Caminero A, Herran AR, Arias L, Vivas S, de Morales JM, et al. Differences of small intestinal bacteria populations in adults and children with/without celiac disease: effect of age, gluten diet, and disease. *Inflammatory bowel diseases* 2012;18:649-56.
60. Nistal E, Caminero A, Vivas S, Ruiz de Morales JM, Saenz de Miera LE, Rodriguez-Aparicio LB, et al. Differences in faecal bacteria populations and faecal bacteria metabolism in healthy adults and celiac disease patients. *Biochimie* 2012;94:1724-9.
61. Murray JA, Rubio-Tapia A. Diarrhoea due to small bowel diseases. *Best Pract Res Clin Gastroenterol* 2012;26:581-600.
62. Guarino A, Lo Vecchio A, Berni Canani R. Chronic diarrhoea in children. *Best Pract Res Clin Gastroenterol* 2012;26:649-61.
63. Sharma M, Singh P, Agnihotri A, Das P, Mishra A, Verma AK, et al. Celiac disease: A disease with varied manifestations in adults and adolescents. *J Dig Dis* 2013.
64. Carroccio A, Iannitto E, Cavataio F, Montalto G, Tumminello M, Campagna P, et al. Sideropenic anemia and celiac disease: one study, two points of view. *Digestive diseases and sciences* 1998;43:673-8.
65. Hijaz NM, Bracken JM, Chandratte SR. Celiac crisis presenting with status epilepticus and encephalopathy. *Eur J Pediatr* 2013.
66. Rodrigo Saez L. Celiac disease in the adult. *Revista espanola de enfermedades digestivas: organo oficial de la Sociedad Espanola de Patologia Digestiva* 2006;98:397-407.

67. Pulido O, Zarkadas M, Dubois S, Macisaac K, Cantin I, La Vieille S, et al. Clinical features and symptom recovery on a gluten-free diet in Canadian adults with celiac disease. *Can J Gastroenterol* 2013;27:449-53.
68. Tanpowpong P, Broder-Fingert S, Katz AJ, Camargo CA, Jr. Age-related patterns in clinical presentations and gluten-related issues among children and adolescents with celiac disease. *Clin Transl Gastroenterol* 2012;3:e9.
69. Oberhuber G, Granditsch G, Vogelsang H. The histopathology of coeliac disease: time for a standardized report scheme for pathologists. *European journal of gastroenterology & hepatology* 1999;11:1185-94.
70. Ludvigsson JF, Leffler DA, Bai JC, Biagi F, Fasano A, Green PH, et al. The Oslo definitions for coeliac disease and related terms. *Gut* 2013;62:43-52.
71. Gasbarrini G, Mangiola F. Wheat-related disorders: A broad spectrum of 'evolving' diseases. *United European gastroenterology journal* 2014;2:254-62.
72. Biesiekierski JR, Newnham ED, Irving PM, Barrett JS, Haines M, Doecke JD, et al. Gluten causes gastrointestinal symptoms in subjects without celiac disease: a double-blind randomized placebo-controlled trial. *The American journal of gastroenterology* 2011;106:508-14; quiz 15.
73. Sapone A, Bai JC, Ciacci C, Dolinsek J, Green PH, Hadjivassiliou M, et al. Spectrum of gluten-related disorders: consensus on new nomenclature and classification. *BMC medicine* 2012;10:13.
74. Volta U, Tovoli F, Cicola R, Parisi C, Fabbri A, Piscaglia M, et al. Serological tests in gluten sensitivity (nonceliac gluten intolerance). *J Clin Gastroenterol* 2012;46:680-5.
75. Sapone A, Lammers KM, Mazzarella G, Mikhailenko I, Carteni M, Casolaro V, et al. Differential mucosal IL-17 expression in two gliadin-induced disorders: gluten sensitivity and the autoimmune enteropathy celiac disease. *Int Arch Allergy Immunol* 2010;152:75-80.
76. Sapone A, Lammers KM, Casolaro V, Cammarota M, Giuliano MT, De Rosa M, et al. Divergence of gut permeability and mucosal immune gene expression in two gluten-associated conditions: celiac disease and gluten sensitivity. *BMC medicine* 2011;9:23.
77. Gibson PR, Shepherd SJ. Evidence-based dietary management of functional gastrointestinal symptoms: The FOD-MAP approach. *Journal of gastroenterology and hepatology* 2010;25:252-8.
78. Ong DK, Mitchell SB, Barrett JS, Shepherd SJ, Irving PM, Biesiekierski JR, et al. Manipulation of dietary short chain carbohydrates alters the pattern of gas production and genesis of symptoms in irritable bowel syndrome. *Journal of gastroenterology and hepatology* 2010;25:1366-73.
79. Barbara G, Stanghellini V, Brandi G, Cremon C, Di Nardo G, De Giorgio R, et al. Interactions between commensal bacteria and gut sensorimotor function in health and disease. *The American journal of gastroenterology* 2005;100:2560-8.
80. Tornblom H, Abrahamsson H, Barbara G, Hellstrom PM, Lindberg G, Nyhlin H, et al. Inflammation as a cause of functional bowel disorders. *Scand J Gastroenterol* 2005;40:1140-8.
81. Pan H, Gershon MD. Activation of intrinsic afferent pathways in submucosal ganglia of the guinea pig small intestine. *J Neurosci* 2000;20:3295-309.
82. Brehmer A, Croner R, Dimmler A, Papadopoulos T, Schrodler F, Neuhauser W. Immunohistochemical characterization of putative primary afferent (sensory) myenteric neurons in human small intestine. *Auton Neurosci* 2004;112:49-59.
83. Verdu EF, Huang X, Natividad J, Lu J, Blennerhassett PA, David CS, et al. Gliadin-dependent neuromuscular and epithelial secretory responses in gluten-sensitive HLA-DQ8 transgenic mice. *Am J Physiol Gastrointest Liver Physiol* 2008;294:G217-25.
84. Carroccio A, Brusca I, Mansueto P, Pirrone G, Barrale M, Di Prima L, et al. A cytologic assay for diagnosis of food hypersensitivity in patients with irritable bowel syndrome. *Clin Gastroenterol Hepatol* 2010;8:254-60.
85. Giorgetti GM, Tursi A, Iani C, Arciprete F, Brandimarte G, Capria A, et al. Assessment of autonomic function in untreated adult coeliac disease. *World journal of gastroenterology: WJG* 2004;10:2715-8.
86. Gibbons CH, Freeman R. Autonomic neuropathy and coeliac disease. *J Neurol Neurosurg Psychiatry* 2005;76:579-81.
87. Pan H, Galligan JJ. 5-HT1A and 5-HT4 receptors mediate inhibition and facilitation of fast synaptic transmission in enteric neurons. *Am J Physiol* 1994;266:G230-8.
88. Coates MD, Mahoney CR, Linden DR, Sampson JE, Chen J, Blaszyk H, et al. Molecular defects in mucosal serotonin content and decreased serotonin reuptake transporter in ulcerative colitis and irritable bowel syndrome. *Gastroenterology* 2004;126:1657-64.
89. Bercik P, Verdu EF, Collins SM. Is irritable bowel syndrome a low-grade inflammatory bowel disease? *Gastroenterol Clin North Am* 2005;34:235-45, vi-vii.
90. Coleman NS, Foley S, Dunlop SP, Wheatcroft J, Blackshaw E, Perkins AC, et al. Abnormalities of serotonin metabolism and their relation to symptoms in untreated celiac disease. *Clin Gastroenterol Hepatol* 2006;4:874-81.
91. Hadjivassiliou M, Williamson CA, Woodroffe N. The immunology of gluten sensitivity: beyond the gut. *Trends Immunol* 2004;25:578-82.
92. Giovannini C, Sanchez M, Straface E, Scazzocchio B, Silano M, De Vincenzi M. Induction of apoptosis in caco-2 cells by wheat gliadin peptides. *Toxicology* 2000;145:63-71.
93. van Elburg RM, Uil JJ, Mulder CJ, Heymans HS. Intestinal permeability in patients with coeliac disease and relatives of patients with coeliac disease. *Gut* 1993;34:354-7.
94. Shepherd SJ, Parker FC, Muir JG, Gibson PR. Dietary triggers of abdominal symptoms in patients with irritable bowel syndrome: randomized placebo-controlled evidence. *Clin Gastroenterol Hepatol* 2008;6:765-71.
95. Volta U, Caio G, Tovoli F, De Giorgio R. Non-celiac gluten sensitivity: questions still to be answered despite increasing awareness. *Cellular & molecular immunology* 2013;10:383-92.
96. Verdu EF, Armstrong D, Murray JA. Between celiac disease and irritable bowel syndrome: the "no man's land" of gluten sensitivity. *The American journal of gastroenterology* 2009;104:1587-94.
97. Volta U, Corazza GR, Frisoni M, Valentini RA, Molinaro N, Bianchi FB, et al. IgA antigliadin antibodies and persistence of jejunal lesions in adult coeliac disease. *Digestion* 1990;47:111-4.
98. Bizzaro N, Tozzoli R, Villalta D, Fabris M, Tonutti E. Cutting-edge issues in celiac disease and in gluten intolerance. *Clinical reviews in allergy & immunology* 2012;42:279-87.
99. Calleja S, Vivas S, Santiuste M, Arias L, Hernando M, Nistal E, et al. Dynamics of non-conventional intraepithelial lymphocytes-NK, NKT, and gammadelta T in celiac disease: relationship with age, diet, and histopathology. *Digestive diseases and sciences* 2011;56:2042-9.
100. Volta U, De Giorgio R. New understanding of gluten sensitivity. *Nat Rev Gastroenterol Hepatol* 2012;9:295-9.
101. Johansson SG, Bieber T, Dahl R, Friedmann PS, Lanier BQ, Lockey RF, et al. Revised nomenclature for allergy for global use: Report of the Nomenclature Review Committee of the World Allergy Organization, October 2003. *The Journal of allergy and clinical immunology* 2004;113:832-6.
102. Sampson HA. Food allergy. Part 1: immunopathogenesis and clinical disorders. *The Journal of allergy and clinical immunology* 1999;103:717-28.
103. Zuidmeer L, Goldhahn K, Rona RJ, Gislason D, Madsen C, Summers C, et al. The prevalence of plant food allergies: a systematic review. *The Journal of allergy and clinical immunology* 2008;121:1210-8 e4.
104. Novembre E, de Martino M, Vierucci A. Foods and respiratory allergy. *The Journal of allergy and clinical immunology* 1988;81:1059-65.
105. Niggemann B, Reibel S, Roehr CC, Felger D, Ziegert M, Sommerfeld C, et al. Predictors of positive food challenge

- outcome in non-IgE-mediated reactions to food in children with atopic dermatitis. *The Journal of allergy and clinical immunology* 2001;108:1053-8.
106. Brisman J. Baker's asthma. *Occupational and environmental medicine* 2002;59:498-502; quiz , 426.
 107. Keet CA, Matsui EC, Dhillon G, Lenehan P, Paterakis M, Wood RA. The natural history of wheat allergy. *Annals of allergy, asthma & immunology: official publication of the American College of Allergy, Asthma, & Immunology* 2009;102:410-5.
 108. Inomata N. Wheat allergy. *Current opinion in allergy and clinical immunology* 2009;9:238-43.
 109. Scibilia J, Pastorello EA, Zisa G, Ottolenghi A, Bindslev-Jensen C, Pravettoni V, et al. Wheat allergy: a double-blind, placebo-controlled study in adults. *The Journal of allergy and clinical immunology* 2006;117:433-9.
 110. Crespo JF, Rodriguez J. Food allergy in adulthood. *Allergy* 2003;58:98-113.
 111. Majamaa H, Moisiö P, Holm K, Turjanmaa K. Wheat allergy: diagnostic accuracy of skin prick and patch tests and specific IgE. *Allergy* 1999;54:851-6.
 112. Simpson S, Thompson T. Nutrition assessment in celiac disease. *Gastrointestinal endoscopy clinics of North America* 2012;22:797-809.



Revisión

Indicaciones de diferentes tipos de fibra en distintas patologías

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Resumen

Introducción: la fibra engloba los carbohidratos no digeridos ni absorbidos en el tubo digestivo, llegando intactos al colon. Se clasifica en soluble e insoluble, con propiedades fisiológicas distintas. La fibra se ha empleado frecuentemente para tratar y prevenir diversas patologías gastrointestinales. También se ha estudiado su papel en la fisiopatología de enfermedades como la diabetes, la dislipemia, la hipertensión arterial y la obesidad. Además se ha relacionado su consumo con la prevención de ciertos tumores, en especial del cáncer colorrectal, así como con el aumento de la excreción de nitrógeno en heces.

Objetivos: analizar la evidencia del papel que la fibra puede tener en el tratamiento y prevención de distintas enfermedades, así como el tipo de fibra más adecuado en cada una.

Métodos: revisión no sistemática en Medline y Pubmed, y posterior aplicación de los criterios de inclusión y exclusión.

Resultados: diferentes tipos de fibra pueden ser útiles en el tratamiento de enfermedades gastrointestinales, como el estreñimiento, la diarrea, el síndrome de intestino irritable, la colitis ulcerosa en remisión o el síndrome de intestino corto. Los pacientes con diabetes, obesidad, hiperlipidemia, hipertensión y enfermedad cardiovascular también pueden beneficiarse del consumo principalmente de fibra soluble. La fibra alimentaria ha demostrado prevenir el cáncer de colon y otros tumores. En pacientes con encefalopatía hepática o insuficiencia renal, la fibra fermentable ha demostrado beneficios.

Conclusiones: la fibra tiene un papel importante en la prevención y tratamiento de múltiples enfermedades; sin embargo, son necesarios más estudios de calidad para poder realizar recomendaciones más específicas.

(Nutr Hosp. 2015;31:2372-2383)

DOI:10.3305/nh.2015.31.6.9023

Palabras clave: Fibra dietética. Enfermedades gastrointestinales. Enfermedades metabólicas. Cáncer colorrectal.

FIBER-TYPE INDICATION AMONG DIFFERENT PATHOLOGIES

Abstract

Introduction: fiber definition includes all those carbohydrates which are not digested nor absorbed in the upper gastrointestinal tract allowing them to reach the colon with no previous processing. Traditionally fiber has been classified according to their solubility into soluble and insoluble and different physiological properties have been defined for each type. The physiologic role of the fiber intake has been studied in diabetes, dyslipidemia or obesity. Fiber intake has also demonstrated to be beneficial in the prevention of many neoplastic diseases like colorectal cancer. It's also known that fiber plays an important role in the faecal excretion of nitrogen.

Aim: to evaluate the current evidence that fiber intake plays in the management and prevention of several different diseases, being able to determine, if possible, the most recommended fiber type for each clinical condition.

Methods: a non-systematic review by searching the Medline and Pubmed was made and studies which met the inclusion criteria were identified and selected for analysis.

Results: different fiber types can be useful for the treatment of several gastrointestinal diseases like constipation, diarrhea, irritable bowel syndrome, ulcerative colitis remission or short bowel syndrome. Patients diagnosed with diabetes, obesity, hyperlipidemia, hypertension and other cardiometabolic diseases can get a clinical improvement with soluble fiber intake. Dietary fiber has demonstrated to play a role in the prevention of colorectal cancer and other neoplastic diseases. Patients with hepatic encephalopathy or chronic kidney disease will also benefit from fermentable fiber intake.

Discussion: fiber plays an important role in the prevention and treatment of many clinical conditions. However further investigations are needed to establish specific fiber intake recommendations.

(Nutr Hosp. 2015;31:2372-2383)

DOI:10.3305/nh.2015.31.6.9023

Key words: Dietetic fiber. Gastrointestinal diseases. Metabolic diseases. Colorectal cancer.

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Recibido: 26-III-15.

Aceptado: 27-IV-15.

Introducción

El interés por la fibra surge a principios de los años 70, a partir de los trabajos de Burkitt en los cuales, a través de un estudio epidemiológico, puso de manifiesto que ciertas “enfermedades de la civilización” tales como el estreñimiento, la obesidad, la diabetes, o el cáncer de colon eran prácticamente inexistentes en países africanos, donde la ingesta de fibra dietética era mucho más elevada¹.

No existe una definición de la fibra universalmente aceptada. Se trata, por tanto, de una entidad heterogénea que engloba multitud de compuestos diferentes. Tradicionalmente, el concepto de fibra incluye a todos aquellos hidratos de carbono que no se digieren ni absorben en la parte alta del tubo intestinal, llegando intactos al colon. De ese modo, el Codex Alimentarius en el año 2005 definió fibra dietética como “los polímeros de carbohidratos con un grado de polimerización no inferior a 3, que no son digeridos y/o absorbidos en el intestino delgado”².

De forma clásica, la fibra se ha clasificado en función de su condición de solubilidad. Así, distinguimos entre *fibra soluble* y *fibra insoluble*³.

La *fibra soluble* incluye el almidón resistente, pectinas, gomas, mucílagos, algunas hemicelulosas y polisacáridos no amiláceos de reserva de la planta. Son compuestos muy hidratables que forman geles en el tracto digestivo. A esta característica se deben muchos de sus efectos fisiológicos como son el retraso en el vaciamiento gástrico o el enlentecimiento y disminución de la absorción de ciertos nutrientes en el intestino delgado. Al llegar al colon, sufren un proceso de fermentación por las bacterias allí presentes, produciéndose ácidos grasos de cadena corta (acetato, propionato, butirato). El butirato es utilizado por las células del epitelio intestinal colónico como principal fuente de energía, mientras que el propionato y el acetato son metabolizados en el hígado, pudiendo ser transportados hasta los tejidos periféricos siendo allí utilizados como fuente de energía.

La *fibra insoluble* incluye la celulosa, algunas hemicelulosas, lignina y otros polifenoles. A diferencia de la fibra soluble, apenas es fermentada por las bacterias colónicas. Presenta un importante papel en la formación y el tránsito intestinal del bolo fecal, aumentando el volumen del mismo y disminuyendo su tiempo de tránsito.

Sin embargo se sabe que algunas fibras insolubles son rápidamente fermentadas y ciertas fibras solubles no afectan a la absorción de glucosa. Por lo que la clasificación de los tipos de fibra se considera más compleja y actualmente no se recomienda utilizar esta terminología.

La principal fuente de fibra de los españoles está constituida por los cereales, siendo el pan blanco el principal contribuidor (el pan blanco contiene la mitad de fibra que el pan integral, pero al estar su consumo mucho más extendido, lo convierte en el principal

origen de la fibra que se consume en España). Otros alimentos que contribuyen ampliamente a la ingesta de fibra son frutas, legumbres, hortalizas y tubérculos⁴.

En España, los varones ingieren una media de 21 g. diarios de fibra frente a 18 g. al día las mujeres. Si bien, analizando el contenido de fibra en función de las calorías ingeridas, el consumo relativo es mayor en éstas últimas (10 g/ 1000 kcal frente a 8 g/ 1000 kcal)⁴.

La Asociación Americana de Dietética (ADA) establece el consumo recomendado de fibra en adultos en 25-30 g/día, o 10-13 g. de fibra por cada 1000 kcal consumidas. Además, la proporción insoluble/soluble debe ser 3/1⁵. Del mismo modo, la Sociedad Española de Nutrición Comunitaria recomienda una ingesta de fibra dietética superior a 25 g/día⁶.

No existe evidencia suficiente para recomendar una cantidad adecuada de fibra en niños menores de dos años. Por el contrario, en los mayores de esta edad se recomienda el consumo de la cantidad de fibra que resulte de sumar 5 g/día a la edad del niño⁵.

Existen pocos datos publicados con respecto a las necesidades de fibra en ancianos. Se recomienda, igual que en adultos, el consumo de 10-13 g. de fibra por cada 1000 kcal. Como los ancianos requieren menos calorías diarias que los adultos jóvenes, la cantidad de fibra total necesaria disminuye⁵.

La fibra se clasifica en función de su comportamiento en contacto con el agua (fibra soluble e insoluble) y de su fermentabilidad (fibras no fermentables, fibras parcialmente fermentables, fibras fermentables). También, podemos dividir la fibra según su estructura en carbohidratos de cadena larga o de cadena corta⁷. Dentro de las fibras solubles, podemos clasificarlas en viscosas (psyllium, betaglucanos, goma guar, salvado de avena) y no viscosas (inulina, maltodextrina, goma guar parcialmente hidrolizada)⁸. (Tabla I)

El objetivo principal de esta revisión ha sido analizar la evidencia científica disponible del papel que la fibra puede tener en el tratamiento y prevención de distintas enfermedades, así como el tipo de fibra más adecuado en cada una de ellas, para poder realizar unas recomendaciones al respecto basadas en la evidencia. En la actualidad existen estudios que han puesto de manifiesto la importancia de la fibra para tratar y prevenir diversas patologías; sin embargo, debido a la heterogeneidad de los mismos, en especial con respecto a las cantidades de fibra empleadas y a su origen, no es posible establecer pautas específicas a seguir en cada una de ellas.

Material y métodos

Para llevar a cabo esta revisión, se ha realizado una búsqueda bibliográfica en las bases de datos Medline y Cochrane, en los meses de junio y julio de 2014. Las palabras clave utilizadas han sido las siguientes: *fiber*, *dietary fiber*, *soluble fiber*, *insoluble fiber*, *wheat bran*, *psyllium*, *guar gum*, *gum Arabic*, *beta-glucan*, *gluco-*

Tabla I
Clasificación de la fibra

**a) Carbohidratos de cadena corta:
solubles y altamente fermentables.**

- fructooligosacáridos.
 - galactooligosacáridos: rafinosa, esteaquirosa.
- Fuentes:* legumbres, nueces, semillas, trigo, centeno, ajo, alcachofa.

b) Carbohidratos de cadena larga:

b1) fibra soluble y altamente fermentable:

- almidón resistente.
- goma guar, goma de caraua o de algarrobo, goma arábiga, goma tragacanto.
- glucomanano.
- pectina.
- inulina.
- dextrina de trigo.

Fuentes: legumbres, centeno, cebada, bananas, trigo sarraceno, mijo, avena, patata, arroz, pasta cocida y enfriada.

b2) fibra soluble y medianamente fermentable:

- psyllium/ispagula (*Plantago ovata*).
- avena (*betaglucono*).

Fuentes: semillas de la planta *Plantago ovata*, y avena.

b3) fibra insoluble y escasamente fermentable:

- salvado de trigo.
- lignina.

Fuentes: muchos vegetales y frutas, salvado de trigo, centeno, arroz integral, pasta integral, quinoa, semillas de lino.

b4) fibra insoluble y no fermentable:

- celulosa.
- metilcelulosa.
- goma estercúlea.

Fuentes: granos y cereales, nueces, semillas. Piel de frutas y vegetales.

mannan, whole grains, resistant starch, fructo-oligosaccharides, short-chain fatty acid, gastrointestinal disorders, short bowel syndrome, irritable bowel syndrome, short bowel syndrome, diarrhea, constipation, ulcerative colitis, Crohn's disease, diverticulosis, diabetes, glucose, insulin, postprandial glucose, cholesterol, hyperlipidemia, obesity, hypertension, metabolic syndrome, cardiovascular disease, C-reactive protein, inflammation, cancer, colorectal cancer, chronic kidney disease, protein utilization, fecal nitrogen, chronic liver disease, hepatic encephalopathy, gut flora, prebiotics, probiotics, synbiotics.

Como criterios de inclusión se establecieron que los artículos estuviesen escritos en castellano o en inglés, y que hubieran sido publicados en los últimos 10 años preferiblemente. Además, los artículos debían responder a los siguientes tipos de publicación: ensayos clínicos, ensayos clínicos controlados, ensayos clínicos controlados aleatorizados, metaanálisis, guías de práctica clínica, revisiones y revisiones sistemáticas.

Tras aplicar estos criterios, se seleccionaron un total de 107 publicaciones.

Resultados y discusión

Efectos de la fibra sobre las enfermedades gastrointestinales.

Los efectos de la fibra tienen una importante repercusión en la totalidad del tracto gastrointestinal. En tramos superiores, la fibra soluble enlentece el vaciado gástrico y altera la absorción en el intestino delgado de algunos nutrientes, entre ellos la glucosa⁹. Además la fibra soluble fermentable aumenta la masa fecal a través del aumento de la biomasa (actuando como prebióticos) y de los subproductos de la fermentación (gas y ácidos grasos de cadena corta). La fibra soluble escasamente fermentable presenta la capacidad de retener agua y formar un gel, a lo largo de todo el tubo digestivo, normalizando la consistencia de las heces (haciéndolas más suaves en caso de estreñimiento, y más firmes en caso de diarrea)⁸.

Por otro lado, a nivel del colon, la fibra insoluble aumenta el contenido de agua de las heces y, por lo tanto, su volumen, aumentando así la velocidad de tránsito por estimulación mecánica de la mucosa, incrementando la secreción y la peristalsis y contribuyendo a mejorar el estreñimiento⁹.

Existe evidencia de que la ingesta de fibra influye cuantitativa y cualitativamente en la microbiota intestinal. Así, el proceso de fermentación de la fibra soluble altamente fermentable por parte de las bacterias endógenas tiene lugar en el íleon y tramos más proximales del colon, obteniéndose así energía a través de la producción de ácidos grasos de cadena corta. Este proceso estimula favorablemente el crecimiento de especies de bacterias beneficiosas para la homeostasis intestinal, especialmente *Lactobacillus* y *Bifidobacterias*, en detrimento de otras, como *E. coli* o *Clostridium*. La fibra, a través de su fermentación y la producción de butirato, supone la principal fuente de alimentación de los colonocitos. Sin un aporte suficiente de la misma, la integridad de la barrera intestinal podría verse amenazada, situación que facilita la traslocación bacteriana⁷.

Estreñimiento.

Además de aumentar la ingesta de agua y realizar ejercicio físico, incrementar el consumo de fibra suele ser el primer escalón en el tratamiento del estreñimiento. Las guías clínicas recomiendan la ingesta de fibra dietética y, en aquellos casos en los que la fibra que contiene la dieta no permita normalizar el tránsito intestinal, recomiendan suplementar con fármacos con alto contenido en fibra. Siguiendo estas medidas se consigue el control satisfactorio del estreñimiento en un 50 % de los pacientes aproximadamente⁷.

Aunque existen múltiples estudios^(10,11,12) que reflejan los efectos beneficiosos de la fibra en el estreñimiento, sólo algunos son ensayos clínicos aleatoriza-

dos, por lo que el grado de evidencia en cuanto al tipo de fibra a consumir en la mayoría de los casos es baja¹³.

En el estudio de Hamilton et al¹⁰ la ingesta de metilcelulosa mejoró de forma significativa el estreñimiento, sin embargo se trató de un estudio no aleatorizado ni comparado con placebo.

Los estudios^{11,12} que evalúan la eficacia del salvado (fibra insoluble) muestran, en general, mejoría del estreñimiento.

El psyllium o *Plantago Ovata* ha sido evaluado en múltiples ensayos comparándolo con placebo^{14,15,16} y ha mostrado una mejoría estadísticamente significativa en la frecuencia defecatoria¹³.

Attaluri et al han comparado en un reciente estudio el consumo de ciruelas secas (6 g/día) con psyllium, resultando que ambos grupos presentaron de forma similar mejoría de la clínica de estreñimiento¹⁷.

En ocasiones, los pacientes pueden presentar un claro empeoramiento del estreñimiento en relación con el consumo de fibra. Cuando esto ocurre, debe descartarse la presencia de un retraso significativo del tránsito colónico o una disineria en la defecación⁷.

Diarrea.

La fibra soluble, en concreto la goma guar, ha demostrado ser efectiva en la prevención y el tratamiento de la diarrea asociada a la nutrición enteral^{18,19}. Este tipo de fibra, junto con la rehidratación oral, ha demostrado ser eficaz también en pacientes con cólera²⁰.

Así mismo, existen algunos estudios que relacionan determinados tipos de fibra con la mejoría de tipos específicos de diarrea. Una mezcla de galactooligosacáridos ha mostrado ser efectiva en la prevención y tratamiento de la diarrea del viajero²¹, el psyllium y el salvado de avena han demostrado eficacia en el tratamiento de la diarrea asociada a los inhibidores de la proteasa²². Sin embargo, no existe evidencia suficiente como para establecer unas recomendaciones concretas.

Síndrome de intestino irritable

El síndrome de intestino irritable es una patología crónica funcional del tracto digestivo que se caracteriza por dolor abdominal y alteraciones del hábito intestinal, en ausencia de enfermedad orgánica. Puede predominar el estreñimiento, la diarrea, o ambos por igual²³.

El papel de la fibra en el síndrome de intestino irritable es controvertido. Una reciente revisión de la Cochrane²⁴ concluye que la fibra, tanto soluble como insoluble, no es eficaz como tratamiento del intestino irritable. Sin embargo, el metaanálisis de Ford et al²⁵, analizando los mismos ensayos clínicos que la Cochrane, muestra una pequeña pero estadísticamente significativa mejoría en los pacientes con síndrome de intes-

tino irritable, independientemente del subtipo, tratados con psyllium/*plantago ovata*. El salvado no demostró ser superior a placebo en ninguno de los estudios.

Posteriormente, el ensayo clínico aleatorizado de Bijkerk et al²⁶, llevado a cabo en 275 pacientes seguidos en atención primaria, también mostró una mejoría en aquellos tratados con psyllium, no así en los pacientes tratados con salvado.

Los efectos adversos habituales del tratamiento con suplementos de fibra observados en este tipo de paciente son: dolor abdominal, estreñimiento, náuseas, flatulencia y diarrea cuya intensidad y frecuencia no son distintas a las que presentarían los pacientes sin dicha patología de base²⁷.

Por lo tanto, y a pesar de la ausencia de nuevos metaanálisis que aborden específicamente este tema y que permitan aclarar la controversia existente a día de hoy, la amplia experiencia de uso y los recientes estudios arriba citados apoyarían la recomendación del uso de la fibra, concretamente *plantago ovata*, en el paciente con síndrome de intestino irritable.

Enfermedad inflamatoria intestinal: colitis ulcerosa y enfermedad de Crohn.

A pesar de que la etiopatogenia exacta de la enfermedad inflamatoria intestinal (EII) es desconocida en la actualidad, se sabe que en el trasfondo de dicha patología existe una respuesta autoinmunitaria exagerada frente a agentes que se encuentran en la luz del intestino, pudiendo tener la microbiota intestinal un importante papel en el desarrollo de esa respuesta inflamatoria.

En los pacientes con enfermedad inflamatoria intestinal existe una síntesis disminuida de ácidos grasos de cadena corta (acetato, propionato y butirato principalmente) por parte de la microbiota intestinal presente en el colon. Por ello un aporte adicional de fibra soluble podría facilitar un aumento en la síntesis de estos ácidos grasos deficitarios²⁸. En este sentido, una reciente revisión sistemática de ensayos clínicos²⁹ concluyó que la colitis ulcerosa es más sensible al tratamiento con fibra soluble que la enfermedad de Crohn. Esto podría deberse a que la fermentación de la fibra y su consecuente producción de ácidos grasos de cadena corta tienen lugar en el colon, que es donde asienta la inflamación en la colitis ulcerosa. Por el contrario, la enfermedad de Crohn con afectación de tramos más proximales del intestino no se beneficiaría de dicho efecto.

Sin embargo, el consumo de fibra soluble durante el brote agudo de colitis ulcerosa podría ser potencialmente perjudicial. La presencia de sangre intraluminal y de un bajo pH en el contexto del brote puede favorecer el crecimiento de bacterias productoras de ácido láctico (*Lactobacilli* y *Streptococci*) y la fermentación de la fibra soluble por parte de estas bacterias conllevaría un daño directo sobre la mucosa intestinal³⁰.

Tabla II
Patología gastrointestinal y tipo de fibra recomendada

<i>Perfil de paciente</i>	<i>Tipo de fibra recomendada</i>
Estreñimiento	Psyllium, salvado, metilcelulosa, ciruelas secas
Diarrea	Diarrea asociada a nutrición enteral: goma guar
Síndrome de intestino irritable	Psyllium
Enfermedad inflamatoria intestinal	Psyllium, fibra fermentable (únicamente en colitis ulcerosa en remisión)
Diverticulosis	No evidencia
Síndrome de intestino corto	Fibra fermentable. Si pérdidas de líquidos importantes: fibra altamente viscosa

En cuanto al tratamiento de mantenimiento de la colitis ulcerosa, Fernández-Bañares et al compararon mediante un ensayo clínico aleatorizado³¹ la eficacia del psyllium y de la mesalazina en el mantenimiento de la remisión de la colitis ulcerosa, sin encontrar diferencias significativas entre ambas intervenciones.

Con respecto al papel de la fibra insoluble en los pacientes con EII, al ser escasamente fermentable, su administración no contribuiría a la producción de butirato. Además, su consumo favorece el aumento del volumen del bolo fecal y esto puede desencadenar una obstrucción intestinal en pacientes que presenten áreas estenóticas (fundamentalmente en enfermedad de Crohn o estenosis a nivel de anastomosis quirúrgicas). Por último la fibra insoluble aumenta el tránsito intestinal y esto no es recomendable en pacientes que, frecuentemente, presentan síntomas de diarrea²⁸.

Diverticulosis.

La hipótesis de que una dieta baja en fibra puede ser causa de diverticulosis y que una dieta rica en fibra previene sus síntomas o complicaciones está ampliamente aceptada³. El bajo consumo de fibra daría como resultado un volumen de heces reducido y la musculatura del colon tendería a hipertrofiarse para lograr su propulsión. Esta presión intracolónica aumentada conllevaría una herniación de la mucosa a través de la capa muscular con la consiguiente aparición de los divertículos.

Es por esto que la mayoría de guías de práctica clínica aconsejan aumentar el consumo de fibra para prevenir la diverticulosis y sus complicaciones. Sin embargo esto no está basado en estudios clínicos aleatorizados.

Sólo hay ensayos clínicos que estudian el efecto de una dieta rica en fibra en pacientes con divertículos, pero no aportan resultados consistentes³².

Además, un estudio transversal publicado recientemente concluye que un consumo elevado de fibra (documentado mediante encuesta dietética), y el incremento de los movimientos intestinales, se asocian sorprendentemente a una mayor prevalencia de diverticulosis³³.

A la vista de estos resultados, es evidente que son necesarios más estudios de calidad para aclarar el efecto de la fibra en la aparición de la diverticulosis y prevención de sus complicaciones.

Síndrome de intestino corto.

El síndrome de intestino corto se define como un cuadro de malabsorción de fluidos, electrolitos y nutrientes debido a una disminución de la superficie de intestino delgado funcional, y puede ser el resultado de una anomalía congénita, resección quirúrgica o cualquier entidad que pueda causar un defecto de la función intestinal. Este síndrome puede causar una malnutrición progresiva, diarrea severa y deshidratación³⁴.

Tras la cirugía, la mucosa intestinal remanente sufre un proceso de adaptación progresivo que dura hasta 2 años produciéndose una hiperplasia de la mucosa que termina por minimizar la diarrea y malabsorción existentes. Esta adaptación únicamente tiene lugar en presencia de nutrientes en la luz intestinal. Cuando existe colon funcional, la fibra fermentable es metabolizada por las bacterias allí presentes, dando como resultado ácidos grasos de cadena corta, principalmente acetato, propionato y butirato. Los dos primeros son metabolizados por las células del epitelio colónico, o por los tejidos periféricos. El butirato puede regular la proliferación de las células colónicas, y servir de fuente de energía a los colonocitos. Esto puede ser una fuente de calorías importante para los pacientes con síndrome de intestino corto³⁵.

Por tanto, con el objetivo de lograr la mayor capacidad adaptativa del intestino residual se debe introducir la dieta lo más precozmente posible, si bien durante las primeras fases el paciente requerirá soporte nutricional complementario por vía parenteral³⁶. La introducción de los alimentos ricos en fibra se hace de forma progresiva, evaluando la respuesta del paciente³⁷.

Es importante reseñar que en los frecuentes casos en que la pérdida de líquidos por las heces es elevada está indicada la administración de suplementos de fibra altamente viscosa con el fin de gelatinizar las heces contribuyendo así a disminuir la pérdida de líquidos.

En la tabla II se recogen las recomendaciones del tipo de fibra más adecuado, en función de la evidencia científica disponible, para cada patología gastrointestinal.

Numerosos estudios^{38,39,40,41} han intentado evaluar la importancia del consumo de fibra en la prevención de las enfermedades cardiovasculares. En muchos casos, los resultados han sido contradictorios. Esto podría ser debido a la ausencia de una definición de fibra aceptada universalmente, la variable duración de los estudios, los distintos tipos y cantidades de fibra utilizadas, y la no homogeneidad de la población estudiada. Además, la mayoría de los estudios se han realizado aumentando el consumo de fibra contenida en los alimentos, en vez de suplementándola de forma aislada. Es por esto que no puede afirmarse categóricamente que, los beneficios observados sean exclusivamente producidos por la fibra, que exista influencia de otras sustancias también presentes en estos alimentos (antioxidantes, fitoesteroles), o que sea simplemente debido a la implementación de hábitos dietéticos más saludables que suele acompañar a las dietas ricas en fibra (menor ingesta calórica y de grasas).

La proteína C reactiva (PCR) es un marcador de inflamación reconocido como predictor independiente de riesgo de enfermedad coronaria además de presentar una fuerte asociación con el síndrome metabólico y la diabetes mellitus⁴². Existen estudios donde se establece una relación directa entre el consumo de fibra y las cifras bajas de PCR⁴³, observándose dicha asociación en presencia tanto de fibra soluble como insoluble⁴². El mecanismo por el cual esto sucede no se conoce bien, aunque se ha sugerido que la fibra puede producir una disminución en la oxidación de los lípidos, asociándose esto con un descenso de la inflamación. Otros estudios, sin embargo, no han podido demostrar esta asociación entre fibra y niveles bajos de PCR⁴⁴.

Diabetes Mellitus e hiperglucemia.

Estudios epidemiológicos sugieren que las dietas ricas en fibra juegan un papel protector frente al desarrollo de diabetes mellitus y que este papel es independiente de otros factores de la dieta⁹.

Los mecanismos a través de los cuales la fibra dietética podría mejorar el perfil glucémico son: retraso del vaciado gástrico gracias a sus propiedades viscosas y de absorción de agua a este nivel, retardo en la absorción de hidratos de carbono en el intestino delgado, y alteración en la secreción de insulina y la sensibilidad a la misma⁴⁵.

Numerosos estudios con alto grado de evidencia ponen de manifiesto este papel beneficioso de la fibra en la diabetes mellitus tipo 1 y 2⁴⁶. Las dietas con un contenido moderado en hidratos de carbono ricos en fibra han demostrado producir un descenso de la glucemia postprandial de hasta el 21% con respecto a dietas con un contenido moderado de hidratos de carbono pobres en fibra. Este efecto se refleja en una disminución sig-

nificativa de la hemoglobina glicosilada y la glucemia basal cuyos niveles están significativamente reducidos en individuos diabéticos que consumen dietas con alto contenido en fibra (>42,5 g/día) o suplementos de fibra soluble (>15 g/día)⁴⁷. Así, suplementos dietéticos como el psyllium han demostrado ser eficaces para mejorar el control glucémico⁴⁸.

La influencia de la fibra en el control glucémico se ha atribuido principalmente a la fibra soluble debido a sus efectos en el estómago y el intestino delgado. Sin embargo, tanto la fibra soluble como la insoluble han sido asociadas con un aumento de la sensibilidad periférica a la insulina sin haber sido aclarados los mecanismos que lo propician⁴⁷.

La evidencia disponible no permite, por tanto, establecer con certeza qué subtipos de fibra serían los más adecuados en pacientes con diabetes mellitus. La cantidad de fibra recomendada sería similar a la de la población general⁴⁹.

Obesidad.

Se ha observado que las personas que consumen más fibra en su dieta tienen un peso más bajo que aquellas que ingieren menos cantidad⁵⁰. Un consumo elevado de fibra en la dieta, sobre todo de fibra proveniente de semillas o cereales, reduce el riesgo de desarrollar obesidad en un 30%⁹.

El consumo de fibra, en concreto de fibra soluble y viscosa, podría favorecer la pérdida de peso ya que aumenta la sensación de saciedad debido a que requiere más tiempo de masticación y retrasa el vaciamiento gástrico al producir una retención de agua a este nivel formando un gel. Este enlentecimiento del vaciado gástrico contribuye, a su vez, a la disminución de la absorción de algunos nutrientes, como son los hidratos de carbono, a nivel del intestino delgado, y al enlentecimiento de la absorción de la glucosa, produciéndose así una disminución de la liberación de insulina postprandial⁵¹. Así mismo, se ha sugerido que la ingesta de fibra aumenta la liberación de hormonas relacionadas con la saciedad, como la colecistoquinina⁵². La condición de viscosidad de la fibra, por lo tanto, parece jugar un papel fundamental en los beneficios de ésta en el peso⁵¹.

Por último cabe destacar que las dietas ricas en fibra presentan una baja proporción calórica. Esto se debe a que la cantidad, en peso, de alimentos ingeridos diariamente es constante por lo que al aumentar la proporción de fibra ingerida, la cual presenta un muy bajo índice calórico, se produce un desplazamiento de la dieta de otros alimentos con un mayor contenido calórico⁵².

Existen numerosos estudios^{53,54,55} que relacionan el consumo de suplementos de fibra con la pérdida de peso, sin embargo, presentan múltiples limitaciones: la pérdida de peso no era el objetivo principal del estudio en muchos de ellos, los seguimientos suelen ser exce-

Tabla III
Enfermedades metabólicas y tipo de fibra recomendada

<i>Perfil de paciente</i>	<i>Tipo de fibra recomendada</i>
Diabetes mellitus	Psyllium, fibra soluble, fibra insoluble
Obesidad	Glucomanano
Hiperlipidemia	Fibra soluble, salvado de trigo
Hipertensión arterial	Probablemente fibra soluble
Enfermedad cardiovascular y síndrome metabólico	Fibra total

sivamente cortos (menores de 4 semanas) y los grupos de pacientes son muy heterogéneos⁵⁶. En muchos de los estudios se han individualizado los distintos tipos de fibra utilizados. Así, el *glucomanano* ha demostrado ser efectivo en la pérdida de peso, tanto en dietas hipocalóricas como normocalóricas y tanto en pacientes obesos como en personas con sobrepeso, siendo un compuesto bien tolerado y con pocos efectos secundarios⁵². El *betaglucano* ha demostrado ser efectivo a dosis elevadas aumentando la sensación de saciedad pero logrando resultados contradictorios en cuanto a la pérdida de peso⁵⁷. Respecto al *psyllium* o *plantago ovata*, a pesar de no existir evidencia de su eficacia en la pérdida de peso⁵⁶, sí ha demostrado inducir cambios en la distribución de la grasa corporal logrando una disminución de la adiposidad abdominal en jóvenes adolescentes⁵⁸. Por último, la *goma guar*, uno de los compuestos tradicionalmente estudiados al respecto, no ha demostrado ser eficaz en la pérdida de peso⁵⁹.

Hiperlipidemia.

La fibra ayuda a disminuir la absorción de sales biliares a nivel intestinal, ya que forma una matriz donde éstas quedan atrapadas impidiendo su reabsorción (circulación enterohepática) y conllevando su eliminación por heces. Esto obliga al hígado a sintetizar nuevas sales biliares a partir de colesterol, contribuyendo así a disminuir sus niveles en sangre. Además los ácidos grasos de cadena corta, producto de la fermentación de la fibra soluble por las bacterias del colon (acetato, propionato, butirato), podrían tener un papel relevante inhibiendo la síntesis hepática de colesterol y favoreciendo así el descenso de sus niveles sanguíneos⁶⁰.

Brown et al⁶¹ publicaron un metaanálisis analizando el efecto hipolipemiente de la fibra, concluyendo que las dietas con alto contenido en fibra soluble (independientemente del tipo: psyllium, avena, pectina, betaglucano o goma guar) disminuyen el colesterol total y el LDL-colesterol sin afectarse significativamente los niveles de HDL-colesterol ni de triglicéridos. En otros estudios

la suplementación con psyllium resultó bien tolerada y mejoró el perfil lipídico incluso en adolescentes^{58,62}.

La utilización de fibra insoluble también ha sido evaluada al respecto, demostrándose asimismo una disminución en las cifras de colesterol total tras la administración de salvado de trigo en el desayuno⁶³.

Hipertensión arterial.

Varios estudios epidemiológicos^{64,65,66} muestran que las dietas ricas en fibra se asocian inversamente con la presión arterial.

El efecto antihipertensivo de la fibra podría explicarse porque, concretamente la fibra soluble, mejora la resistencia a la insulina, factor determinante en la patogénesis de la hipertensión arterial. La reducción en las cifras de colesterol plasmático también se relaciona con una mejor función endotelial y tiene una repercusión directa en la mejoría de la presión arterial⁵⁷.

Dos metaanálisis^{67,68} han evaluado el efecto del consumo de fibra en la presión arterial concluyendo que el aumento del consumo de fibra ayuda a reducir la presión arterial en pacientes hipertensos, y de forma más modesta, en pacientes normotensos. El mayor efecto se consigue en pacientes mayores de 40 años y fundamentalmente tras, al menos, 8 semanas de tratamiento continuado.

No existen estudios concluyentes que muestren un descenso significativo de la presión arterial en función del tipo de fibra estudiada, si bien, al igual que sucede con el resto de factores de riesgo cardiovascular, probablemente el mayor beneficio se obtenga con la administración de fibra soluble⁶⁹.

Enfermedad cardiovascular y síndrome metabólico.

El metaanálisis de Threapleton et al⁷⁰ publicado en 2013 pretendió establecer la relación entre el consumo de fibra y los eventos coronarios, fatales y no fatales. Los autores concluyeron que un consumo de fibra elevado (fibra total, fibra insoluble y fibra proveniente de cereales y vegetales) se asocia con un riesgo más bajo de enfermedad cardiovascular y eventos coronarios.

Además un consumo elevado de cereales integrales, fruta y vegetales se ha asociado con una reducción de la prevalencia de ictus isquémicos⁹.

En la tabla III se resumen los tipos de fibra recomendados según las distintas enfermedades metabólicas.

Efectos de la fibra sobre la prevención y el tratamiento del cáncer colorrectal y otros tumores.

Cáncer colorrectal.

Se han realizado múltiples estudios para valorar el papel de la fibra en la patogénesis del cáncer de co-

Tabla IV
Cáncer y tipo de fibra recomendada

<i>Perfil de paciente</i>	<i>Tipo de fibra recomendada</i>
Riesgo de cáncer de colon	Fibra cereal, salvado de trigo
Riesgo cáncer de mama	Fibra soluble
Riesgo de cáncer de esófago	Fibra vegetal y fruta
Riesgo cáncer de estómago y hepático	Fibra cereal

No existe suficiente evidencia en la literatura como para recomendar un tipo de fibra concreto.

lon. Los mecanismos biológicos por los que la ingesta de fibra disminuiría el riesgo de cáncer colorrectal incluirían la dilución de carcinógenos fecales, el acortamiento del tiempo de tránsito intestinal, cambios en la microbiota intestinal, la producción de ácidos grasos de cadena corta con la disminución resultante en el pH, o la absorción de la bilis citotóxica⁷¹.

Inicialmente Burkitt⁷² describió una asociación inversa entre el consumo de fibra y el riesgo de cáncer de colon al comparar los patrones de alimentación en Inglaterra y África oriental. Aunque varios estudios^{73,74,75,76} confirmaron esta hipótesis, la evidencia de que la fibra es un factor protector en el cáncer de colon continúa siendo incierta.

Varios estudios epidemiológicos demostraron que la alta ingesta de fibra disminuía el riesgo de adenoma colónico y cáncer colorrectal^{73,74,75,76}. Sin embargo en dos estudios realizados únicamente en mujeres no se encontró relación entre una dieta rica en fibra, con aumento de fruta y vegetales y la prevención del cáncer de colon^{77,78}.

Además en la revisión de Park et al⁷⁹ observaron que aunque inicialmente la ingesta de fibra se asociaba de forma inversa con los tumores de colon, esa relación se perdía cuando se ajustaba por otros factores de riesgo de la dieta (carne roja, alcohol, leche entera).

Tampoco en dos ensayos clínicos aleatorizados^{80,81} encontraron que la suplementación con fibra tuviera algún efecto protector sobre el desarrollo de adenomas asegurando una ingesta de 18g de fibra por cada 1000kcal, o con suplementación con salvado de trigo. Únicamente en el estudio de MacLennan et al⁸² se observó que en los pacientes con antecedente de adenoma colónico que siguieron con una dieta baja en grasa más suplementación con 25g de salvado de trigo no presentaron, a los 2 y 4 años, crecimiento de los adenomas.

Por todo ello, la Cochrane database⁸³, afirma que no hay evidencia suficiente en la actualidad con estudios aleatorizados que sugiera que el aumento de la ingesta de fibra reduzca la incidencia o recurrencia de adenomas de colon en un periodo de 2 a 4 años.

El estudio prospectivo de Dahm et al⁸⁴ concluye que la ingesta de fibra se asocia de forma inversa con el riesgo de cáncer colorrectal, y que la diferencias metodológicas (diseño, método de evaluación de la dieta, o definición de fibra) en los estudios previos, podrían ser la causa de la ausencia de evidencia clara respecto al papel protector de la fibra en el desarrollo de los tumores del colon.

Además el tipo de fibra podría ser también un factor importante. En el World Cancer Research Fund metanálisis⁸⁵ se encontraron diferencias en función del tipo de fibra incrementada en la dieta, así, la mayor ingesta de cereales resultó un factor protector del cáncer de colon y sin embargo la fruta, verdura y las legumbres no. En el estudio EPIC⁸⁶ encontraron que el consumo elevado de cereales no procesados, se asociaba sólo con una menor tasa de cáncer colorrectal distal.

La sociedad americana de gastroenterología en sus recomendaciones en la prevención del cáncer de colon, incluye la ingesta de fibra de 30-35 g/día, en base a su potencial protección frente al cáncer colorrectal y sus otros beneficios demostrados para salud⁸⁷.

Otros tumores.

Varios estudios^(88,89,90,91) han puesto de manifiesto que la ingesta de fibra disminuye el riesgo de desarrollar cáncer de mama. En un metanálisis esa asociación inversa se encontró sólo con la fibra soluble⁹⁰.

En el caso del cáncer de próstata, Deschasaux M et al⁹³ encontraron sólo que la ingesta de fibra dietética total, insoluble o procedente de las legumbres disminuía el riesgo de este tipo de cáncer.

También se ha demostrado el papel protector de la fibra en cánceres del tracto gastrointestinal superior, así, la ingesta de fibra procedente de vegetales y frutas podría disminuir el riesgo de adenocarcinoma de esófago⁹².

Por último, en el estudio EPIC⁸⁸ se analizó la relación de la ingesta de fibra procedente de cereales, frutas y vegetales con el desarrollo de distintos tipos de cáncer. A nivel gastrointestinal (estómago, hígado y colorrectal) la ingesta de fibra cereal disminuía de forma significativa el riesgo de cáncer y no la procedente de fruta y vegetales. El riesgo de cáncer de pulmón se asoció inversamente con la ingesta de fruta únicamente en fumadores activos y el riesgo de cáncer de hígado se asoció inversamente con la ingesta de fibra total.

La tabla IV muestra el beneficio que aporta la fibra en los distintos tipos de cáncer.

Efectos de la fibra sobre la excreción de nitrógeno en las heces.

La mayoría del amonio contenido en la sangre procede de la degradación, por parte de las bacterias intestinales, de los productos nitrogenados ingeridos en la

dieta. Este amonio es transportado desde el intestino, a través de la circulación portal, hasta el hígado, y se elimina en forma de urea vía renal⁹⁴.

Las dietas con alto contenido en fibra han demostrado aumentar la excreción de nitrógeno en las heces, en animales de laboratorio y en humanos^{95,96}. La fibra insoluble aumenta el tamaño del bolo fecal y el aumento en la excreción de nitrógeno parece proceder de la descamación de las proteínas de la pared celular de los enterocitos⁹⁷. La fibra fermentable actúa como sustrato para la flora bacteriana estimulando su crecimiento y proliferación. Las bacterias incorporan nitrógeno en su pared celular, y éstas serán posteriormente excretadas por las heces, arrastrando por tanto el nitrógeno incorporado en su pared. Además, los ácidos grasos de cadena corta producidos como consecuencia del proceso de fermentación acidifican el pH intraluminal, reduciendo la difusión de amonio a la sangre portal⁹⁸. El descenso en el pH provoca un ambiente hostil para la supervivencia de las bacterias productoras de ureasa (*Proteus*, *Klebsiella*) y, a su vez, creando un ambiente propicio para el crecimiento de bacterias no productoras de ureasa (*Lactobacilli*, *Bifidobacteria*), resultando una reducción neta de la producción de amonio en la luz del colon⁹⁹.

Insuficiencia hepática.

En la insuficiencia hepática, la fibra puede tener un papel terapéutico en los pacientes que presentan encefalopatía hepática, definida como el conjunto de síntomas y signos neuropsiquiátricos originados por la acumulación de sustancias nitrogenadas en sangre que no pueden metabolizarse en el hígado.

La lactulosa es un disacárido que actúa como prebiótico, con eficacia ampliamente demostrada en el manejo de la encefalopatía hepática, siendo actualmente el pilar de su tratamiento¹⁰⁰. Dos ensayos clínicos aleatorizados^{94,101} comparan la eficacia de un simbiótico (bifidobacterias más fructooligosacáridos) con lactulosa o con placebo en el tratamiento de la encefalopatía hepática leve. Ambos estudios muestran una mejoría en la disminución de los niveles de amonio en sangre y en los tests neuropsicológicos tras el tratamiento con bifidobacterias más fructooligosacáridos.

Los fructooligosacáridos, a diferencia de la lactulosa (que es hidrolizada por una amplia variedad de bacterias intestinales), son metabolizados selectivamente por un número limitado de microorganismos, entre ellos las bifidobacterias, promoviendo así el desarrollo de una microbiota intestinal más adecuada y produciendo menos cantidad de amonio⁹⁴.

El metaanálisis de Shukla et al¹⁰² concluye que el uso de simbióticos tiene una eficacia demostrada en el tratamiento de la encefalopatía hepática leve.

Liu et al⁹⁹ demostraron mediante un ensayo clínico aleatorizado que tanto los simbióticos como la fibra

Tabla V
Insuficiencia hepática y renal y tipo de fibra recomendada

<i>Perfil de paciente</i>	<i>Tipo de fibra recomendada</i>
Encefalopatía hepática leve	Simbióticos Fibra fermentable
Insuficiencia renal crónica	Fibra fermentable

fermentable (utilizaron un suplemento compuesto por varios tipos de fibras fermentables) producen un descenso de las cifras de amonio sanguíneo en pacientes con encefalopatía hepática leve.

Por lo tanto, podemos concluir que existe evidencia suficiente para recomendar el uso de simbióticos, y probablemente también el uso de fibra fermentable, en la encefalopatía hepática leve.

Insuficiencia renal.

En la insuficiencia renal crónica las concentraciones plasmáticas de productos del metabolismo proteico, incluida la urea, están aumentadas. El manejo dietético de la insuficiencia renal crónica incluye, entre otros, la restricción en la ingesta de proteínas, si bien la fibra podría jugar un papel en el tratamiento de estos pacientes al aumentar la excreción de nitrógeno por las heces y disminuyendo por tanto la cantidad de urea en sangre¹⁰³.

Existen varios estudios que han intentado evaluar la eficacia de la fibra en la insuficiencia renal crónica. Younis et al¹⁰⁴ demostraron un descenso en las cifras de creatinina y una mejora del filtrado glomerular tras el consumo de alimentos enriquecidos con fibra. En el trabajo de Zimmaro et al¹⁰⁵ observaron un descenso de la urea plasmática tras la suplementación con goma arábiga. Y recientemente, Younes et al¹⁰³ han encontrado los mismos beneficios con una dieta con elevado contenido en fibra fermentable que con una dieta baja en proteínas. Sin embargo, hacen falta más estudios de calidad que corroboren el efecto de la fibra en este tipo de pacientes.

En la tabla V quedan recogidas las recomendaciones del tipo de fibra más adecuado, en función de la evidencia científica disponible, en este tipo de patologías.

Conclusión

La fibra es un elemento importante dentro de una alimentación equilibrada. Por sus características fisiológicas y múltiples efectos a nivel del tránsito digestivo se considera que tiene un papel importante en la fisiopatología, prevención y tratamiento de múltiples enfermedades. Sin embargo son necesarios más estudios de calidad para poder realizar recomendaciones

más específicas al respecto, en cuanto a tipos concretos de fibra o cantidad de la misma.

Bibliografía

- Burkitt DP, Walker ARD, Painter NS. Dietary fibre and disease. *JAMA* 1974; 229:1068-1074.
- Codex Alimentarius Commission (CAC). Report of the 27th Session of the Codex Committee on Nutrition and Foods for Special Dietary Uses, Bonn, Germany, 21-25 November 2005. ALINORM 06/29/6.2006.
- Mataix Verdú J. Nutrición y alimentación humana. 2ª edición. Editorial Ergon; 2009.
- Aranceta Bartrina J. Dieta y riesgo cardiovascular. Estudio DORICA II. Madrid: Editorial Médica Panamericana; 2007.
- Slavin JL. Position of the American Dietetic Association: health implications of dietary fiber. *J Am Diet Assoc*. 2008; 108(10):1716-1731.
- www.nutricioncomunitaria.org
- Eswaran S, MD, Muir J, Chey WD. Fiber and functional gastrointestinal disorders. *Am J Gastroenterol*. 2013; 108(5):718-727.
- Chutkan R, Fahey G, Wright WL, McRoie J. Viscous versus non viscous soluble fiber supplements: mechanisms and evidence for fiber-specific health benefits. *Journal of the American Academy of Nurse Practitioners* 2012; 24(8):476-487.
- Anderson JW, Baird P, Davis RH Jr, Ferreri S, Knudtson M, Koraym A, Waters V, Williams CL. Health benefits of dietary fiber. *Nutrition reviews* 2009; 67 (4):188-205.
- Hamilton JW, Wagner J, Burdick BB, et al. Clinical evaluation of methylcellulose as a bulk laxative. *Dig Dis Sci* 1988; 33:993-918.
- Badiali D, Corazziari E, Habib FI, et al. Effect of wheat bran in treatment of chronic nonorganic constipation. A double-blind controlled trial. *Dig Dis Sci* 1995; 40:349-56.
- Mantle J. Research and serendipitous secondary findings. *Can Nurs* 1992; 88:15-18.
- Ramkumar D, Rao SS. Efficacy and safety of traditional medical therapies for chronic constipation: systematic review. *Am J Gastroenterol* 2005; 100(4):936-971.
- Cheskin LJ, Kamal N, Crowell MD, et al. Mechanisms of constipation in older persons and effects of fiber compared with placebo. *J Am Geriatr Soc* 1995; 43:666-69.
- Mc Rorie JW, Dagy BP, Morel JG, et al. Psyllium is superior to docusate sodium for treatment of chronic constipation. *Aliment Pharmacol Ther* 1998; 12(5):491-917.
- Dettmar PW, Sykes J. A multi-centre, general practice comparison of ispaghula husk with lactulose and other laxatives in the treatment of simple constipation. *Curr Med Res Opin* 1998; 14(4):227-33.
- Attaluri A, Donahoe R, Valestin J et al. Randomised clinical trial: dried plums (prunes) vs psyllium for constipation. *Aliment Pharmacol Ther* 2011; 33(7):822-8.
- Homann HH, Kemen M, Fuessenich C, Senkal M, Zumbobel V. Reduction in diarrhea incidence by soluble fiber in patients receiving total or supplemental enteral nutrition. *J Parenter Enteral Nutr* 1994; 18(6):486-90.
- Rushdi TA, Pichard C, Dhater YH. Control of diarrhea by fiber-enriched diet in ICU patients on enteral nutrition: a prospective randomized controlled trial. *Clin Nutr* 2004; 23(6):1344-52.
- Alam NH, Ashraf H, Sarker SA, Olesen M, Troup J, Salam MA, Gyr N, Mejer R. Efficacy of partially hydrolyzed guar gum-added oral rehydration solution in the treatment of severe cholera in adults. *Digestion* 2008; 78(1):24-9.
- Drakoularakou A, Tzortzis G, Rastall RA, Gibson GR. A double-blind, placebo-controlled, randomized human study assessing the capacity of a novel galacto-oligosaccharide mixture in reducing travellers' diarrhoea. *European Journal of Clinical Nutrition* 2010; 64(2):146-152.
- Sherman DS, Fish DN. Management of protease inhibitor-associated diarrhea. *Clinical infectious diseases* 2000; 30(6):908-14.
- Ford AC, Vandvik PO. Irritable bowel syndrome. Clinical review. *BMJ Clin Evid (online)* 2012; pii: 0410.
- Ruepert L, Quartero AO, De Wit NJ, van der Heiden GJ, Rubin G, Muris JW. Bulking agents, antispasmodics and antidepressants for treatment of irritable bowel syndrome. *Cochrane Database Syst Rev* 2011; 10(8).
- Ford AC, Talley NJ, Spiegel BM, Foxx-Orenstein AE, Schiller L, Quigley EM, Moayyedi P. Effect of fibre, antispasmodics and peppermint oil in the treatment of irritable bowel syndrome: systematic review and meta-analysis. *BMJ* 2008; 337:a2313.
- Bijkerk CJ, de Wit NJ, Muris JWM, Whorwell PJ, Knottnerus JA, Hoes AW. Soluble or insoluble fibre in irritable bowel syndrome in primary care? Randomised placebo controlled trial. *BMJ* 2009; 339:b3154.
- Trinkley KE., Nahata MC. Medication management of irritable bowel syndrome. *Digestion* 2014; 89(4):253-267.
- Ananthakrishnan AN., Khalili H, Konijeti GG, Higuruchi LM, de Silva P, Korzenik JR, Fuchs CS, Willett WC, Richter JM, Chan AT. A prospective study of long-term intake of dietary fiber and risk of Crohn's disease and ulcerative colitis. *Gastroenterology* 2013; 145(5):970-977.
- Galvez J, Rodríguez-Cabezas ME, Zarzuelo A. Effects of dietary fiber on inflammatory bowel disease. *Mol.Nutr.Food.Res.* 2005; 49(6):601-8.
- Cabré E, Domènech E. Impact of environmental and dietary factors on the course of inflammatory bowel disease. *World J Gastroenterol* 2012;18(29):3814-22.
- Fernández-Bañares F, Hinojosa J, Sánchez-Lombrana JL, Navarro E, Martínez-Salmerón JF, García-Pugés A, González-Huix F, Riera J., González-Lara V, Domínguez-Abascal F, Giné JJ, Moles J, Gomollón F, Gassull MA. Randomized clinical trial of Plantago ovata Seeds (dietary fiber) as compared with Mesalamine in maintaining remission in ulcerative colitis. *Am J Gastroenterol* 1999; 94(2):427-33.
- Ünlü C, Daniels L, Vrouenraets BC, Boermeester MA. A systematic review of high-fibre dietary therapy in diverticular disease. *Int J Colorectal Dis* 2012; 27(4):419-27.
- Peery AF, Barrett PR, Park D, Rogers AJ, Galanko JA, Martin F, Sandler RS. A high-fiber diet does not protect against asymptomatic diverticulosis. *Gastroenterology* 2012; 142(2):266-72.
- Matarese LE, O'Keefe SJ, Kandil HM, Bond G, Costa G, Abu-Elmagd K. Short bowel syndrome: clinical guidelines for nutrition management. *Nutrition in clinical Practice* 2005; 20(5):493-502.
- Byrne TA, Persinger RL, Young LS, Ziegler TR, Wilmore DW. A new treatment for patients with short-bowel syndrome. *Annals of surgery* 1995; 222(3):243-54.
- Wedlake L, Slack N, Andreyev JN, Whelan K. Fiber in the treatment and maintenance of inflammatory bowel disease: a systematic review of randomized controlled trials. *Inflamm Bowel Dis* 2014; 20(3):576-86.
- Pérez de la Cruz AJ., Moreno-Torres Herrera R., Pérez Roca C. Tratamiento nutricional del fallo intestinal y potenciales mecanismos de estimulación. *Nutrición Hospitalaria* 2007; 22(2):86-102.
- Liu S, Buring JE, Sesso HD, Rimm EB, Willett WC, Manson JE. A prospective study of dietary fiber intake and risk of cardiovascular disease among women. *J Am Coll Cardiol* 2002; 39(1):49-56.
- Pietinen P, Rimm EB, Korhonen P et al. Intake of dietary fiber and risk of coronary heart disease in a cohort of Finnish men: the Alpha-tocopherol, beta-carotene cancer prevention study. *Circulation* 1996; 94(11):2720-27.
- Liu S, Stampfer M, Hu BF et al. Whole grain consumption and risk of coronary heart disease: results from the Nurses Health Study. *Am J Clin Nutr* 1999; 70(3):412-9.
- Wolk A, Manson JE, Stampfer MJ et al. Long term intake of dietary fiber and decreased risk of coronary heart disease among women. *JAMA* 1999; 281(21):1998-2004.
- Ma Y, Griffith JA, Chasan-Taber L, Olendzki BC, Jackson E, Stanek EJ, Li W, Pagoto SL, Hafner AR., Ockene IS. Associa-

- tion between dietary fiber and serum C-reactive protein. *Am J Clin Nutr* 2006; 83(4):760-6.
43. Ajani UA, Ford ES, Mokdad AH. Dietary fiber and C-Reactive protein: findings from National Health and Nutrition Examination survey data. *J Nutr*. 2004; 134(5):1181-5.
 44. Jensen MK, Koh-Banerjee P, Franz M, Sampson L, Gronboek M, Rimm EB. Whole grains, bran, and germ in relation to homocysteine and markers of glycemic control, lipids, and inflammation. *Am J Clin Nutr* 2006; 83(2):275-83.
 45. Jenkins DJ, Jenkins AL, Wolever TM et al. Low glycemic index: lent carbohydrates and physiological effects of altered food frequency. *Am J Clin Nutr* 1994; 59(3):706S-9S.
 46. Anderson JW, Randles KM, Kendall CWC, Jenkins DJA. Carbohydrate and fiber recommendations for individuals with diabetes: a quantitative assessment and meta-analysis of the evidence. *J Am Coll Nutr*. 2004; 23(1):5-17.
 47. Silva FM, Kramer CK, Almeida JC, Steemburgo T, Gross JL, Azevedo MJ. Fiber intake and glycemic control in patients with type 2 diabetes mellitus: a systematic review with meta-analysis of randomized controlled trials. *Nutrition Reviews* 2013; 71(12):790-801.
 48. Bajorek SA, Morello CM. Effects of dietary fiber and low glycemic index diet on glucose control in subjects with type 2 diabetes mellitus. *Ann Pharmacother*. 2010; 44(11):1786-92.
 49. American Diabetes Association. Standards of medical care in diabetes-2014. *Diabetes care* 2014; 37(1):s14-80.
 50. Willis HJ, Thomas W, Eldridge AL, Harkness L, Green H, Slavin JL. Increasing doses of fiber do not influence short-term satiety or food intake and are inconsistently linked to gut hormone levels. *Food and Nutrition Research* 2010; 54:5135.
 51. Pittler MH, Ernst Ed. Dietary supplements for body-weight reduction: a systematic review. *Am J Clin Nutr* 2004; 79(4):529-36.
 52. Keithley J, Swanson B. Glucomannan and obesity: a critical review. *Altern Ther Health Med*. 2005; 11(6):30-4.
 53. Pittler MH, Ernst E. Guar gum for body weight reduction: meta-analysis of randomized trials. *Am J Med* 2001; 110(9):724-30.
 54. Birketvedt GS, Aaseth J, Florholmen JR, Rytting K. Long term effect of fibre supplement and reduced energy intake on body weight and blood lipids in overweight subjects. *Acta Medica (Hradec Kralove)* 2000; 43(4):129-32.
 55. Howart NC, Saltzman E, Roberts SB. Dietary fiber and weight regulation. *Nutr Rev* 2001; 59(5):129-39.
 56. Salas-Salvado J, Farrés X, Luque X, Narejos S, Borrell M, Basora J, Anguera A, Torres F, Bulló M, Balanza R. Effect of two doses of a mixture of soluble fibres on body weight and metabolic variables in overweight or obese patients: a randomised trial. *British Journal of Nutrition* 2008; 99(6):1380-7.
 57. El Khoury D, Cuda C, Luhovyy BL, Anderson GH. Beta glucan: health benefits in obesity and metabolic syndrome. Review article. *Journal of Nutrition and Metabolism* 2012; 851362.
 58. De Bock M, Derraik JG, Brennan CM, Biggs JB, Smith GC, Cameron-Smith D, Wall CR, Cutfield WS. Psyllium supplementation in adolescents improves fat distribution and lipid profile: a randomized, participant-blinded, placebo-controlled, crossover trial. *PLoS ONE* 2012; 7(7):e41735.
 59. Pittler MH, Ernst E. Guar gum for body weight reduction: meta-analysis of randomized trials. *Am J Med* 2001; 110(9):724-30.
 60. Mugdil D, Barak S. Composition, properties and health benefits of indigestible carbohydrate polymers as dietary fiber: a review. *International Journal of biological macromolecules* 2013; 61:1-6.
 61. Brown L, Rosner B, Willett WW, Sacks FM. Cholesterol-lowering effects of dietary fiber: a meta-analysis. *Am J Clin Nutr* 1999; 69(1):30-42.
 62. Anderson JW, Allgood LD, Lawrence A, Altringer LA, Jerdack GR, Hengehold DA, Morel JG. Cholesterol-lowering effects of psyllium intake adjunctive to diet therapy in men and women with hypercholesterolemia: meta-analysis of 8 controlled trials. *Am J Clin Nutr* 2000; 71(2):472-9.
 63. Hamilton J W, Wagner J, Burdick BB et al. Clinical evaluation of methylcellulose as a bulk laxative. *Dig Dis Sci* 1988; 33(8):993-8.
 64. He J, Klag MJ, Whelton PK, Chen JY, Qian MC, He GQ. Dietary macronutrients and blood pressure in southwestern China. *J Hypertens*. 1995; 13(11):1267-74.
 65. Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, Sacks FM, Bray GA, Vogt TM, Cutler JA, Windhauser MM, Lin PH, Karana N. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. *N Engl J Med*. 1997; 336(17):1117-24.
 66. Stamler J, Caggiula AW, Grandits GA. Relation of body mass and alcohol, nutrient, fiber and caffeine intakes to blood pressure in the special intervention and usual care groups in the Multiple Risk Factor Intervention Trial. *Am J Clin Nutr*. 1997; 65(1suppl):338(S)-65(S).
 67. Whelton SP, Hyre AD, PBonnie, Yi Y, Whelton PK, He J. Effect of dietary fiber intake on blood pressure: a meta-analysis of randomized, controlled clinical trials. *Journal of hypertension* 2005; 23(3):475-81.
 68. Streppel MT, Arends LR, van'tVeer P, Grobbee DE, Geleijnse JM. Dietary fiber and blood pressure. *Arch intern Med*. 2005(2);165:150-6.
 69. Burke V, Hodgson JM, Beilin LJ., Giangiulioi N, Rogers P, Puddeley IB. Dietary protein and soluble fiber reduce ambulatory blood pressure in treated hypertensives. *Hypertension* 2001; 38(4):821-6.
 70. Threapleton DE, Greenwood DC, Evans CE, Cleghorn CL, Nykjaer C, Woodhead C, Cade JE, Gale CP, Burley V. Dietary fiber intake and risk of cardiovascular disease: systematic review and meta-analysis. *BMJ* 2013; 347:f6879.
 71. Corfe BM, Williams EA, Buiry JP, Riley JP, Riley SA, Croucher LJ, Lay DY, Evans. A study protocol to investigate the relationship between dietary fibre intake and fermentation, colon cell turnover, global protein acetylation and early carcinogenesis: the FACT study. *BMC Cancer* 2009; 9:332.
 72. Burkitt DP: Epidemiology of cancer of the colon and rectum. *Cancer* 1971; 28(1):3-13.
 73. Peters U, Sinha R, Chatterjee N, Subar AF, Ziegler RG, Kull-dorff M et al. Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial Project Team. Dietary fibre and colorectal adenoma in a colorectal cancer early detection programme. *Lancet*. 2003; 361(9368):1491-5.
 74. Bingham SA, Day NE, Luben R, Ferrari P, Slimani N, Norat T et al. European Prospective Investigation into Cancer and Nutrition. Dietary fibre in food and protection against colorectal cancer in the European Prospective Investigation into Cancer and Nutrition (EPIC): an observational study. *Lancet*. 2003;361(9368):1496-501.
 75. Larsson SC, Giovannucci E, Bergkvist L, Wolk A. Whole grain consumption and risk of colorectal cancer: a population-based cohort of 60,000 women. *Br J Cancer*. 2005; 92(9):1803-7.
 76. Dahm CC, Keogh RH, Spencer EA, Greenwood DC, Key TJ, Fentiman IS et al. Dietary fiber and colorectal cancer risk: a nested case-control study using food diaries. *J Natl Cancer Inst*. 2010; 102(9):614-26.
 77. Beresford SA, Johnson KC, Ritenbaugh C, Lasser NL, Snet-selaar LG, Black HR et al. Low-fat dietary pattern and risk of colorectal cancer: the Women's Health Initiative Randomized Controlled Dietary Modification Trial. *JAMA*. 2006; 295(6):643-54.
 78. Fuchs CS, Giovannucci EL, Colditz GA, Hunter DJ, Stampfer MJ, Rosner B, et al. Dietary fiber and the risk of colorectal cancer and adenoma in women. *N Engl J Med*. 1999; 340(3):169-76.
 79. Park Y, Hunter DJ, Spiegelman D, Bergkvist L, Berrino F, van den Brandt PA et al. Dietary fiber intake and risk of colorectal cancer: a pooled analysis of prospective cohort studies. *JAMA*. 2005; 294(22):2849-57.
 80. Schatzkin A, Lanza E, Corle D, Lance P, Iber F, Caan B et al. Lack of effect of a low-fat, high-fiber diet on the recurrence of colorectal adenomas. Polyp Prevention Trial Study Group. *N Engl J Med*. 2000; 342(16):1149-55.
 81. Alberts DS, Martínez ME, Roe DJ, Guillén-Rodríguez JM, Marshall JR, van Leeuwen JB et al. Lack of effect of a high-fiber cereal supplement on the recurrence of colorectal adenoma

- mas. Phoenix Colon Cancer Prevention Physicians' Network. *N Engl J Med*. 2000; 342(16):1156-62.
82. MacLennan R, Macrae F, Bain C, Battistutta D, Chapuis P, Gratten H et al. Randomized trial of intake of fat, fiber, and beta carotene to prevent colorectal adenomas. *J Natl Cancer Inst*. 1995; 87(23):1760-6.
 83. Asano T, McLeod RS. Dietary fibre for the prevention of colorectal adenomas and carcinomas. *Cochrane Database Syst Rev*. 2002.
 84. Dahm CC, Keogh RH, Spencer EA, Greenwood DC, Key TJ, Fentiman IS et al. Dietary fiber and colorectal cancer risk: a nested case-control study using food diaries. *J Natl Cancer Inst*. 2010; 102(9):614-26.
 85. Colorectal cancer report 2010: Food, Nutrition, Physical Activity, and the Prevention of Colorectal Cancer. *World Cancer Research Fund and American Institute for Cancer Research*.
 86. Kyro C, Olsen A, Landberg R, Skeie G, Loft S, Åman P, Leenders M, et al. Plasma alkylresorcinols, biomarkers of whole-grain wheat and rye intake, and incidence of colorectal cancer. *J Natl Cancer Inst*. 2014 Jan;106(1):djt352.
 87. American Gastroenterological Association medical position statement: impact of dietary fiber on colon cancer occurrence. American College of Gastroenterology. *Gastroenterology*. 2000 Jun;118(6):1233-4.
 88. Fruit, vegetable, and fiber intake in relation to cancer risk: findings from the European Prospective Investigation into Cancer and Nutrition (EPIC). *Am J Clin Nutr*. 2014 Jun 11; 100(Supplement 1):394S-398S.
 89. Dong JY, He K, Wang P, Qin LQ. Dietary fiber intake and risk of breast cancer: a meta-analysis of prospective cohort studies. *Am J Clin Nutr* 2011; 94: 900-5.
 90. Aune D, Chan DS, Greenwood DC, Vieira AR, Rosenblatt DA, et al. Dietary fiber and breast cancer risk: a systematic review and meta-analysis of prospective studies. *Ann Oncol* 2012; 23: 1394-1402.
 91. Ferrari P, Rinaldi S, Jenab M, Lukanova A, Olsen A, et al. Dietary fiber intake and risk of hormonal receptor-defined breast cancer in the European Prospective Investigation into Cancer and Nutrition study. *Am J Clin Nutr* 2013; 97: 344-53.
 92. Coleman HG, Murray LJ, Hicks B, Bhat SK, Kubo A, Corley DA, Cardwell CR, Cantwell NM. Dietary fiber and the risk of precancerous lesions and cancer of the esophagus: a systematic review and meta-analysis. *Nutr Rev*. 2013; 71(7):474-82.
 93. Deschasaux M, Pouchieu C, His M, Hercberg S, Latino-Martel P, Touvier M. Dietary total and insoluble fiber intakes are inversely associated with prostate cancer risk. *J Nutr* 2014; 144(4):504-10.
 94. Malaguarnera M, Gargante MP, Malaguarnera G, Salmeri M, Mastrojeni S, Rampello L, Pennisi G, Li Volti G, Galvano F. Bifidobacterium combined with fructo-oligosaccharide versus lactulose in the treatment of patients with hepatic encephalopathy. *Eur J Gastroenterol Hepatol* 2010; 22(2):199-206.
 95. Walker ARP. Effect of high crude fiber intake on transit time and the absorption of nutrients in South African Negro Schoolchildren. *Am J Clin Nutr*. 1975; 28(10):1161-9.
 96. Bergner H, Simon O, Zimmer M. Contents of crude fiber in the diet as affecting the process of amino acid resorption in rats. *Arch Tierernaehr*. 1975; 25:95-104.
 97. Eggum BO. The influence of dietary fibre on protein digestion and utilization in monogastrics. *Arch Tierernahr*. 1995; 48(1-2):89-95.
 98. Scheppach W, Luehrs H, Menzel T. Beneficial health effects of low-digestible carbohydrate consumption. *British Journal of Nutrition* 2001; 85(Suppl.1):S23-S30.
 99. Liu Q, Duan ZP, Kang HD, Bengmark S, Kurtovic J, Riordan SM. Synbiotic modulation of gut flora: effect on minimal hepatic encephalopathy in patients with cirrhosis. *Hepatology* 2004; 39(5):1441-9.
 100. Amodio P, Bemeur C, Butterworth R, Cordoba J, Kato A, Montagnese S, Uribe M, Vilstrup H, Morgan MY. The nutritional management of hepatic encephalopathy in patients with cirrhosis: international society for hepatic encephalopathy and nitrogen metabolism consensus. *Hepatology* 2013; 58(1):325-36.
 101. Malaguarnera M, Greco F, Barone G, Gargante MP, Malaguarnera M, Toscano M A. Bifidobacterium longum with fructo-oligosaccharide (FOS) treatment in minimal hepatic encephalopathy: a randomized, double-blind, placebo-controlled study. *Dig Dis Sci* 2007; 52(11):3259-65.
 102. Shukla S, Shukla A, Mehboob S, Guha S. Meta-analysis: the effects of gut flora modulation using prebiotics, probiotics and synbiotics on minimal hepatic encephalopathy. *Aliment Pharmacol Ther* 2011; 33(6):662-71.
 103. Younes H, Egret N, Hadj-Abdelkader M, Remsey C, Demigné C, Gueret C, Deteiw P, Alphonse JC. Fermentable carbohydrate supplementation alters nitrogen excretion in chronic renal failure. *J Ren Nutr*. 2006; 16(1):67-74.
 104. Salmean Y A, Segal M S, Langkamp-Henken B, Canales M T, Zello G A, Dahl W J. Foods with added fiber lower serum creatinine levels in patients with chronic kidney disease. *Journal of renal nutrition* 2013; 23(2):c29-32.
 105. Zimmaro B D, Stein T P, Schleifer C R, Settle R G. Supplementation with gum Arabic fiber increases fecal nitrogen concentration in chronic renal failure patients consuming a low-protein diet. *Am J Clin Nutr* 1996; 63(3):392-8.
 106. Meijers B K, De Preter V, Verbeke D, Vanrenterghem Y, Evenepoel P. p-Cresyl sulfate serum concentrations in haemodialysis patients are reduced by the prebiotic oligofructose-enriched inulin. *Nephrol Dial Transplant* 2010; 25(1):219-24.
 107. Moreiras O, Carbajal A, Cabrera L, Cuadrado C. Tablas de composición de alimentos. 10ª edición. Madrid: Editorial Pirámide; 2006.



Revisión

La adicción al ejercicio: un trastorno emergente de la conducta

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Resumen

Introducción: la actividad física regular juega un papel relevante en el mantenimiento de la salud y en la prevención de la enfermedad. Sin embargo, el ejercicio en exceso puede generar efectos adversos tanto sobre la salud física como mental.

Objetivos: sintetizar el estado actual de los conocimientos sobre la adicción al ejercicio, considerando su definición, sintomatología, diagnóstico, aspectos epidemiológicos, factores etiológicos y posibilidades de intervención.

Método: se revisaron artículos relacionados con el tema en las bases de datos Pubmed, Sportdiscus, PsycINFO, Scopus y Web of Science, utilizando combinaciones de las siguientes palabras clave: “ejercicio”, “adicción” y “dependencia”.

Resultados: el ejercicio regular practicado en exceso puede generar comportamientos adictivos con consecuencias adversas sobre la salud y pérdida de la calidad de vida. El diagnóstico de la adicción al ejercicio se apoya en la utilización de cuestionarios, siendo los más empleados la Escala de Dependencia del Ejercicio (EDS) y el Inventario de Adicción al Ejercicio (EAI). Mediante dichos instrumentos se ha estimado una prevalencia entre quienes practican habitualmente ejercicio en torno a un 3%. Las distintas hipótesis propuestas para explicar la etiología de este trastorno incluyen mecanismos tanto fisiológicos como psicológicos. El tratamiento se basa en aproximaciones cognitivo-conductuales, cuya eficacia requiere confirmación.

Conclusiones: aunque existen distintas hipótesis para explicar la dependencia del ejercicio, aún son necesarios modelos integrativos. También se requiere una validación clínica de los instrumentos utilizados para el diagnóstico y la profundización en la relación con las alteraciones de la conducta alimentaria.

(Nutr Hosp. 2015;31:2384-2391)

DOI:10.3305/nh.2015.31.6.8934

Palabras clave: Adicción al ejercicio. Dependencia del ejercicio. Diagnóstico. Prevalencia. Etiología.

EXERCISE ADDICTION: AN EMERGENT BEHAVIORAL DISORDER

Abstract

Background: regular physical activity plays a relevant role in health maintenance and disease prevention. However, excess exercise may generate adverse effects both on physical and mental activity.

Aims: to provide a state-of-the-art overview on exercise addiction, considering its concept, symptoms, diagnosis, epidemiological aspects, etiological factors, and potential interventions.

Methods: articles related to the topic were reviewed through Pubmed, Sportdiscus, PsycINFO, Scopus and Web of Science databases, using combinations of the following keywords: “exercise”, “addiction” and “dependence”.

Results: regular exercise taken into excess may result in adverse health consequences and quality of life impairment. Diagnosis of exercise addiction requires the employment of questionnaires such as the Exercise Dependence Scale (EDS) and the Exercise Addiction Inventory (EAI). These instruments have allowed the estimation of a 3% prevalence among exercise practitioners. Proposed hypotheses to explain the etiology of this disorder include both physiological and psychological mechanisms. Treatment is based on the cognitive-behavioral approach, but effectiveness needs to be evaluated.

Conclusions: although different hypotheses have been proposed to explain exercise dependence, integrative models are still necessary. A clinical validation of diagnostic instruments and a deepening into the relationship with behavioral eating disorders are also required.

(Nutr Hosp. 2015;31:2384-2391)

DOI:10.3305/nh.2015.31.6.8934

Key words: Exercise addiction. Exercise dependence. Diagnosis. Prevalence. Etiology.

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Recibido: 12-III-15.

Aceptado: 3-IV-15.

Abreviaturas

CB₁: Cannabinoide tipo-1.
DSM-5: Diagnostic and Statistical Manual of Mental Disorders.
EAI: Inventario de Adicción al Ejercicio.
EDQ: Cuestionario de Dependencia del Ejercicio.
EDS: Escala de Dependencia del Ejercicio.
IL-6: Interleucina C.
OEQ: Cuestionario de Ejercicio Obligatorio.
VO_{2máx}: Consumo máximo de oxígeno.

Introducción

El ejercicio físico se define como la actividad planeada, estructurada y repetitiva que tiene por objeto el mantenimiento o mejora de uno o más componentes de las aptitudes físicas del sujeto¹. Su práctica regular se traduce en una serie de beneficios para la salud tanto desde el punto de vista físico como psicosocial, produciendo efectos positivos sobre la salud mental y la forma física, y reduciendo el riesgo y la prevalencia de patologías diversas, tales como la diabetes mellitus y la enfermedad cardiovascular, entre otras². Sin embargo, cuando el ejercicio físico se practica en exceso, puede llegar a generar adicción y traducirse en alteraciones tanto físicas como psicológicas. El objeto del presente estudio es realizar una revisión crítica acerca del estado actual de nuestros conocimientos sobre la adicción al ejercicio, abordando tanto su definición, síntomas y diagnóstico como aspectos epidemiológicos, causas potenciales y posible tratamiento. La búsqueda de artículos se realizó en las bases de datos Pubmed, Sportdiscus, PsycINFO, Scopus y Web of Science, utilizando combinaciones de las siguientes palabras clave: “ejercicio”, “adicción” y “dependencia”.

Definición

Aunque el término adicción se ha utilizado clásicamente para referirse a la adicción a las drogas, en la actualidad se sabe que el elemento fundamental en cualquier trastorno adictivo es la falta de control y que existen hábitos de conducta que en determinadas circunstancias pueden llegar a ser adictivos, generando alteraciones graves del comportamiento y un síndrome de abstinencia. En el *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5)³ se realiza una nueva caracterización de las adicciones, incluyendo una categoría de trastornos no relacionados con sustancias. Por el momento solo engloba el trastorno por ludopatía, mencionando la adicción a internet exclusivamente en su apéndice, al objeto de fomentar la investigación en esta área. La adicción al ejercicio, a pesar de tratarse de un trastorno conocido desde hace décadas, aún no se contempla en el DSM-5. No obstante, la incorporación de adicciones conductuales supone un cambio

importante que debe redundar en un mejor diagnóstico y tratamiento integral de estas alteraciones.

El término adicción apareció por primera vez en la literatura científica en relación al ejercicio cuando Glasser en 1976⁴ utiliza la expresión “adicción positiva” para referirse a la relación positiva dosis-respuesta entre ejercicio y salud. Sin embargo, ya en 1979 Morgan⁵ demostró que el ejercicio en exceso podía inducir no solo posibles lesiones, sino también alteraciones importantes de la conducta. El diagnóstico clínico de casos de adicción al ejercicio ha llevado a una categorización del problema que se describe utilizando diversas expresiones, tales como “dependencia del ejercicio” o “ejercicio compulsivo”, aunque el término adicción se ha convertido en el utilizado más habitualmente⁶.

La adicción al ejercicio comparte rasgos con diversos trastornos mentales y conductuales tales como predominio sobre otras actividades, alteraciones emocionales, tolerancia, síntomas de abstinencia, y tendencia a una excesiva actividad tras periodos de control⁷. Veale⁸ propuso una serie de criterios diagnósticos que incluían una preocupación con el ejercicio estereotipada y rutinaria, síntomas significativos de abstinencia en ausencia de ejercicio o alteraciones físicas, sociales, ocupacionales y de otros tipos a consecuencia de la preocupación excesiva por el ejercicio. Una aproximación interesante es la realizada por Hausenblas et al.^{9,10}, quienes sugieren la identificación en base a una serie de criterios que se aproximan bastante a los componentes establecidos en el DSM-5 para las adicciones conductuales. Dichos criterios serían: a) Tolerancia, con un incremento de la cantidad de ejercicio para alcanzar el efecto deseado; b) Retirada, con efectos negativos en ausencia de ejercicio, tales como ansiedad, irritabilidad o problemas de sueño; c) Falta de control y fracaso en los intentos de reducir o cesar la práctica de ejercicio; d) Efectos intencionales, con incapacidad de ajustarse a una rutina establecida; e) Dedicación excesiva a la preparación, realización o recuperación del ejercicio; f) Reducción de otras actividades sociales, ocupacionales y/o recreacionales; y g) Continuidad en la práctica a pesar de saber que se están generando problemas.

Una consideración importante hace referencia a la diferencia entre adicción al ejercicio primaria y secundaria. La adicción primaria ocurriría en ausencia de alteraciones del comportamiento alimentario, mientras que la adicción secundaria puede ser un síntoma de diversos trastornos alimentarios, como la anorexia nerviosa y la bulimia nerviosa, en las que el ejercicio excesivo se relaciona con el control del equilibrio energético y la pérdida de peso^{11,12}. Esta situación puede originar problemas si el tratamiento se focaliza en la alteración de la conducta alimentaria sin considerar la necesidad de regular adecuadamente la práctica del ejercicio¹³.

Uno de los aspectos claves en la definición adecuada de la adicción al ejercicio radica en la necesidad de

distinguirlo de prácticas de ejercicio, que, aun suponiendo frecuencias y duraciones relativamente elevadas, no impliquen riesgos para la salud ni supongan una conducta adictiva. A este respecto, Freimuth¹⁴ ha establecido una heurística clínica que puede permitir la distinción entre el ejercicio puramente recreacional y las prácticas adictivas. En la fase uno el ejercicio se practica simplemente por su carácter placentero y beneficioso para la salud; en la fase dos -ejercicio en riesgo- el sujeto percibe al ejercicio como intrínsecamente gratificante y pueden aparecer efectos emocionales indeseados; en la fase tres -ejercicio problemático- la vida diaria comienza a organizarse alrededor del ejercicio, que se aborda de una forma cada vez más rígida, pudiendo desencadenarse conductas difíciles de controlar; finalmente, se entra en la fase cuatro -adicción al ejercicio- en la que la frecuencia e intensidad de la práctica se incrementan hasta convertirse en el principio alrededor del cual gira la vida y los trastornos del comportamiento se tornan incontrolables.

Al igual que otras conductas adictivas, la adicción al ejercicio tiene características compulsivas, con una preocupación excesiva cuando la conducta no puede desarrollarse, que se acompaña de un aumento en los niveles de ansiedad y un efecto ansiolítico inducido por el ejercicio⁶. No obstante, la dependencia del ejercicio tiene características que la distinguen de los típicos trastornos obsesivo-compulsivos, ya que no solo disminuyen los estados afectivos negativos, sino que también se crean afectos positivos que refuerzan la conducta¹³.

Aunque la adicción al ejercicio es una disfunción en la que juegan un papel relevante elementos ambientales, entre los factores de riesgo que pueden desencadenar este tipo de trastornos de la conducta se han identificado distintos rasgos de personalidad. Por ejemplo, en un estudio con una muestra de 150 participantes italianos que acudían a gimnasios, se ha puesto de manifiesto que tanto una autoestima baja como un elevado narcisismo son factores de riesgo para el desarrollo de la adicción al ejercicio¹⁵. En una investigación realizada en Australia con 1500 personas que acudían regularmente a centros de acondicionamiento físico se confirmó la relación entre dependencia del ejercicio y narcisismo y se demostró, además, que el perfeccionismo constituye un factor de riesgo adicional para este comportamiento adictivo¹⁶.

Instrumentos de evaluación y prevalencia

Existen diversos cuestionarios que permiten evaluar la adicción al ejercicio. Entre ellos se pueden mencionar el Cuestionario de Ejercicio Obligatorio (OEQ), el Cuestionario de Dependencia del Ejercicio (EDQ), la Escala de Dependencia del Ejercicio (EDS) o el Inventario de Adicción al Ejercicio (EAI). El OEQ¹⁷ es un cuestionario de 20 ítems que cubre diversos aspectos del ejercicio: componente emocional, frecuencia e in-

tensidad y preocupación. El EDQ¹⁸ es un cuestionario de 27 ítems que permite analizar los efectos sociales y factores motivacionales del ejercicio. El EDS⁹ y el EAI¹⁹ se utilizan ampliamente y son instrumentos válidos y fiables²⁰, que no identifican cuando un sujeto padece adicción, sino el riesgo de desarrollar la misma. El EDS es un instrumento de 20 ítems organizados en 7 escalas que permite categorizar los sujetos en tres grupos: en riesgo, sintomáticos no dependientes y asintomáticos no dependientes. El EAI se desarrolló como un instrumento de más facilidad y rapidez de aplicación en el que solamente se incluyen 6 ítems correspondientes a los seis síntomas del modelo de componentes de la adicción (tolerancia, retirada, efectos intencionales, pérdida de control, tiempo y conflicto), estableciéndose un punto de corte para los individuos en riesgo.

El hecho de que se puedan utilizar diversos cuestionarios para evaluar la adicción al ejercicio, ha llevado a que exista una amplia variabilidad en la estimación de su prevalencia. En el estudio de validación del EDS⁹, en el cual participaron 266 estudiantes universitarios, se identificó que un 3.4% estaban en riesgo de padecer adicción al ejercicio. Con una muestra de características similares, el EAI ha puesto de manifiesto valores parecidos (3%)²¹. Posteriormente se confirmó que la prevalencia en población general que practica el ejercicio se encuentra en torno al 3.6%, mientras que se eleva hasta un 6.9% en estudiantes universitarios de ciencias del deporte²². En un estudio llevado a cabo en Hungría con una muestra de 3.183 sujetos, de los que 474 practicaban ejercicio al menos una vez a la semana, se ha observado que la proporción de sujetos en riesgo de adicción era de un 1.9% entre quienes practicaban ejercicio y de un 0.3% en la población general cuando se utilizaba el EDS; sin embargo, los valores se incrementaban cuando se empleaba el EAI, hasta un 3.2% entre quienes practicaban ejercicio y 0.5% en la población general. A pesar de las diferencias entre ambos cuestionarios, los datos en sujetos que practican ejercicio no se alejan en exceso y posiblemente den una razonable estimación de la prevalencia de esta adicción. Utilizando muestras más específicas, se ha demostrado que entre 300 clientes de un gimnasio francés un 42% presentaban criterios diagnósticos de dependencia del ejercicio²³. Sin embargo, la prevalencia en un grupo de usuarios españoles de centros de acondicionamiento físico era de solo un 8.1% al utilizar el EDS²⁴. En una muestra de 234 deportistas austriacos un 34% podían clasificarse como adictos, cuando se empleaba una escala diseñada específicamente para medir dependencia del ejercicio en deportistas de élite²⁵. En corredores, se ha llegado a describir un riesgo del 22%²⁶, que se puede incrementar hasta un 50%, cuando se aplica el EDS a corredores competitivos²⁷. No obstante, utilizando también el EDS, se ha encontrado una prevalencia bastante más reducida (3.2%) en una muestra de 516 maratonianos franceses²⁸. En población española se ha descrito, con una muestra de

242 sujetos, que el riesgo de padecer adicción medido mediante el EAI era de un 8.8% en deportistas universitarios y de un 17% en corredores de élite²⁹. Empleando también el EAI con una muestra de 1285 triatletas norteamericanos, se han descrito prevalencias de entorno al 25%³⁰. Es evidente que las prevalencias encontradas en la literatura fluctúan en un rango bastante amplio y que deben existir diversos factores mediadores/moduladores, más allá de los aspectos puramente metodológicos, que contribuyan a explicar las diferencias observadas. Curiosamente, en un estudio reciente en el que se aplicó el EAI a 176 practicantes de actividades individuales y 98 de deportes de equipo se encontraron prevalencias muy similares, de un 9.7% y 7.1% respectivamente³¹. Y de hecho, en deportistas españoles se ha llegado a indicar, utilizando también el EAI, que se alcanzan puntuaciones más altas en practicantes de deportes colectivos respecto a individuales³⁰. Estos hallazgos resultan llamativos si se considera que la adicción al deporte debería desarrollarse en menor medida en contextos en los que predomina la cooperación sobre un ejercicio extremo. En un estudio reciente realizado en cinco países diferentes, Dinamarca, Hungría, España, Reino Unido y Estados Unidos, con un total de 6.031 participantes, se evaluó la dependencia al ejercicio mediante el EAI, advirtiendo de la utilidad potencial y de las limitaciones de esta herramienta por la relevancia de los factores culturales en la explicación de los resultados³².

En lo que hace referencia a posibles diferencias de género, se ha puesto de manifiesto en una muestra de 204 sujetos, que utilizando el EDQ las mujeres tenían mayor probabilidad de clasificarse como dependientes, mientras que con el EDS la probabilidad era mayor en varones³³. Los resultados con el EDQ se han replicado posteriormente en una muestra de 79 participantes que practicaban habitualmente ejercicio³⁴, y se encuentran en línea con los estudios llevados a cabo en modelos animales que muestran un comportamiento más compulsivo hacia la utilización de ruedas de carrera³⁵. Por el contrario, en los estudios antes mencionados con participantes españoles, tanto el EDS²⁴ como el EAI²⁶ arrojaban puntuaciones más elevadas en el sexo masculino. Utilizando la denominada Escala de Adicción Negativa, centrada en los aspectos psicológicos negativos de la dependencia³⁶, se ha descrito en un grupo de 300 atletas la ausencia de diferencias en el desarrollo de síntomas de adicción entre hombres y mujeres; sin embargo, en este estudio sí se observaron más síntomas de depresión en las mujeres, lo que podría atribuirse a una posible asociación con trastornos alimentarios y de la imagen corporal, más prevalentes en la población femenina. Muy recientemente se ha utilizado el EDS en una muestra de 517 estudiantes universitarios, poniendo de manifiesto mediante modelización estructural, que un 3.3% de los sujetos estaban en riesgo de dependencia del ejercicio, existiendo en mujeres un efecto directo de dicha dependencia sobre la incidencia de trastornos alimentarios³⁷.

En resumen, los estudios hasta ahora realizados indican que los cuestionarios estudiados miden aspectos posiblemente distintos de la dependencia del ejercicio, que favorecerían de forma diferente a cada sexo, y que la diferente prevalencia de las alteraciones de la conducta alimentaria entre varones y mujeres puede afectar de forma importante a los resultados obtenidos en distintas investigaciones. Una complicación adicional proviene del hecho recientemente demostrado en el estudio antes mencionado con participantes provenientes de seis países a los que se aplicó el EAI, de que no es posible establecer una invarianza métrica en función del género, lo que ha llevado a sugerir que la relación de género y adicción al ejercicio no debería analizarse mediante una simple comparación de puntuaciones entre varones y mujeres, sino considerando el género como una covariable³².

Etiología

Las distintas hipótesis que pueden explicar la adicción al ejercicio se clasifican en dos grandes grupos relacionados con mecanismos fisiológicos y psicológicos.

Mecanismos fisiológicos

La hipótesis más conocida es la denominada del *runners' high*, relacionada con la sensación de euforia que sienten muchos corredores tras una carrera intensa y que se ha atribuido a efectos centrales de las endorfinas⁶. Las beta-endorfinas y otros opioides endógenos pueden generar dependencia y los estudios en animales sugieren que el ejercicio reduce la sensibilidad a los mismos, siendo necesario aumentar la dosis de ejercicio para mantener sus efectos³⁹. El incremento en los niveles de endorfinas en sangre depende de la intensidad y duración del ejercicio y requiere que éste se realice por encima del 60% del consumo máximo de oxígeno (VO_{2max})⁴⁰. El hecho de que las beta-endorfinas no crucen la barrera hematoencefálica restaría validez a esta hipótesis. No obstante también se ha propuesto un papel para otros opiáceos endógenos, que si son capaces de atravesar dicha barrera, tales como encefalinas y dinorfina^{6,38}. De hecho, un estudio con tomografía de emisión positrónica ha puesto de manifiesto que la euforia producida en deportistas tras la carrera se asocia de manera inversa con la unión de opioides en distintas áreas corticales⁴¹.

El sistema endocannabinoide podría tener también un papel en la adicción al ejercicio, ya que dicho sistema se activa por el ejercicio aeróbico⁴² y produce efectos de sedación, bienestar y reducción de la ansiedad. De hecho, en ratones se ha demostrado que la inhibición de los receptores del cannabinoide tipo-1 (CB_1) disminuye el ejercicio voluntario⁴³. La hipótesis de las catecolaminas mantiene que el ejercicio modifica la

actividad catecolinérgica cerebral⁴⁴. Dado el papel de las catecolaminas en la regulación de afectos y emociones y en los sistemas de recompensa, podrían jugar un papel en la adicción al ejercicio. No obstante esta teoría requeriría una confirmación mediante medidas directas en el cerebro. Igualmente, se ha propuesto un papel de la citoquinas en la dependencia a del ejercicio, que se relacionaría con la hiperproducción de interleucina-6 (IL-6) y que podría constituir el nexo de unión con los trastornos alimentarios³⁹.

La hipótesis de la activación simpática⁴⁵ mantiene que la adaptación al entrenamiento, especialmente aeróbico, genera una disminución de la frecuencia cardíaca y de la actividad simpática que se traduce en un menor nivel de activación. En consecuencia los sujetos que practican habitualmente ejercicio tenderían a incrementar sus niveles al objeto de alcanzar un estado óptimo de activación. Quizás la principal limitación del modelo radica en que la adaptación simpática al ejercicio ocurre con carácter general y solo una pequeña parte de los practicantes muestran el fenómeno de adicción¹².

Un mecanismo adicional se contempla en la hipótesis de la regulación termogénica, según la cual el incremento de la temperatura desencadenado por la actividad física intensa generaría un estado de relajación y una disminución de la ansiedad que actuarían como refuerzos positivos para el mantenimiento de la conducta adictiva⁴⁶.

Por último, muy recientemente se ha puesto de manifiesto en un grupo de 24 sujetos con adicción al ejercicio establecida mediante el EAI que, tras realizar un ajuste en función del porcentaje de grasa corporal, existía una asociación positiva entre la dependencia del ejercicio y unos niveles bajos de leptina en sangre, lo que sugiere una posible implicación de esta molécula en la patogénesis de la adicción al ejercicio, aunque no puede descartarse que sea un resultado del trastorno⁴⁷.

Mecanismos psicológicos

La hipótesis de la valoración cognitiva plantea que el proceso de adicción se iniciaría cuando los sujetos comienzan a utilizar el ejercicio como un medio de enfrentarse al estrés y se produce una dependencia que se racionaliza para explicar el que el ejercicio comience a sustituir las actividades y rutinas de la vida diaria. La presencia de eventos imprevistos que obliguen a reducir la cuantía del ejercicio se traduce en una pérdida de control y la emergencia de sentimientos negativos que amplifican la sensación de vulnerabilidad al estrés⁴⁸.

La hipótesis de la regulación afectiva propone que el ejercicio origina, por una parte, afectos positivos que contribuyen a una mejora del estado emocional general; por otra, disminuye los afectos negativos y los sentimientos de culpa, irritabilidad o ansiedad, lo que se suma a los beneficios sobre el estado emocional. Cuando existe una privación del ejercicio se

exacerban los afectos negativos y aparecen los típicos síntomas de abstinencia que solo pueden neutralizarse a través de más ejercicio³⁹.

Según el modelo biopsicosocial, los factores biológicos, como las alteraciones del índice de masa corporal, se situarían al comienzo del proceso y desencadenarían trastornos psicológicos (pérdida de la autoestima, creencia en la necesidad del entrenamiento ...) y sociales (presión de entrenador, compañeros o familiares) que confluirían en la adicción al ejercicio²⁵. Este modelo ha sido criticado porque sería más bien de aplicación a atletas exitosos de élite y, a pesar del solapamiento con las situaciones adictivas, no debería confundirse con éstas¹².

Más recientemente se ha propuesto un modelo interactivo expandido¹² para explicar la adicción al ejercicio (Figura 1) que estaría en línea con el modelo PACE (*Pragmatics, Attraction, Communication, Expectation*) establecido para adicciones en general⁴⁹. Según este modelo, los factores de tipo personal, tales como necesidades, intereses o habilidades, interaccionan con factores situacionales del tipo de valores y aspectos sociales, coste y accesibilidad o entorno grupal, generando los motivos para la práctica del ejercicio. La motivación puede tener una doble orientación: por una parte los sujetos practicarían ejercicio por razones de salud, bien sea para mejorar la misma o para evitar hábitos inadecuados que puedan llevar a consecuencias como el aumento de peso. Por otra parte, pueden existir motivos orientados a la maestría, tales como ser más fuerte, aumentar el rendimiento o concentrarse mejor. Si se producen interacciones que llevan a situaciones estresantes sobre las que se pierde el control, los sujetos intentarán enfrentarse adecuadamente a las mismas (fase pragmática), produciéndose interacciones entre antecedentes, aspectos individuales y factores situacionales (fase de atracción). Ahora, incluso los sujetos orientados a la maestría tenderán a centrarse en aspectos más terapéuticos para librarse del estrés (fase de atención). La elección vendrá determinada por la experiencia y creencias del sujeto, de tal modo que quienes carecen de experiencia con sustancias tóxicas tenderán a enfrentarse al estrés a través del ejercicio (fase de comunicación).

Tratamiento

El tratamiento requiere, en primer lugar, el transmitir a los pacientes la información adecuada acerca de los efectos adversos que tiene la práctica del ejercicio en exceso. Deben ser conscientes de la cantidad de ejercicio que puede generar tal tipo de efectos y cuáles son los síntomas y repercusiones negativas sobre la calidad de vida⁵⁰.

El tratamiento suele basarse en intervenciones de tipo cognitivo-conductual, siendo el primer objetivo el ayudar a los pacientes a cambiar su actitud sobre el ejercicio, abordando las creencias y comportamien-

Tabla I
Orientaciones para la intervención cognitivo-conductual en pacientes con adicción al ejercicio
(adaptado de Adams et al., 2003)

1. Identificar e interrumpir la conducta compulsiva a través de apoyo psicoterapéutico individualizado
2. Hacer que el paciente comprenda los beneficios del ejercicio para la salud y la importancia de practicarlo de forma moderada
3. Ayudar al paciente a desarrollar estrategias para abordar el problema
4. Entender la organización de la estructura defensiva del paciente y como se enfrenta al problema de adicción
5. Incrementar la tolerancia del paciente para adaptarse o acomodarse a la conducta compulsiva a través de modificaciones de sus defensas psicológicas y de la aceptación y comprensión de sus respuestas a la ganancia de control
6. Separar la compulsión y los desencadenantes específicos relacionados con la adicción al ejercicio
7. Reconstruir las estrategias de afrontamiento y estimular los sistemas de apoyo

tos que han llevado a la situación de dependencia, así como su situación emocional y las posibles alteraciones en la autoestima. Adams et al⁵¹. han propuesto una serie de orientaciones para la intervención que se muestran en la tabla I. Resulta esencial el reconocimiento por parte de los sujetos de la existencia del problema y de las consecuencias negativas sobre su salud, pudiendo ser de utilidad el papel del entorno en dicho

reconocimiento. Además, es importante que el paciente encuentre el equilibrio adecuado entre la práctica moderada de ejercicio y la prevención de su exceso, dejándole claro que el ejercicio es un hábito deseable que contribuye al mantenimiento de la salud; a este respecto puede ser interesante el cambio a formas de ejercicio distintas a las practicadas habitualmente¹³. Así mismo, debe aprender a alcanzar un equilibrio en-

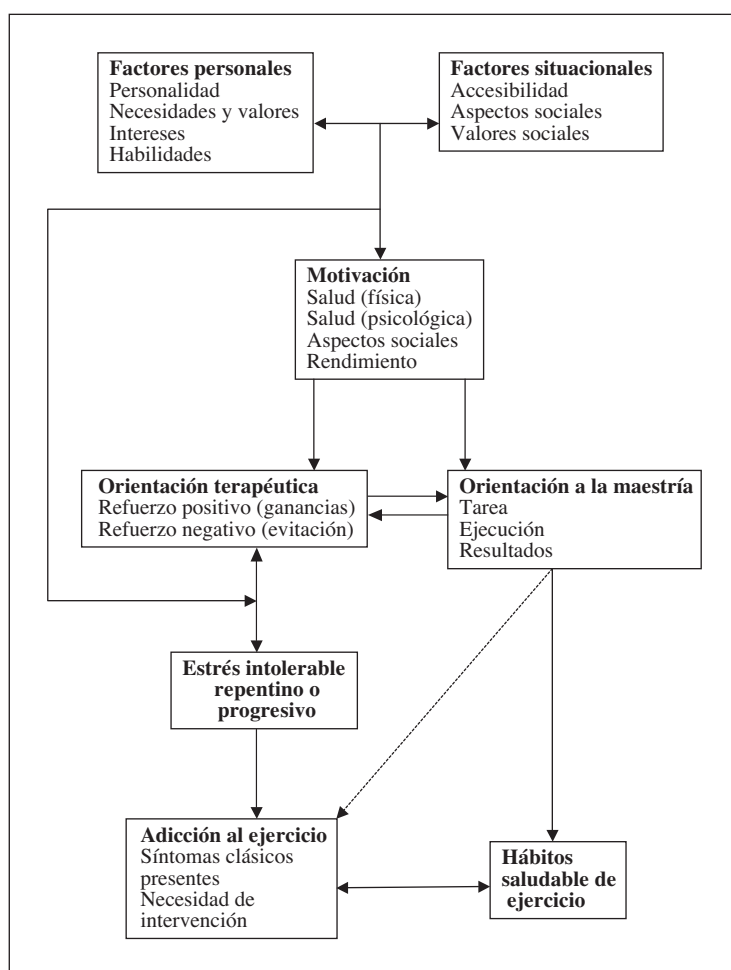


Fig. 1.—Modelo interactivo expandido de la adicción al ejercicio (adaptado de Egorov et al., 2013).

tre el ejercicio y su vida social, lo que puede suponer la elección de actividades que impliquen a personas no relacionadas con su trastorno adictivo⁵⁰.

Dada la frecuencia de otros trastornos relacionados con alteraciones de la conducta alimentaria⁵², es vital abordar su tratamiento, caso de estar presentes, buscando unos niveles adecuados de ejercicio que no potencien el que los pacientes recurran en mayor medida a conductas de tipo anoréxico o bulímico¹³.

Por último, no deben olvidarse los aspectos educativos y la importancia que reviste la promoción pública de los beneficios de una práctica adecuada de ejercicio regular, pero incorporando siempre el mensaje de que el exceso puede producir consecuencias adversas⁴⁶.

Conclusiones

Aunque el ejercicio regular es una práctica adecuada para preservar y mejorar la salud física y mental, en una pequeña parte de la población el ejercicio excesivo puede desencadenar problemas, generando un trastorno de la conducta con aparición de comportamientos adictivos y consecuencias adversas tanto fisiológicas como psicológicas. Aunque el riesgo de adicción se estima en torno a un 3% de quienes practican ejercicio, se han descrito valores de prevalencia en un rango muy amplio que pueden ser consecuencia de barreras tanto teóricas como metodológicas. Por una parte, aunque se han propuesto distintos componentes fisiológicos y psicológicos, los modelos explicativos todavía son incompletos. Por otra, los instrumentos utilizados para el diagnóstico aun requieren de validación clínica y no existen criterio objetivos de confirmación. Es necesaria, además, la exploración en profundidad de la relación con otras comorbilidades como los trastornos de la conducta alimentaria.

Referencias

1. Caspersen C.J, Powell K, Christenson GM. Physical activity, exercise and physical fitness: Definitions and distinctions for health-related research. *Public Health Rep* 1985; 100:126-131.
2. Márquez S, Rodríguez Ordaz J, De Abajo S. Sedentarismo y salud: efectos beneficiosos de la actividad física. *Apunts Ed Fis Dep* 2006; 83: 12-24.
3. American Psychiatric Association. *Diagnostic and statistical manual of mental health disorders: DSM-5* (5ª ed.). Washington, DC: American Psychiatric Publishing. 2013.
4. Glasser, W. *Positive addiction*. New York, NY: Harper & Row. 1976.
5. Morgan, W. P. Negative addiction in runners. *Phys Sports Med* 1979; 7: 57-70.
6. Berczik K, Szabo A, Griffiths M, Kurimay T, Kun B, Urban R, et al. Exercise addiction: Symptoms, diagnosis, epidemiology, and etiology. *Subst Use & Misuse* 2001; 47: 403-417.
7. Weinstein A, Weinstein Y. Exercise addiction: Diagnosis, bio-psychological mechanisms and treatment issues. *Curr Pharmacol Design* 2014; 20: 4062-4069.
8. Veale DMW. Does primary exercise dependence really exist? En: Annet J, Cripps B, Steinberg H (eds.). *Exercise addiction:*

motivation for participation in sport and exercise. Leicester: The British Psychological Society, 1995.

9. Hausenblas HA, Downs DS. How much is too much? The development and validation of the Exercise Addiction scale. *Psychol Health* 2002; 17: 387-404.
10. Downs DS, Hausenblas HA, Nigg CR. Factorial validity and psychometric examination of the Exercise Dependence Scale-Revised. *Meas Phys Educ Exerc Sci* 2004; 8: 183-201.
11. Márquez S, Molinero O. Energy availability, menstrual dysfunction and bone health in sports; An overview of the female athlete triad. *Nutr Hosp* 2013; 28: 1010-1017.
12. Egorov AY, Szabo A. The exercise paradox: An interactional model for a clearer conceptualization of exercise addiction. *J Behav Addict* 2013; 2: 199-208.
13. Freimuth M, Moniz S, Kim SR. Clarifying exercise and addiction: Differential diagnosis, co-occurring disorders, and phases of addiction. *Int J Environ Res Public Health* 2011; 8: 4069-4081.
14. Freimuth M. *Addicted? Recognizing destructive behavior before it's too late*. Rowman & Littlefield Publishers, Inc: Lanham, USA, 2008.
15. Bruno A, Quattrone D, Scimece G, Ciciarelli C, Romeo VM, Pandolfo G, et al. Unraveling exercise addiction: The role of narcissism and self-esteem. *J Addict* 2014; 987841.
16. Miller KJ, Messagno C. Personality traits and exercise dependence: Exploring the role of narcissism and perfectionism. *Int J Sport Exerc Psychol* 2014; 12: 368-381.
17. Pasman L, Thomson JK. Body image and eating disturbance in obligatory runners, obligatory weightlifters, and sedentary individuals. *Int J Eating Disord* 1988; 7: 759-769.
18. Ogden J, Veale D, Summers Z. The development and validation of the Exercise Dependence Questionnaire. *Addict Res* 1997; 5: 343-356.
19. Terry A, Szabo A, Griffiths M. The Exercise Addiction Inventory: A new brief screening tool. *Addict Res Theor* 2004; 12: 489-499.
20. Monok K, Berczik K, Urban R, Szabo A, Griffith MD, Farkas J, et al. Psychometric properties And concurrent validity of two exercise measures: A population wide study. *Psychol Sport Exerc* 2012; 13: 739-746.
21. Griffith MD, Szabo A, Terry A. The Exercise Addiction Inventory: A quick early screening tool for health practitioners. *Br J Sports Med* 2005; 39: e30.
22. Szabo A, Griffiths MD. Exercise addiction in British sport science students. *Int J Mental Health Addict* 2007; 5: 25-28.
23. Lejoyeux M, Avril M, Richoux C, Embouazza H, Nivoli F. Prevalence of exercise dependence and other behavioral addictions among clients of a Parisian fitness room. *Compr Psychiatry* 2008; 49: 353-358.
24. González-Cutre D, Sicilia A. Dependencia del ejercicio físico en usuarios españoles de centros de acondicionamiento físico (fitness): diferencias según el sexo, la edad y las actividades practicadas. *Behavior Psychol* 2012; 20: 349-364.
25. McNamara J, McCabe M. Striving for success or addiction? Exercise dependence among elite Australian athletes. *J Sports Sci* 2012; 30: 755-766.
26. Anderson SJ, Basson CJ, Geils C. Personality style and mood states associated with a negative addition to running. *Sports Med* 1997; 4: 6-11.
27. Smith D, Wright C, Winrow D. Exercise-dependence and social psyche anxiety in competitive and non-competitive runners. *Int J Sport Exerc Psychol* 2010; 8: 61-69.
28. Allegre B, Therme P. Confirmative study of a French version of the Exercise Dependence Scale-revised with a French population. *Encephale* 2008; 34: 490-495.
29. Szabo A, de la Vega R, Ruiz-Barquín R, Rivera O. Exercise addiction in Spanish athletes: Investigation of the roles of gender, social context and level of involvement. *J Behav Addict* 2013; 2: 249-252.
30. Youngman J, Simpson D. Risk for exercise addiction: A comparison of triathletes training for sprint-, Olympic-, half-ironman- and ironman distance triathlons. *J Clin Sport Psychol* 2014; 8: 19-37.

31. Lichtenstein MB, Larsen KS, Christiansen E, Stoving RK, Bredahl TVG. Exercise addiction in team sport and individual sport: prevalences and validation of the exercise addiction inventory. *Addict Res Theor* 2014; 22: 431-437.
32. Griffiths MD, Urban R, Demetrovics Z, Lichtenstein MB, de la Vega R, Kun B, et al. A cross-cultural re-evaluation of the Exercise Addiction Inventory (EAI) in five countries. *Sports Med* 2015; 1: 5.
33. Weik M, Hale BD. (2009). Contrasting gender differences on two measures of exercise dependence. *Br J Sports Med* 2009; 43: 204-207.
34. Grabndi S, Clementi C, Guidi J, Benassi M, Tossani E. Personality characteristics and psychological distress associated with primary exercise dependence: An exploratory study. *Psychiatr Res* 2011; 189: 270-275.
35. Boakes RA, Dwyer DM. Weight loss in rats produced by running: Effects of prior experience and individual hosting. *Q J Exp Psychol B* 1997; 50: 129-148.
36. Bonilha V, Antunes HKM, Borba PR, De Mello ML, Tufik S, De Mello MT. Negative addiction to exercise: Are there differences between genders?. *Clin Sci* 2011; 66: 255-260.
37. Meulemans S, Pribis P, Grajales T, Krivak G. Gender differences in exercise dependence and eating disorders in young adults: A path analysis of a conceptual model. *Nutrients* 2014; 6: 4895-4905.
38. Kraemer WJ, Fragala MS, van Henegouwen WR, Gordon SE, Bush JA, Volek JS, et al. Responses of proenkephalin Peptide F to aerobic exercise stress in the plasma and white blood cell biocompartments. *Peptides* 2013; 42: 118-124.
39. Hamer M, Karageorghis CI. Psychobiological mechanisms of exercise dependence. *Sports Med* 2007; 37: 477-484.
40. Goldfarb AH, Jamurtas AZ. Beta-endorphin response to exercise: An update. *Sports Med* 1997; 24: 8-16.
41. Boecker H, Sprenger T, Spilker ME, Henriksen G, Koppenhoefer M, Wagner KJ, et al. The runners' high opioidergic mechanisms of the human brain. *Cereb Cortex* 2008; 18: 2523-2531.
42. Dietrich A, McDaniel W. Endocannabinoids and exercise. *Br J Sports Med* 2004; 38: 536-541.
43. Dubreucq S, Koehl M, Abrous DN, Marsicano G, Chaouloff F. CB1 receptor deficiency decreases wheel-running activity: consequences on emotional behaviors and hippocampal neurogenesis. *Exp Neurol* 2010; 224: 106-113.
44. Cousineau D, Ferguson R J, de Champlain J, Gauthier P, Cote P, Bourassa M. Catecholamines in coronary sinus during exercise in man before and after training. *J Appl Physiol* 1977; 4: 801-806.
45. Thompson JK, Blanton P. Energy conservation and exercise dependence: a sympathetic arousal hypothesis. *Med Sci Sports Exerc* 1987; 19: 91-99.
46. Berczik K, Griffiths MD, Szabo A, Kurimay T, Kookonyei G, Urban R, et al. Exercise addiction: The emergence of a new disorder. *Australas Epidemiol* 2014; 21: 36-40.
47. Lichtenstein MA, Andries A, Hansen S, Frstyk J, Stoving RK. Exercise addiction in men is associated with lower fat-adjusted leptin levels. *Clin J Sport Med* 2014; 25: 138-143.
48. Szabo, A. The impact of exercise deprivation on wellbeing of habitual exercisers. *Austral J Sci Med Sport* 1995; 27: 68-75.
49. Sussman S, Leventhal A, Bluthenthal R., Freimuth M, Forster M, Ames SL. A framework for the specificity of addictions. *Int J Environm Health Pub Health* 2011; 8: 3399-3415.
50. Landolfi E. Exercise addiction. *Sports Med* 2013; 43: 111-119.
51. Adams JM, Miller TW, Kraus R. Exercise dependence and associated disorders: Diagnostic and therapeutic issues for patients in psychotherapy. *J Contemp Psychother* 2003; 33: 93-107.
52. San Mauro I, Garicano E, González M, Villacorta P, Megias A, Miralles B, et al. Hábitos alimentarios en personas que realizan ejercicio. *Nutr Hosp* 2014; 30: 1324-1332.



Original/*Obesidad*

A strategy for weight loss based on healthy dietary habits and control of emotional response to food

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Abstract

Introduction: a sedentary lifestyle and unhealthy eating habits are major causes of a negative energy balance and excess body weight. The lifestyle of the Mediterranean diet eating pattern significantly reduces risk factors for non communicable diseases. Moreover, emotions have a powerful effect on feeding behavior. There is a direct relationship between food choices (type and amount), emotions and increased energy intake.

Objective: to know the emotional behavior of individuals as a function of the relation between food intake and emotions to facilitate the establishment of personalized dietary guidelines based on healthy eating habits and increase the patient fidelity until the desired weight.

Subjects and methods: 99 overweight adult people (81 women and 18 men) were subjected to a weight-reduction program based on the establishment of lifestyle and healthy eating habits. The adherence to Mediterranean dietary pattern and the effect of emotions on the choice of food and eating habits were determined using Mediterranean Diet Adherence Screener (MEDAS) and Emotional-Eater Questionnaire (EEQ) respectively.

Results: the studied population was sedentary, consumed an unhealthy diet and eating behavior was highly affected by emotions. The majority of participants, (66% of women and 71% of men) were classified as emotional eater. During the treatment program eating habits and lifestyle subjects were modified and reduced at least 10% of their body weight.

Conclusion: know the relation between food intake and emotions allows to personalize the dietary strategy for weight loss in overweight and obesity.

(Nutr Hosp. 2015;31:2392-2399)

DOI:10.3305/nh.2015.31.6.8736

Key words: *Healthy dietary habits. Emotional-Eater. Obesity.*

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Recibido: 29-I-2015.
Aceptado: 3-III-2015.

UNA ESTRATEGIA PARA DISMINUIR EL PESO CORPORAL, BASADA EN HÁBITOS ALIMENTARIOS SALUDABLES Y EL CONTROL DE LA RESPUESTA EMOCIONAL ANTE LOS ALIMENTOS

Resumen

Introducción: el sedentarismo y los hábitos alimentarios poco saludables son las principales causas de un balance energético negativo y un exceso de peso corporal. El estilo de vida del patrón de dieta mediterránea reduce significativamente los factores de riesgo de enfermedades no transmisibles. Por otra parte, las emociones tienen un poderoso efecto en el comportamiento alimentario. Existe una relación directa entre la elección de alimentos, las emociones y el aumento de la ingesta energética.

Objetivo: conocer el comportamiento emocional de los individuos para facilitar el establecimiento de pautas dietéticas personalizadas basadas en hábitos alimentarios saludables y aumentar la fidelidad del paciente hasta conseguir el peso deseado.

Material y métodos: 99 personas adultas con sobrepeso fueron sometidos a un programa de reducción de peso basado en establecer unos hábitos alimentarios y un estilo de vida saludables. La adhesión al patrón de dieta mediterránea y el efecto de las emociones en la elección de alimentos se determinaron utilizando los cuestionarios MEDAS (Mediterranean Diet Adherence Screener) y EEQ (Emocional Eater Questionnaire), respectivamente.

Resultados: la población estudiada era sedentaria, consumía una dieta poco saludable y su conducta alimentaria era dependiente de las emociones. La mayoría de los participantes (66% mujeres y 71% hombres) fueron clasificados como comedores emocionales. Durante el programa de tratamiento, los participantes modificaron sus hábitos alimentarios y su estilo de vida, consiguiendo reducir el peso corporal en al menos un 10% respecto al peso inicial.

Conclusión: conocer la relación entre la ingesta de alimentos y las emociones permite personalizar la estrategia dietética para disminuir el peso corporal y la tasa de abandono.

(Nutr Hosp. 2015;31:2392-2399)

DOI:10.3305/nh.2015.31.6.8736

Palabras clave: *Hábitos dietéticos saludables. Comedor emocional. Obesidad.*

Abbreviations

BMI: Body Mass Index.
MEDAS: Mediterranean Diet Adherence Screener.
EEQ: Emotional Eater Questionnaire.
F1: Dishinhibition factors.
F2: Type of food factors.
F3: Sense of guilt factors.

Introduction

Excess body weight is one of the modifiable risk factors of non communicable diseases¹. A sedentary lifestyle and unhealthy eating habits are major causes of these diseases. Over 44% of the population, not enough physical activity and only 14% of the population can be considered active². In addition, the eating habits of the population follow an unhealthy trend. A significant reduction in risk factors diseases with an increasing score for adherence to a Mediterranean diet, that is considered healthy dietary pattern, has been reported³. A score based on a theoretically defined Mediterranean diet is an effective preventive tool for measuring the risk of mortality and morbidity in the general population.

The Mediterranean diet, has been widely reported to be a model of healthy eating for its contribution to a favourable health status and a better quality of life³⁻⁵. This Mediterranean dietary pattern incorporates most of the protective factors (fruits, vegetables, legumes, whole grains, fish, olive oil) but few of the adverse dietary factors (fast food, sugar-sweetened beverages, refined grain products, energy density, and partially hydrogenated or trans-fat) for obesity⁶. However, research interest in this field has been focused on estimating adherence to the whole Mediterranean diet rather than analysing the individual components of the dietary pattern in relation to the health status of the population. This because food components of diet present synergistic and antagonist interactions and because people eat a mixture of foods. Moreover, the overall quality of a dietary pattern appears to affect adiposity and the risk of obesity to a greater extent than relative macronutrient quantity².

Despite being a healthy dietary pattern, only a small percentage of the population consumes a diet with these healthy features. This trend is similar in developed populations. Therefore, determining the degree of adherence to the Mediterranean dietary pattern is a good indicator of the quality of a diet^{2,6,7}. It was defined through scores that estimated the conformity of the dietary pattern of the studied population with the traditional Mediterranean dietary pattern³.

On the other hand, is well known that emotions have a powerful effect on the choice of food and eating habits and some persons eat as a response to a range of negative emotions, such as anxiety, depression, anger and loneliness and emotional eating has been associa-

ted with overeating, binge eating, bulimia nervosa, and obesity.

Several studies indicated why some people eat in response to both positive and negative emotions and situations⁸⁻¹¹. Positive emotions may contribute to food consumption in normal eaters. Eating more under negative emotions may contribute to being overweight.

Each subject handled differently their attitude to food. Much of people who are overweight or obese, have conditions for emotion to food choices and eating adequate amounts.

The Community Pharmacy, as part of the Integrated Health and specifically the pharmacies distributed evenly throughout the country, offers the ability to positively interact with the population. The pharmacist as a health agent in daily contact with the patient, can provide information on eating habits, physical activity, overweight, obesity, eating behavior disorders, etc., thus participating in prevention and nutritional education programs.

This study was conducted to demonstrate how the adoption of healthy eating habits may be effective to decrease the weight in people with overweight and obesity. In addition know the emotional behavior may facilitate the establishment of personalized dietary guidelines and increase the patient fidelity (decreasing the discontinuation rate) until the desired weight.

Methods

A longitudinal study during 12 months, from September 2012 to September 2013, in users of community pharmacy in the Community of Madrid, were conducted.

Subjects

A sample of 99 participants (81 women and 18 men) ranged in age from 18 to 75 years was included in this study. Recruitment was carried out in a community pharmacy placed in the Community of Madrid. They went voluntarily or under medical prescription to apply for dietary advice for weight loss. Patient who had diseases, were referred to the appropriate specialist units. In any case, each participant was advised by the nutritionist to report to your primary care physician

The written informed consent was obtained before subjects were accepted and was performed in accordance with the Helsinki Declaration of Human Studies and the protocol was approved by the Official College of Pharmacists of Madrid.

The first experimental day, weight (Kg) and height (m) were measured in all participants, using a calibrated clinical balance and a stadiometer. Body mass index (BMI) was calculated and expressed as Kg/m². Normal weight was defined with BMI less than 25; overweight

if BMI values were between 25 and 29.9, while obesity was defined with a BMI higher than 30¹.

The initial body weight and changes in this parameter was weekly determined throughout the experimental period to calculate the loss in weight until the loss of at least 10% of the initial weight, which was the target. It was expressed in kg and percentage of the initial body weight.

Procedure

At baseline, the dietitian completed a general medical questionnaire assessing lifestyle, health conditions, smoking habits, sociodemographic variables, history of illness, medication use, culinary habits, food preferences and aversions, toxic habits, eating habit between meals, habitual serving size, etc. Moreover, also other questionnaires related with physical activity pattern and emotional eating were conducted.

For the assessment of adherence to the Mediterranean diet with 14-item was conducted, in a face-to-face interview with the participant, (Table I). The 14-item tool was developed in PREDIMED study that is a large trial of nutritional intervention for the primary prevention of cardiovascular disease, conducted in 11 Spanish recruiting centers².

The 14-item screener of Mediterranean Diet Adherence Screener (MEDAS) includes 12 questions on food consumption frequency and 2 questions on food habits considered characteristics of the Spanish Mediterranean diet. One point is given for each target achieved. The total MEDAS score ranges from 0 to 14, with a higher score indicating better Mediterranean diet accordance. The value 0 was applied when the condition was not met. MEDAS score > 9 represented strict accordance with the healthy dietary pattern and a score > 7 (mid-range value) represented modest accordance¹².

Finally, each participant filled out a questionnaire on emotional eating for use in cases of obesity, named Emotional Eater Questionnaire (EEQ). This questionnaire have been developed and validated in order to assess many aspects of the motivation to eat that may be susceptible to impair adequate food intake and body weight control⁸. This questionnaire classifies individuals as a function of the relation between food intake and emotions. Such information will permit personalized treatments by drawing up early strategies from the very beginning of treatment programs. EEQ contains 10 questions each of which have 4 possible replies: Never, sometimes, generally and always. Each reply was given a score of 1 to 4. 1 corresponds with the lower score and 4 with the healthier the behavior. For the clinical practice, the subjects were classified in four groups attending to the score obtained: Non-emotional eater, with a score between 0-5; low emotional eater, with score between 5-10; emotional eater, with score between 11-20; very emotional eater, with score between 21-30.

EEQ questions were grouped to meet three emotional aspects of participants: 1) Disinhibition factors (F_1), group of questions that refer to the lack of control in terms of eating; 2) Type of food factors (F_2), includes questions related with the type of food that patients eat more frequently in given situations; 3) Sense of guilt factors (F_3), questions refer to the sense of guilt felt by individuals when they look at the weighing scales or eat forbidden foods.

The information collected in the questionnaires formed the basis for the establishment of a customized diet program, particularly adapted according to the effect of emotions on the choice of food and eating habits. The program was based on the dietary and lifestyle patterns of Mediterranean diet². Each participant received instructions (orally and in writing) on culinary techniques, size of portions, guidelines for the purchase of food and personal recommendations on physical activity.

In addition, was established the biweekly schedule to review and update the guidelines and weekly weight control. Once achieved the goal of weight loss (> 10% of initial weight), quarterly reviews were scheduled to complete the period of four years, considered optimal for the consolidation of habits¹³.

Statistical analysis

Paired t-tests were used to analyze the differences in the data at the baseline and the 12-month changes. ANOVA was applied to analyze the differences in the data between the groups. Results were expressed as mean and standard error. Two-sided $p < 0.05$ was considered significant (95% confidence intervals). Statistical analysis was performed using STATGRAPHICS Plus 5.1.

Results

The distribution of participants by sex and age was indicated in the Table I. The majority were females (82%) and the age of the major part of women and men ranged between 41 and 65 years old.

Most of men and women were aged between 41 and 65 years, followed by the population between 18 and 40.

All participants went to the community pharmacy for help to lose weight because they thought that their weight was excessive. Subsequent measurement of weight and height and BMI calculation confirmed that all patients had overweight and the majority could be classified as obese people.

Most of the men presented obesity type I (BMI between 30 and 35 Kg/m²) and 11 % presented morbidly obese. However, the majority group of women (41.98 %) were classified as overweight, 35.8 % had type I obesity, and only 4.9 % presented morbidly obese, (Table I).

Table I
Initial characteristics of participants¹

	Men	Women	Total
Number of participants	18	81	99
Age (year):			
18-40	6	17	23
41-65	10	56	66
>65	2	8	10
Weight (Kg)	104.69±3.65	80.92±1.35	85.24±15.73
Weight situation (%):			
Normopeso (BMI: 18.5-24.9 Kg/m ²) ²	0	0	0
Overweight (BMI: 25-29.9 Kg/m ²)	11.11	41.98	36.36
Obesity (BMI: > 30 Kg/m ²)			
- Type I: (BMI: 30-34.9 Kg/m ²)	55.56	35.80	39.39
- Type II: (BMI: 35-39.9 Kg/m ²)	22.22	17.28	18.18
- Morbid: (BMI: > 40 Kg/m ²)	11.11	4.94	6.06
BMI (Kg/m ²)	34.70±1.01 ^a	31.82±0.53 ^b	32.34±0.48
Physical activity	sedentary	sedentary	sedentary
MEDAS ³	4.89±0.37 ^a	6.30±0.18 ^b	6.22±0.17

¹Results were expressed as mean ± standard error. Different letters indicate significant differences between men and women (one-way ANOVA, $P < 0.05$). ²BMI: Body mass index. ³MEDAS: Mediterranean diet adherence screener

Other important characteristic of the studied population was the sedentary lifestyle. Only 10% of women and 5% of men did some slight activity, but not enough so that they could be classified as active people. Taking account the common physical activity, people could be classified as very sedentary¹⁴, (Table I).

Only a small percentage of the population consumed a diet according to the characteristics of a healthy dietary pattern. Poorly suited eating habits that had a serious impact on the degree of adherence rate to Mediterranean diet pattern were detected. The most common defects in eating habits were overeating between meals; lack of time to make the purchase and preparation of food, so that participants quite often resorted to the use of ready meals, cheeses and sausages; and realization of one family meal per day.

According to the questionnaire results MEDAS (Table II), most participants used olive oil for cooking and more than 60% consumed 4 tablespoons or more.

The women ate more fruit and vegetables than men, although only 45% complied with the recommendations. Consumption of sauteed vegetables was similar in both groups. Men (80%) daily ate at least one serving of red meat and only 44% chose poultry or rabbit. However, almost 50% of women reached the MEDAS target on consumption of red meat and 75% chose poultry or rabbit.

The women ate less legumes, industrial bakery and fish than men. The consumption of nuts was not common in this population.

Regarding the consumption of drinks, only 5% and 20% of women and men respectively, drank seven or more glasses of wine per week. Men also drank more sweetened and/or carbonated beverages than women

although it should be noted that in both groups, a high percentage take these beverages and only 64% of women and 50% of men achieved the target of MEDAS.

Attending to the results of EEQ, the majority of participants, (66% of women and 71% of men) were classified as emotional eater, because both men and women reached values around 11, although the group of women had slightly higher values. The distribution of participants according to the emotional response to food was indicated in Figure 1. Score values were indicated in the table III. From the score obtained and based on the grouping of the questions after principal components analysis, three important aspects could be identified for treating patients. They were desinhibition (F_1), type of food chosen (F_2), and guilt (F_3).

As was indicated in Table I, the initial weight and BMI for men were higher than the initial values of women, so the degree of obesity was higher in the male group. The weight loss expressed as Kg lost was of higher for men (12.9 Kg and 9.2 kg in males and females respectively). However, weight loss as percentage of initial weight was exactly the same for both groups (Figure 2). We also have to take into account that women needed less time (3 to 6 months) to achieve the goal of weight loss (> 10%), while the group of men needed between 6 and 12 months to achieve this objective.

Discussion

All participants in the study were overweight and obese people. They were sedentary, consumed an unhealthy diet and were also people whose eating behavior was highly dependent on the emotions aroused

Table II
Participants who achieve each target of the MEDAS¹ score,
and accordance of food consumption with the Mediterranean diet²

Questions	Target	Achievement of MEDAS target	
		Women (%)	Men (%)
1. Do you use olive oil as main culinary fat?	Yes	98	100
2. How much olive oil do you consume in a given day? (including frying, salads, etc)	> 4 tablespoon/d (1 tablespoon: 13.5g)	69	72
3. How many vegetable servings do you consume per day? (consider side dishes as a half a serving)	> 2 servings/d (1 serving: 200g)	40	22
4. How many fruit units do you consume per day? (including natural fruit juices)	> 3	45	28
5. How many servings of red meat, hamburger or meat products do you consume per day?	< 1	48	22
6. How many servings of butter, margarine, or cream do you consume per day?	< 1	26	33
7. How many sweetened and/or carbonated beverages do you drink per day?	< 1	64	50
8. How many wine do you drink per week?	> 7 glasses	5	22
9. How many servings of legumes do you consume per week? (1 serving 150 g)	> 3	34	56
10. How many servings of fish or shellfish do you consume per week? (1 serving 100-150 g of fish or 4-5 units or 200 g of shellfish)	> 3	53	44
11. How many times per week do you consume commercial sweets or pastries	< 3	14	28
12. How many servings of nuts do you consume per week? (1 servings 30 g)	> 1	13	17
13. Do you preferentially consume chicken, turkey or rabbit meat instead of veal, pork, hamburgers or sausage?	Yes	75	44
14. How many times per week do you consume vegetables, pasta, rice or other dished seasoned with sauce of tomato, onion, garlic, or leek with olive oil?	> 2	49	50

¹MEDAS, Mediterranean Diet Adherence Screener. ²Accordance of food consumption with Mediterranean diet is defined as achieving >9 targets of MEDAS (3)

Table III
Degree of emotional eater in overweight and obese people¹

	F_1^2	F_2^2	F_3^2	Total
Men	7.00 ± 0.88 ^a	2.06 ± 0.40 ^a	1.56 ± 0.50 ^a	10.61 ± 1.23
Women	6.75 ± 0.41 ^a	2.40 ± 0.20 ^a	3.62 ± 0.24 ^b	12.77 ± 0.63
Total	6.80 ± 0.38	2.33 ± 0.18	3.24 ± 0.24	12.37 ± 0.59

¹Results were expressed as mean ± standard error. Different letters indicate significant differences between men and women (one-way ANOVA. $P < 0.05$). ² F_1 : Dishinhibition factors; F_2 : Type of food factors; F_3 : Sense of guilt factors.

by food. Therefore, to establish the dietary guidelines was necessary to consider not only the energy balance (energy intake and energy expenditure) but also the eating behavior of each patient.

All people in this study were identified as overweight or obese patients, based on their BMI. BMI was used to assess the degree of overweight or obese at ba-

seline, but also as a guide to measure the effectiveness of treatment for weight loss. BMI and body weight were used to monitor the weight loss and to determine the effectiveness of therapy.

The initial goal was to reduce body weight by approximately 10 percent of the initial weight. This objective was achieved by the major part of patients.

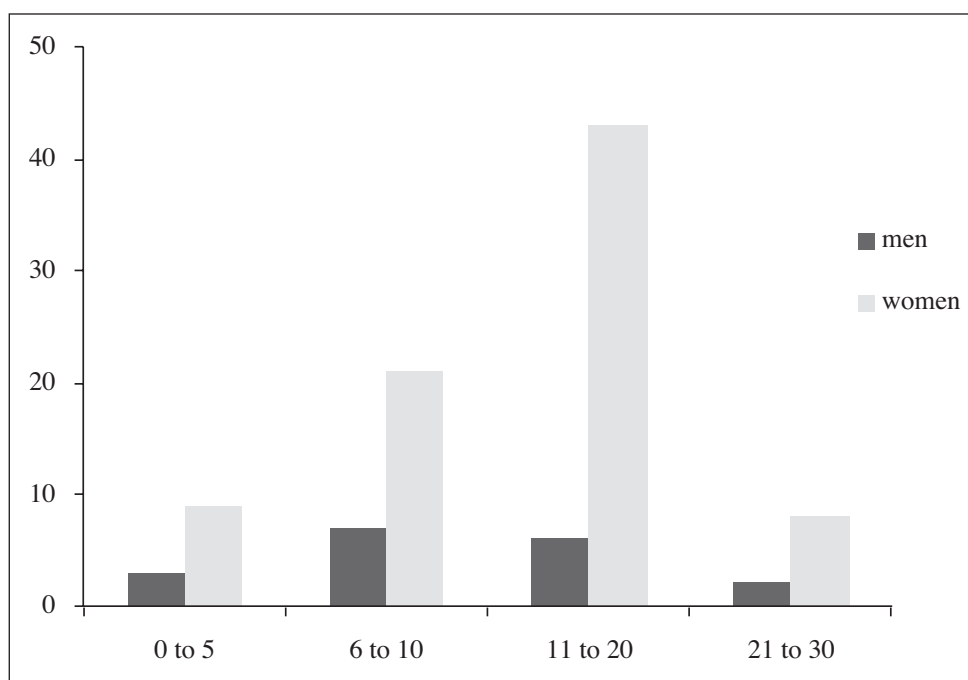


Fig. 1.—Emotional response of participants at baseline¹.¹Score values: 0-5: Non-emotional eater; 6-10: Low emotional eater; 11 – 20 Emotional eater; 21 – 30, Very emotional eater⁸.

Guidelines recommend gradual weight loss for the treatment of obesity, indicative of a widely held opinion that weight lost rapidly is more quickly regained. However, Purcell et al¹⁵ demonstrated that the rate of weight loss does not affect the proportion of weight regained after a long period of time. Furthermore, if losing weight is accompanied by nutrition education and establishing habits of healthy lifestyle, the chances that patients do not leave the weight loss program may be higher.

In the present study, only 12% of women took less than three months to lose weight agreed on; most men and almost 50% of women need more than six months.

These results were expected since we wanted to promote progressive changes in habits and lifestyle, to consolidate more strongly these changes.

Physical activity is an integral part of weight loss program because modestly it contributes to weight loss in overweight and obese adults. Moreover, regular physical activity and a prudent diet can reduce the risk

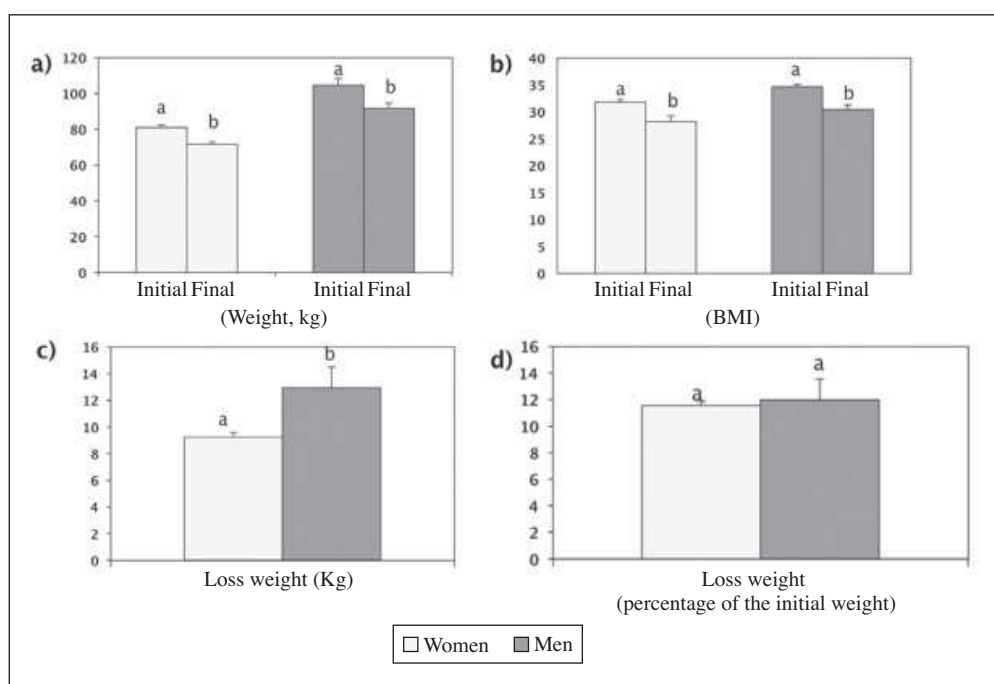


Fig. 2.—Weight loss of participants in 12 months¹.¹Different letters indicate significant differences between men and women, (One-way ANOVA, $P \leq 0.05$).

of premature death and disability from a variety of conditions including coronary heart disease, and are strongly related to the incidence of obesity¹⁶.

Changes in physical activity habits were significant. At baseline, 90% of the population was sedentary or very sedentary, while at the end, almost all participants (90%) included daily activities such as climbing stairs, play a sport or avoid taking the bus.

Know the degree of emotion experienced by each participant with food could be used as an effective tool for driving change in food habits required to correct dietary defects of obese people. Moreover, it is important that the treatment program requires a greater frequency of contacts between the patient and the dietitian and to know the emotional behavior of participants lead to more successful weight loss and weight maintenance. Emotional eating was conceptualized as eating in response to negative affect. Many obese people in times of distress, use food as an emotional defense which, in turn, leads to obesity. On the other hand, a lot of obese persons engage in excessive eating in response to negative emotions, while normal weight persons have more adaptive coping mechanisms and do not eat in response to emotional distress. Consequently, emotional eating research, particularly in adults, has often focused on obese populations. Obviously there are a variety of affective factors that can alter the feeding behaviour, including anxiety, depression, anger, and boredom. Moreover, is interesting take in account that dietary restrained eaters are particularly vulnerable to adverse effects of stress on health, through influences on food intake¹⁷.

The implementation of the emotional eater questionnaire allowed differentiation three types of emotional factors and to knowledge the personality of patients facilitated establish healthy guidelines customized and adapted to each person. The distribution of the sample in the four diagnostic groups: no emotional; little emotional, emotional and very emotional, according to the total points scored in EEQ, was indicated in the figure 1. All participants were emotional eaters, but only 4.76 percent of the total sample showed the highest degree of emotionality.

The first factor, F_1 grouped the questions that refer to discontrol in terms of eating and corresponds to a tendency to lose the control over eating behavior and overeat amounts of food in response to a variety of cues and circumstances. When F_1 is high has already been described how the inability to control food-related impulses and cravings is determined by the individual character of each person. These patients showed a greatest need to develop self-control in the face of impulses since these were precisely the patients who will have greatest difficulty in achieving weight loss.

The second factor, F_2 included questions related with the type of food that patients eat most frequently in given situations. Food with high calorie content, such as ice cream, biscuits and chocolate were closely related with decontrol and were used to combat negative emotions since their consumption was associated with the

production of endogenous opiates and serotonin, both directly involved with the emotions¹⁸.

Lastly, the third factor, F_3 refers to the sense of guilt and fear felt by individuals when they look at the weighing scales or the consumption of forbidden foods. It has been described how food was converted into a conflict between guilt and pleasure in more emotional individuals¹⁹. Males showed higher values of F_1 and F_2 than women, while F_3 was higher in the group of women, indicating that factors related to guilt and fear affected more the usual feeding behavior of women in this study.

F_3 to be the least important factor but it could be more remarkable for some persons and useful in clinical practice since it was related to the early prediction of binge eating disorders.

As is known, overweight and obesity are consequences of a negative energy balance and some studies have shown that high adherence to the Mediterranean diet was associated with lower BMI. These data were in line with previous findings reporting a lower risk of obesity and diabetes prevalence among PREDIMED study participants with high adherence to the MEDAS-derived PREDIMED score²⁰. In addition, effective nutritional interventions required information of the extent to which the diet of population adheres to the MD and of the specific subgroups that mostly deviation from this healthy dietary pattern. The potential public health benefits from promoting a healthier lifestyle at all age but especially ages 40-74 years, are substantial²¹. Thus, the quality of the diet consumed by the studied population was evaluated.

The MEDAS adequately ranks individuals according to the adherence to the traditional Mediterranean diet. It is a general indicator of quality of the whole diet and it allows the provision of immediate feedback to the patient. Moreover, it is a good tool to change dietary habits³, that was one of the main objectives of this work.

The goal could be achieved by changing the size of the portions, frequency of intake or cooking methods. To maintain an adequate energy balance for a healthy body weight was necessary to consider not only the caloric density of food consumed, that is, type of food consumed, but also the size of the ration. At present, the size of portions of food commonly served is increasing. This trend, originally only in the United States, has rapidly swept through the world as part of the process of globalization and a possible cause of the high prevalence of obesity.

Only 2% of the population reached a MEDAS score on strict accordance with the Mediterranean diet, and around 20 % attained a modest accordance. The majority (78%) showed no accordance with the healthy dietary pattern. It is possible that 9 point cutoff be a very rigorous goal, but even if was considered 7-point cutoff (the mid-value of the score range), the results were no good because of around 80 % of people followed an unhealthy dietary pattern.

At baseline, the diet of participants was unhealthy, both in the group of men as in women. MEDAS index

values were higher in the group of women. Around 25% of women and 17% of men showed mid-range values, and only 2.5% of women had values considered strict accordance with Mediterranean dietary pattern.

The score of MEDAS also gives specific information on the consumption of typical foods of the Mediterranean diet, such as nuts, legumes, and olive oil, and also inquires about the consumption of foods that do not fit the traditional Mediterranean diet, such as sugary soft drinks and pastries.

MEDAS was positively associated with nutrient and food intakes considered healthy, including vitamins, dietary fiber, unsaturated fatty acids, vegetables, fruits, whole grain cereals, nuts, and fish. There was an inverse relationship between MEDAS score and intakes of sodium, saturated fat, sugared beverages, and refined cereals²².

The more detailed analysis of the responses to MEDAS questionnaire allowed to know the main usual dietary problems of individuals.

Table II shows the percentage of participants meeting the MEDAS targets and achieving accordance with the Mediterranean diet. More than 97% of individuals met the targets for using olive oil as the main cooking fat and eating foods sautéed in olive oil. Men and women only agreed habits related to the consumption of olive oil that was in accordance with the Mediterranean diet. The specific answers to the 14-point of MEDAS questionnaire were indicated in the Table II. In general, the main dietary defects were a low consumption of fruits, vegetables, legumes and fishes. While an elevated consumption of red meat, sweetened and/or carbonated beverages, commercial sweets or pastries, butter, margarine, or cream, were observed.

In conclusion, the program followed for losing weight based on establishing healthy lifestyle habits (diet and physical activity) and knowledge of emotional behavior of subjects with food, was effective and the participants achieved the target of lost weight in a relatively short period of time.

Acknowledgement

This study was supported by the project GR3/14 UCM-Santander 2014

References

1. WHO Technical Report Series, 894. Obesity: Preventing and managing the global epidemic. Geneva 2000.
2. León-Muñoz LM, Guallar-Castillón P, Garciani A, López-García E, Mesas AE, Aguilera MT et al. Adherence to the Mediterranean diet pattern has declined in Spanish adults. *J Nutr* 2012; 142: 1843-1850.
3. Martínez-González MA, Corella D, Salas-Salvadó J, Ros E, Covas MI, Fiol M et al. Cohort profile: Design and methods of PRE-DIMED study. *Int J Epidemiol* 2012; 41: 377-385.
4. Guallar-Castillón P, Rodríguez-Artalejo F, Tormo MJ, Sánchez MJ, Rodríguez L, Quirós JR et al. Major dietary patterns and risk of coronary heart disease in middle-age persons from a Mediterranean country: The EPIC-Spain cohort study. *Nutr Metab Cardiovasc Dis* 2012; 22: 192-199.
5. Miettjavila MT, Fandos M, Salas-Salvadó J, Covas MI, Borrego S, Estruch R, et al. The Mediterranean diet improves the systemic lipid and DNA oxidative damage in metabolic syndrome individuals. A randomized, controlled trial. *Clin Nutr* 2013; 172-.178.
6. Dalen JE, Devries S. Diets to prevent coronary heart disease 1957-2013. *Am J Med* 2014; 127: 364-369.
7. Bhupathiraju SN, Tucker KL. Coronary heart disease prevention: Nutrients, foods, and dietary patterns. *Clin Chimica Acta* 2011; 412: 1493-1514.
8. Garaulet M, Canteras M, Morales G, López-Guimera G, Sánchez-Carracedo Corbalán-Tutau MD. Validation of a questionnaire on emotional eating for use in cases of obesity; the Emotional Eater Questionnaire (EEQ). *Nutr Hosp* 2012; 27 (2): 645-651.
9. Melbourne Academic Mindfulness Interest Group. Mindfulness-based psychotherapies: A review of conceptual foundations, empirical evidence and practical considerations. *Aust NZ J Psychiatry* 2006; 40: 285-294.
10. Wansink B. Environmental factors that increase the food intake and consumption volume of unknowing consumers. *Annu Rev Nutr* 2004; 24: 455-479.
11. Wansink B, Painter JE, North J. Bottomless bowls: why visual cues of portion size may influence intake. *Obes Res* 2005; 13: 93-100.
12. Sánchez-Tañta A, Estruch R, Bulló M, Corella D, Gómez-García E, Fiol M et al. Adherence to a Mediterranean-type diet and reduced prevalence of clustered cardiovascular risk factors in a cohort of 3204 high-risk patients. *Eur J Cardiovasc Prev Rehabil* 2008; 15: 589-593.
13. Wadden TA, Neiberg RH, Wing RR, Clark JM, Delahanty LM, Hill JO, Krakoff J et al. Four-year weight losses in the Look AHEAD study: factors associated with long-term success. *Obesity* 2011; 19 (10): 1987-1998.
14. WHO. 1985. Energy and protein requirements: Report of a joint FAO/WHO/UNU expert consultation. Technical Report Series No. 724. Geneva 1985.
15. Purcell K, Sumithran P, Prendergast L, Bouniu C, Delbridge E, Proietto J. The effect of rate of weight loss on long-term weight management: a randomised controlled trial. 2014; *Lancet Diabetes Endocrinol* 2014; 2 (12): 954-962.
16. King GA, Fitzhugh EC, Bassett DR, McLaughlin JE, Starth SJ, Swartz AM, Thompson DL. Relationship of leisure-time physical activity and occupational activity to the prevalence of obesity. *Int J Obes* 2001; 25 (5): 606-612.
17. Wardle J, Steptoe A, Oliver G, Lipsey Z. Stress, dietary restraint and food intake. *J Psychosom Res* 2000; 48 (2):195-202.
18. Butryn ML, Thomas JG, Lowe MR. Reductions in internal disinhibition during weight loss predict better weight loss maintenance. *Obesity* 2009; 17 (5):1101-1103.
19. Patel KA, Schlundt DG. Impact of moods and social context on eating behavior. *Appetite* 2001; 36: 111-118.
20. Serra-Majem L, Roman B, Estruch R. Scientific evidence of interventions using the Mediterranean diet: a systematic review. *Nutr Rev* 2006;64 (S): 27-47.
21. King DE, Mainous AG, Carnemolla M, Everett CJ. Adherence to healthy lifestyle habits in US adults, 1988-2006. *Am J Med* 2009; 122: 528-534.
22. Román-Viñas B, Ribas-Barba L, Ngo J, Martínez-González MA, Wijnhoven TM, Serra-Majem L. Validity of dietary patterns to assess nutrient intake adequacy. *Br J Nutr* 2009; 101 (S2): 12-20.



Original/*Obesidad*

Modificación del peso corporal de los estudiantes universitarios en Navarra durante los tres primeros años de universidad

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Resumen

Introducción: una de las estrategias para la prevención de la obesidad es la identificación de periodos críticos de aumento de peso, y existen estudios que confirman un aumento de peso corporal durante el periodo universitario.

Objetivo: determinar las modificaciones en el peso corporal de los estudiantes universitarios en España, durante los tres primeros años de universidad.

Métodos: estudio longitudinal y prospectivo de una muestra de estudiantes universitarios en España. Participaron universitarios matriculados en primer curso, a quienes se siguió en tercer curso. De los 1.162 estudiantes iniciales, 499 volvieron a participar (pérdida de seguimiento del 57,05%) y la muestra fue constituida por 452 estudiantes (pérdida de seguimiento del 60,8 %). Los estudiantes respondieron a un cuestionario y se valoró el peso y la talla corporal.

Resultados: el peso corporal experimentó un incremento medio de 0,600 kg. En los hombres 1,88 kg y sin apenas modificación en las mujeres. Entre el 44,7 % de los estudiantes que aumentaron de peso (60,8 % hombres y 36,8 % mujeres), la ganancia media de peso alcanzó los 3,4 kg.

Discusión: durante el periodo universitario se produce un aumento del peso corporal que afecta principalmente a los hombres. Por este motivo, es necesario continuar con los programas de promoción de la salud en este entorno.

(Nutr Hosp. 2015;31:2400-2406)

DOI:10.3305/nh.2015.31.6.8686

Palabras clave: Aumento de peso. Universidad.

CHANGES IN BODY WEIGHT OF THE UNIVERSITY STUDENTS AT UNIVERSITY

Abstract

Introduction: one of the strategies for the prevention of the obesity is the identification of critical periods of gain weight. Some studies confirm gain weight during the university period.

Objective: the purpose of the present study was to determine the changes in the body weight of the university students in Navarre.

Methods: prospective cohort study. Public University of Navarre and the University of Navarre, in Pamplona. Study examined weight change among 452 students attending at university in Pamplona, during first and third course. Four hundred and fifty two students completed the questionnaire. Weight and height were measures and body mass index was calculated.

Results: the mean body weight increased 0,600 kg, 1,8 kg for males and no change in body weight was observed in female. 44,7 % of students gained weight (60,8 % of men and 36,8 % of women), and the gain weight was of 3,4 kg.

Discussion: university years are a critical factor for the gain weight, particularly males. Consideration of this, is necessary the development of effective weight gain prevention strategies during the university.

(Nutr Hosp. 2015;31:2400-2406)

DOI:10.3305/nh.2015.31.6.8686

Key words: Weight gain. Universities.

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Recibido: 21-I-2015.

Aceptado: 3-III-2015.

Abreviaturas

IMC: Índice de masa corporal.

Introducción

La obesidad es uno de los mayores problemas a los que se enfrentan las sociedades modernas, y que afecta a todas las edades, sexos y condiciones sociales¹. Su prevalencia se está incrementando y está adquiriendo proporciones epidémicas, convirtiéndose en la segunda causa de mortalidad prematura evitable después del tabaco, por su asociación con la enfermedad cardiovascular, la diabetes e incluso el cáncer²⁻⁶.

Una de las estrategias para la prevención de la obesidad es la identificación de periodos críticos de aumento de peso, que en EEUU y Canadá lo sitúan en la transición de la educación secundaria a la universidad^{7,8}. Durante esta etapa, la influencia del estrés (incremento de la presión académica, cambios en los grupos de apoyo social, independencia del hogar familiar, responsabilidad en decisiones en materia de alimentación y actividad física) y las modificaciones en los estilos de vida (cambios en los hábitos dietéticos, incremento de consumo de alcohol y disminución de la actividad física), son factores que juegan un rol importante en el aumento de peso⁷⁻¹².

Apoyando esta idea se difundió la creencia del fenómeno denominado “freshman 15”, consistente en una ganancia de peso de 15 libras (6,8 kg) durante el primer año de universidad^{8,13,14}. Muchos investigadores han estudiado el tema y Crombie en una revisión, concluye que el promedio del aumento de peso observado el primer año de universidad, es menor que el sugerido por el “freshman 15”, quedándose en torno a 4,4 - 6,6 libras (2-3 kg)¹³.

Existen pocos estudios que analicen el cambio de peso después del primer año de vida universitaria. Entre ellos, Crombie presenta una estabilización del peso tras el primer curso de universidad¹³. Grooper, en tercer curso observa pequeños aumento de peso y de masa grasa¹⁵ y Racette en cuarto curso, presenta un modesto aumento de peso, con diferencias estadísticamente significativas, que sugiere que las rápidas cifras de aumento de peso en primer curso de universidad, no continúan en los cursos posteriores¹⁶.

El aumento de peso durante el periodo universitario está comprobado en el contexto norteamericano por lo que las diferencias culturales y ambientales no permiten generalizar estos resultados a otros países¹⁷. Pero teniendo en cuenta que los factores predisponentes para el aumento de peso comentados anteriormente son comunes a la población universitaria, el aumento de peso podría ser una constante en los universitarios. En Europa, apenas existe investigación sobre el tema. En un estudio durante el primer semestre universitario en el Reino Unido y otro durante el primer año en Bélgica, se observó un incremento de peso de 1 kg^{17,18}.

En definitiva, dado el escaso número de estudios, no se puede confirmar el fenómeno de aumento de peso durante el periodo universitario en nuestro entorno.

Objetivo

El objetivo de este estudio es determinar las modificaciones en el peso corporal de los estudiantes universitarios en Navarra durante los tres primeros años de universidad.

Métodos

Se realizó un estudio observacional y prospectivo de una cohorte de estudiantes universitarios, enmarcado dentro de un amplio proyecto interuniversitario de ámbito nacional e internacional. El ámbito de estudio se sitúa en los campus de Pamplona de la Universidad Pública de Navarra y la Universidad de Navarra. Constituyeron la población los 4.741 estudiantes matriculados en primer curso de cualquier titulación de las ofertadas, a quienes se invitó a participar en el estudio, mediante de información general en las aulas y el campus, prensa escrita y radio de ámbito provincial.

Participaron un total de 1170 estudiantes de primer curso. A los dos años, cuando estaban cursando el tercer curso universitario, se les convocó nuevamente para constituir la cohorte. Participaron 499 estudiantes y finalmente la cohorte se constituyó con 452 estudiantes, que participaron en el seguimiento al cabo de los dos años (lo que supuso una pérdida de 61,3 % de los 1170 estudiantes que iniciaron el estudio).

En las dos ocasiones, la recogida de datos se realizó durante el mes de abril, en horario ininterrumpido de mañana y tarde. Se habilitaron dos aulas en el campus de cada universidad. En primer lugar los participantes cumplimentaban un cuestionario, siempre en presencia de un miembro del equipo investigador, y a continuación, estudiantes del último curso de enfermería, supervisados por profesores del equipo de investigación, realizaban las valoraciones antropométricas.

Los estudiantes respondieron a un cuestionario de autocumplimentación de forma voluntaria y anónima, formado por preguntas que recogían información de variables sociodemográficas y se valoró el peso y la talla. Para la medición del peso se utilizó una báscula electrónica (Soehnle 7307) adecuadamente calibrada, realizándose el procedimiento con la persona vestida, sin zapatos y sin jersey o chaqueta. La talla se midió un tallímetro incorporado a la báscula, asegurando la posición erguida y que la espalda estuviese en contacto con la columna del tallímetro. Con los datos de peso y talla se calculó el Índice de Masa Corporal (IMC) y se clasificó para definir la obesidad en grados según los criterios de la Sociedad Española para el Estudio de la Obesidad (SEEDO)².

Los estudiantes recibieron un pequeño incentivo por su participación, consistente en un pincho de tortilla y un refresco.

En cuanto a las consideraciones éticas, se garantizó la participación voluntaria e informada, obteniendo un consentimiento informado por escrito de todos los participantes. En dicho consentimiento se incluía la finalidad del estudio, la descripción de los beneficios y los posibles riesgos, la confidencialidad y anonimato, la posibilidad de responder a dudas y el derecho a rehusar la participación en cualquier momento. Aspectos que se recogen en la declaración de Helsinki para las investigaciones en humanos. La confidencialidad de los datos se aseguró mediante la elaboración de una clave por parte de cada uno de los participantes, que a su vez, permitió enlazar los resultados de las pruebas con el cuestionario y con las intervenciones en los dos momentos del estudio.

Para el análisis estadístico de los datos se utilizó el SPSS v21.0 para Windows. En la estadística descriptiva se calcularon las medias y desviación estándar para las variables cuantitativas y frecuencias para las variables cualitativas. En la comparación de variables cualitativas se utilizó el estadístico ji-cuadrado y para las cuantitativas la t de Student. Las modificaciones en la cohorte se evaluaron con la t de Student para muestras pareadas (para variables continuas) y el test de McNemar (para variables categóricas). Para estimar la modificación del peso en función de diferentes variables, se realizó análisis de regresión logística binaria. Se consideró como nivel de significación estadística una $p < 0,05$.

Resultados

El 67,3% fueron mujeres ($n=304$) y el 32,7% hombres ($n=148$). La edad media en la primera cohorte fue de 18,91 años (DS 1,583), con un rango edades entre 18 años y 35 años (52,4% y 0,2% estudiantes, respectivamente) (Tabla I).

Todos los valores antropométricos fueron inferiores en las mujeres respecto a los hombres, resultando estadísticamente significativas las diferencias por sexos ($p < 0,05$) (Tabla II).

La talla y el IMC, se mantuvieron prácticamente estables en la cohorte. El peso corporal experimentó un incremento medio significativo de 0,600 kg ($p < 0,001$), siendo en los hombres de 1,88 kg ($p < 0,001$) y sin apenas cambios en las mujeres ($p > 0,05$). Sin embargo, entre los estudiantes que aumentaron de peso, el valor medio de incremento fue de 3,4 kg (SD 2,51).

Por sexos, el 60,8% de los hombres y el 36,8% de las mujeres aumentaron de peso, con una media de 4,6 kg (DS 2,86) y 3,3 kg (DS 1,96) respectivamente. El 26,3% (119) de los estudiantes no experimentaron cambios en su peso y el 29,0% (131) perdieron peso (Tabla III).

Respecto a la clasificación del índice de masa corporal (IMC), el porcentaje de estudiantes con bajo peso y obesidad apenas experimentó cambios. Los estudiantes con sobrepeso aumentaron un 3,4% y disminuyeron en porcentajes similares los estudiantes con normopeso. Por sexos, destaca el incremento en 11,5% de los hombres con sobrepeso ($p > 0,05$) que conllevaba

Tabla I
Características de los participantes iniciales y la muestra de seguimiento

	<i>Participantes iniciales. n=1170</i>	<i>Primer curso. n=452</i>
	<i>n (SD) IC 95%</i>	<i>n (SD) IC 95%</i>
Sexo % (n)		
Mujeres	64,1 (749)	67,3 (304)
Hombres	35,9 (421)	32,7 (148)
Talla (cm)		
Total	167,82 (9,97) (167,25-168,39)	167,8 (SD 8,8) (167,02-168,65)
Mujeres	163,4 (7,51) (162,86-163,94)	163,5 (SD 5,8) (162,81-164,14)
Hombres	175,77 (8,90) (174,91-176,63)	176,8 (SD 6,6) (175,71-177,88)
Peso (Kg)		
Total	63,99 (11,52) (63,32-64,65)	63,7 (SD 11,2) (62,62-64,69)
Mujeres	58,88 (8,65) (58,26 – 59,51)	58,5(SD 7,8) (57,57-59,34)
Hombres	73,14 (10,31) (72,14 – 74,14)	74,3 (SD 9,3) (72,82-75,85)
IMC (Kg/m²)		
Total	22,72 (4,53) (22,46-22,98)	22,0 (SD 2,8) (21,74-22,26)
Mujeres	22,10 (3,32) (21,86-22,34)	21,4 (SD 2,7) (21,08-21,69)
Hombres	23,84 (6,00) (23,26-24,42)	23,3 (SD 2,6) (22,84-23,69)

Tabla II				
Evolución de los valores antropométricos				
	1 ^{er} curso	3 ^{er} curso	Diferencia	P ^a
	n (SD)	n (SD)	Media (SD). IC 95%	
Talla en cm				
Total	167,8 (SD 8,8). (167,02-168,65)	168,1 (SD 8, 8). (167,25-168,87)	0,2 (SD 1,7). (0,06-0,38)	0,005
Mujeres	163,5 (SD 5,8). (162,81-164,14)	163,7 (SD 6,1). (163,02-164,39)	0,2 (SD 1,5). (-0,57-0,41)	NS*
Hombres	176,8 (SD 6,6). (175,71-177,88)	177,0 (SD 6,4). (175,97-178,05)	0,2 (SD 2,0). (-0,11-0,54)	NS
Peso en Kg				
Total	63,7 (SD 11,2). (62,62-64,69)	64,27 (11,91). (63,17-65,37)	0,60 (SD 3,9). (0,24-0,98)	0,001
Mujeres	58,5(SD 7,8). (57,57-59,34)	58,45 (SD 7,88). (57,56-59,34)	0 (SD 0,0078). (-0,39 -0,38)	NS
Hombres	74,3 (SD 9,3). (72,82-75,85)	76,21 (SD 9,67). (74,64-77,78)	1,9 (SD 4,6). (1,12-2,63)	0
IMC (Kg/m ²)				
Total	22,0 (SD 2,8). (21,74-22,26)	22,1 (SD 2,9). (21,84-22,38)	0,1 (SD 1,5). (-0,02-0,25)	NS
Mujeres	21,4 (SD 2,7). (21,08-21,69)	21,3 (2,6). (20,98-21,57)	0,1 (SD 3,8). (-0,26 -0,4)	NS
Hombres	23,3 (SD 2,6). (22,84-23,69)	23,8 (SD 2,7). (23,39-24,28)	0,5 (SD 1,6). (0,3-0,83)	0

*NS: no significativa.

^aPrueba t de Student para muestras apareadas.

Tabla III <i>Tendencia en la modificación del peso corporal por sexo</i>			
	<i>Hombres</i>	<i>Mujeres</i>	<i>Total</i>
	<i>% (n)</i>	<i>% (n)</i>	<i>% (n)</i>
Mantiene peso corporal	16,9% (25)	30,9% (94)	26,3% (119)
Disminución peso corporal	22,3% (33)	32,2% (98)	29,0% (131)
Aumento peso corporal	60,8% (90)	36,8 % (112)	44,7% (202)

una disminución significativa de 10,8% de los hombres con normopeso ($p<0,05$) (Tabla IV).

Se estudió la relación del aumento de peso con las variables sexo, actividad física y cambio de lugar de residencia mediante un análisis de regresión logística binaria. Todas las variables resultaron significativas para el explicar el aumento de peso ($p<0,05$). Los estudiantes varones tenían mayor probabilidad de aumento de peso, así como los estudiantes que no modificaron su lugar de residencia. Por otra parte, los estudiantes que mantuvieron o aumentaron su frecuencia de actividad física semanal, tenían menor probabilidad de aumento de peso (Tabla V).

Discusión

Este estudio es pionero en la determinación del cambio de peso en estudiantes universitarios de nuestro entorno, a pesar de que la modificación del peso a su paso por la universidad, especialmente durante el primer año, es un fenómeno bastante estudiado en EEUU y Canadá.

Se determinó el peso corporal y la talla en primer curso y se realizó una nueva medición a los dos años siguientes, en tercer curso. Los valores de talla, peso e IMC, fueron superiores en los hombres que en las mujeres, y las diferencias resultaron estadísticamente

Tabla IV
Modificaciones en la clasificación según el IMC

	<i>1^{er} curso</i>	<i>3^{er} curso</i>	<i>Diferencia</i>	<i>P^a</i>
	<i>n (SD)</i>	<i>n (SD)</i>	<i>Media (SD). IC 95%</i>	
<i>Bajo Peso</i>				
Total	7,3 (33)	8,4 (38)	1,1 (5)	NS*
Mujeres	10,2 (31)	11,8 (36)	1,6 (5)	NS
Hombres	1,4 (2)	1,4 (2)	0 (0)	NS
<i>Normopeso</i>				
Total	76,3 (345)	72,5 (329)	-3,80 (16)	0,04
Mujeres	78,3 (238)	77,8 (238)	-0,50 (0)	NS
Hombres	72,3 (107)	61,5 (91)	-10,80 (16)	0,01
<i>Sobrepeso</i>				
Total	14,3 (65)	17,7 (80)	3,4 (15)	NS
Mujeres	9,8 (30)	9,1 (28)	-0,70 (12)	NS
Hombres	23,7 (35)	35,2 (52)	11,5 (17)	NS
<i>Obesidad</i>				
Total	2 (9)	1,5 (7)	-0,50 (2)	NS
Mujeres	1,6 (5)	1,4 (4)	-0,20 (1)	NS
Hombres	2,7 (4)	2 (3)	-0,70 (1)	NS

*NS: no significativa.

^aPrueba de McNemar.

significativas en todos los casos. Situación que se convierte en una constante en otros estudios^{3,19-27-28}.

Coincidiendo con la literatura, se observó un incremento del peso medio. Una ganancia que resultó inferior a la experimentada en estudios que se prolongaron durante el primer año de universidad^{12,17-19,29} y bastante similar a la de estudios con mayor periodo de seguimiento^{15,16}. Esto corrobora cómo el aumento de peso experimentado en el primer año, continúa en los años siguientes, pero con una tendencia decreciente^{12,14,30}.

Tabla V
Variables relacionadas con el aumento de peso

<i>Grupo</i>	<i>N</i>	<i>(%)</i>	<i>OR</i>	<i>(IC 95%)</i>
<i>Sexo</i>				
Mujer	299	66,2	1	
Hombre	146	60,9	2,7	(1,7 - 4,1)
<i>Modifica lugar residencia</i>				
Si	106	29,2	1	
No	339	49,3	2,2	(1,4 - 3,7)
<i>Disminuye actividad física</i>				
Si	91	55,9	1	
No	354	50,7	0,6	(0,3 - 0,9)

La bibliografía revisada destaca que durante los 2, 3 y 4 años de universidad, se produce un aumento en el porcentaje de estudiantes con sobrepeso/obesidad y una disminución en los estudiantes con normopeso^{15,16,19}. En el estudio se incrementó un 3,4% el sobrepeso, disminuyó un 4% el normopeso y se mantuvo estable la obesidad. En los hombres, el aumento en el sobrepeso se elevó por encima del 10%, disminuyendo el normopeso como consecuencia. Esta situación concordaba con los resultados de la regresión logística donde los varones tenían mayor probabilidad de aumento de peso. Este mismo análisis volvía a confirmar la influencia de la actividad física en el mantenimiento del peso corporal y eran los estudiantes que mantenían o aumentaban la frecuencia de actividad física quienes mostraban menos probabilidad de aumento de peso.

Respecto al lugar de residencia, quienes no modificaban su residencia durante el estudio tenían mayor probabilidad de aumento de peso. Resultado interesante, porque entre el 24% del total de estudiantes que cambiaban de lugar de residencia, casi tres cuartas partes se trasladan a piso compartido y en su gran mayoría lo hacían desde residencia o colegio mayor. Se podía pensar que el hecho de vivir en un piso de estudiantes, donde los estudiantes son responsables de su alimentación y que ésta no fuese tan saludable. Aunque también es verdad que según otros estudios estadounidenses, vivir dentro del campus (residencias, colegios, etc) está asociado con

el aumento de peso corporal debido al fácil acceso y tipo de alimentación que se oferta^{17,31}. Sería interesante conocer el régimen o el patrón o pautas de alimentación de estas residencias o colegios mayores para ver si coinciden con el descrito en otros estudios. A su vez, entre quienes mantienen el lugar de residencia, un amplio porcentaje vive en casa de sus padres, por lo que cabría plantearse el tipo de alimentación de las familias, por ejemplo, o si a pesar de vivir con sus padres, comen en los centros universitarios, por ejemplo. Todo ello puede abrir futuras líneas de investigación.

En conclusión, en nuestro estudio se repite la tendencia al aumento de peso durante el periodo universitario. Con un valor inferior a otros estudios, pero que alcanza valores similares cuando se analiza únicamente en los estudiantes que aumentan de peso. Un aumento de peso que es mayor en los hombres, tanto por porcentaje de estudiantes como por cantidad de kilogramos ganados; siendo ellos quienes aumentan el porcentaje de sobrepeso/obesidad. Aspectos, todos ellos, en concordancia con estudios de EEUU, Canadá y europeos^{8,13,14,17,18}.

Era de imaginar que conociendo la presencia del estrés durante el periodo universitario y la emergencia en Europa de pautas de comportamiento con influencia en el aumento de peso (bajo consumo de frutas y verduras, la inactividad física y el incremento de consumo de alimentos ricos en grasas), la situación descrita fuese generalizable a este entorno^{23,32,33}. No obstante, el tratarse de un estudio pionero en este entorno, le confiere fortaleza al trabajo, y ayudará a tener una visión más real de la situación de los universitarios en Europa y más concretamente en España.

Entre las limitaciones del estudio puede estar la configuración de la muestra de forma voluntaria; no habiéndose controlado los motivos que han podido influir para que unos decidan participar y otros no. También se puede considerar como una limitación el tiempo necesario que el estudiante debía dedicar para aportar los datos, que estaba en torno a los 20 minutos (ya que los datos presentados en este artículo estaban incorporados en un cuestionario más amplio, con medición de parámetros antropométricos y clínicos).

La universidad parece no tener un papel significativo en cuanto a potenciar estilos de vida sanos y abandono de estilos nocivos para la salud³⁴, pero sería interesante por lo menos intentar evitar la adquisición de hábitos no saludables o el agravamiento de los estilos de vida nocivos adquiridos. Para ello, se siguen diseñando y desarrollando estrategias y planes, como la Red Española de Universidades Saludable, que incluye centros comprometidos con la promoción de la salud en el entorno universitario³⁵.

Referencias

- González Zapata LI, Alvarez-Dardet Díaz C, Clemente V, Davo MC, Ortiz Moncada MR. Criterios de valoración de po-

- líticas públicas para la obesidad en España según sus actores principales. *Gac Sanit* 2008; 22(4):309-320.
- Salas-Salvadó J, Rubio Herrera MA, Barbany M, Moreno B. Consenso SEEDO 2007 para la evaluación del sobrepeso y la obesidad y el establecimiento de criterios de intervención terapéutica. *Med Clin* 2007; 128(5): 184-196.
- Muros Molina JJ, Som Castillo A, López García de la Serrana H, Zabala Díaz M. Asociaciones entre el IMC, la realización de actividad física y la calidad de vida en adolescentes. *Cult Cienc Deporte* 2009; 4(12): 159-166.
- Arroyo Izaga M. Calidad de la dieta, sobrepeso y obesidad en estudiantes universitarios. *Nutr Hosp* 2006; 21(6): 673-679.
- Rodríguez Rodríguez EM, López Plaza B, López Sobaler AM, Ortega Anta RM. Prevalencia de sobrepeso y obesidad en adultos españoles. *Nutr Hosp* 2011; 26(2): 355-363.
- Rodríguez Guzmán LM, Rodríguez García R. Percepción de la imagen corporal, índice de masa corporal y sobrepeso en estudiantes universitarios del Sureste. *Rev Mex Pediatr* 2001; 68(4): 135-138.
- Anderson D, Shapiro JR, Lundgren JD. The freshman year of college as a critical period for weight gain: an initial evaluation. *Eat Behav* 2003; 4(4): 363-367.
- Pliner P, Saunders T. Vulnerability to freshman weight gain as a function of dietary restraint and residence. *Physiol Behav* 2008; 93(1-2): 76-82.
- Lowe MR, Annunziato RA, Markowitz JT, Didie E, Bellace DL, Riddell L, et al. Multiple types of dieting prospectively predict weight gain during the freshman year of college. *Appetite* 2006; 47(1): 83-90.
- Delinsky SS, Wilson GT. Weight gain, dietary restraint, and disordered eating in the freshman year of college. *Eat Behav* 2008; 9(1): 82-90.
- Dennis EA, Potter KL, Estabrooks PA, Davy BM. Weight Gain Prevention for College Freshmen: Comparing Two Social Cognitive Theory-Based Interventions with and without Explicit Self-Regulation Training. *J Obes* [revista electrónica] 2012; 2012:803769 [consultado 03-03-2014]; Disponible en <http://www.hindawi.com/journals/job/2012/803769/>.
- Lloyd-Richardson E, Bailey S, Fava JL, Wing R, Tobacco Etiology Research Network (TERN). A prospective study of weight gain during the college freshman and sophomore years. *Prev Med* 2009; 48(3): 256-261.
- Crombie AP, Ilich JZ, Dutton GR, Panton LB, Abood DA. The freshman weight gain phenomenon revisited. *Nutr Rev* 2009 Feb; 67(2): 83-94.
- Hajhosseini L, Holmes T, Mohamadi P, Goudarzi V, McProud L, Hollenbeck CB. Changes in body weight, body composition and resting metabolic rate (RMR) in first-year university freshmen students. *J Am Coll Nutr* 2006; 25(2): 123-127.
- Gropper S, Simmons K, Connell L, Ulrich P. Weight and Body Composition Changes during the First Three Years of College. *J Obes* [revista electrónica] 2012; 2012: 634048 [consultado 25-09-2014]; Disponible en <http://www.hindawi.com/journals/job/2012/634048/>.
- Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Changes in weight and health behaviors from freshman through senior year of college. *J Nutr Educ Behav* 2008; 40(1): 39-42.
- Deliens T, Clarys P, Van Hecke L, De Bourdeaudhuij I, Deforche B. Changes in weight and body composition during the first semester at university. A prospective explanatory study. *Appetite* 2013; 65: 111-116.
- Serlachius A, Hamer M, Wardle J. Stress and weight change in university students in the United Kingdom. *Physiol Behav* 2007; 92(4): 548-553.
- Gropper SS, Simmons KP, Connell LJ, Ulrich PV. Changes in body weight, composition, and shape: a 4-year study of college students. *Appl Physiol Nutr Metab* 2012; 37(6): 1118-1123.
- Lameiras Fernández M, Calado Otero M, Rodríguez Castro Y, Fernández Prieto M. Hábitos alimentarios e imagen corporal en estudiantes universitarios sin trastornos alimentarios. *Rev Int Psicol Clin Salud* 2003; 3(1): 23-33.

21. Lim L, Seubsman S, Sleight A. Validity of self-reported weight, height, and body mass index among university students in Thailand: Implications for population studies of obesity in developing countries. *Popul Health Metr* 2009; 7: 15-22.
22. Morán Álvarez IC, Cruz Licea V, Iñárritu Pérez, M^a del Carmen. El índice de masa corporal y la imagen corporal percibida como indicadores del estado nutricional en universitarios. *Rev Fac Med UNAM* 2007; 5(2): 76-79.
23. Racette SB, Deusinger SS, Strube MJ, Highstein GR, Deusinger RH. Weight changes, exercise, and dietary patterns during freshman and sophomore years of college. *J Am Coll Health* 2005; 53(6): 245-251.
24. Ramos Valverde P, Rivera de los Santos F, Moreno Rodríguez C. Diferencias de sexo en imagen corporal, control de peso e Índice de Masa Corporal de los adolescentes españoles. *Psicothema* 2010; 22(1): 77-83.
25. Reig Ferrer A, Cabrero García J, Ferrer Cascales R, Richart Martínez M. La calidad de vida y el estado de salud de los estudiantes universitarios. Biblioteca Virtual Universal 2003.
26. Riba Sicart MM, Martínez Escribano N, Zarion Traité M, Rodríguez P, Friedman S, Portela ML, et al. Estudio de la percepción del peso corporal en tres grupos de estudiantes universitarios de Argentina y España. *DIAETA (Bs. As)* 2008; 26(14): 7-14.
27. Yahia N, Achkar A, Abdallah A, Rizk S. Eating habits and obesity among Lebanese university students. *Nutr J* 2008; 7: 7-32.
28. Zarrazquin I, Torres-Unda J, Ruiz F, Irazusta J, Kortajarena M, Hoyos I et al. Longitudinal study: lifestyle and cardiovascular health in health science students. *Nutr hosp* 2014; 30(5):1144-1151.
29. Gropper SS, Newton A, Harrington P, Simmons KP, Connell LJ, Ulrich P. Body composition changes during the first two years of university. *Prev Med* 2011; 52(1): 20-22.
30. Hoffman DJ, Policastro P, Quick V, Lee SK. Changes in body weight and fat mass of men and women in the first year of college: A study of the "freshman 15". *J Am Coll Health* 2006; 55(1): 41-45.
31. Hull H, Morrow M, Dinger M, Han J, Fields D. Characterization of body weight and composition changes during the sophomore year of college. *BMCI Women's Health* [revista electrónica] 2007;7: 1 [consultado 05-03-2014]: Disponible <http://www.biomedcentral.com/1472-6874/7/21>.
32. Steptoe A, Wardle J, Cui W, Bellisle F, Zotti A-, Baranyai R, et al. Trends in smoking, diet, physical exercise, and attitudes toward health in European university students from 13 countries. *Prev Med* 2002; 35(2): 97-104.
33. Levitsky D, Halbmaier C, Mrdjenovic G. The freshman weight gain: a model for the study of the epidemic of obesity. *Int J Obes* 2004; 28(11): 1435-1442.
34. Martínez Pastor A, Balanza Galindo S, Leal Hernández M, Martínez Navarro A, Conesa C, Abellán Alemán J. Relación entre el consumo de tabaco y alcohol y el ejercicio físico con el paso por la universidad. *Aten Prim (Barc)* 2009; 41(10): 558-563.
35. Ministerio de Sanidad, Servicios Sociales e Igualdad. Red Española de Universidades Saludables. Ministerio de Sanidad, Servicios Sociales e Igualdad. Madrid, 2013. [consultado 01-06-2014]: Disponible en <http://www.msssi.gob.es/profesionales/saludPublica/prevPromocion/promocion/UniversidadesSaludables/docs/AnexoI.pdf>.



Original/*Obesidad*

Association between serum uric acid levels and obesity among university students (China)

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Abstract

Objective: to evaluate the association between serum uric acid and obesity among university students who participated in routine health screening in 2013.

Methods: in this cross-sectional study, 3529 subjects were analyzed. Obesity categories were classified by BMI levels references in China. And serum uric acid levels were classified by serum uric acid quartiles. Two-sample T-test and Wilcoxon Rank sum test were used to compare age, biochemical and anthropometric parameters of subjects of two genders. Rank correlation used to analyze relationship between serum uric acid and obesity.

Results: there were 1285 males (mean age, 19.8 ± 1.3 years) and 2244 females (mean age, 19.9 ± 1.3 years) in this study. Association between 2nd serum uric acid quartile and normal in male are significant and coefficient was 0.519. The 3rd serum uric acid quartile and normal in female was associated significantly ($r = 0.173$, $p = 0.010$). And associations between overweight and 3rd and 4th serum uric acid quartiles in female were significant ($r = 0.128$, $p = 0.038$ in 1st quartile and $r = 0.282$, $p = 0.004$ in 4th quartile). The 4th serum uric acid quartile and Obesity in two gender groups were significantly associated ($r = 0.291$, $p = 0.000$ in male and $r = 0.484$, $p = 0.001$ in female).

Conclusion: high serum uric acid was positively associated with obesity in overweight and obesity group. However, the association was weak between two variables because serum uric acid influenced obesity with other related factors together.

(Nutr Hosp. 2015;31:2407-2411)

DOI:10.3305/nh.2015.31.6.8734

Key words: Serum uric acid. Obesity. Association. University students.

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Recibido: 28-I-2015.

Aceptado: 3-III-2015.

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ASOCIACIÓN ENTRE LA CONCENTRACIÓN DE ÁCIDO ÚRICO EN SUERO Y LA OBESIDAD ENTRE LOS ESTUDIANTES UNIVERSITARIOS (CHINA)

Resumen

Objetivo: evaluar la asociación entre el ácido úrico en suero y la obesidad entre los estudiantes universitarios que participaron en los exámenes de salud de rutina en 2013.

Métodos: en este estudio transversal, 3.529 sujetos fueron analizados. La obesidad categorías fueron clasificados por el IMC niveles referencias en China. Y los niveles de ácido úrico en suero fueron clasificados por el ácido úrico en suero cuartiles. Dos Sample T - test y Wilcoxon Rank sum test se utiliza para comparar los parámetros antropométricos, bioquímicos y de los sujetos de ambos sexos. Rango correlación utilizado para analizar la relación entre el ácido úrico en suero y la obesidad.

Resultado: hay 1.285 hombres (edad media, $19,8 \pm 1,3$ años) y 2.244 mujeres (edad media, $19,9 \pm 1,3$ años) en este estudio. Asociación entre el segundo cuartil de ácido úrico en suero y normal en el macho son significativos y se 0,519 coeficiente. El tercer cuartil de ácido úrico en suero y normal en mujeres se asoció significativamente ($R = 0,173$, $p = 0,010$). Y asociaciones entre sobrepeso y 3º y 4º de ácido úrico sérico cuartiles en mujeres fueron significativa ($R = 0,128$, $p = 0,038$ en 1º cuartil y $R = 0,317$, $p = 0,004$ en cuarto cuartil). El cuarto cuartil de ácido úrico en suero y la obesidad en dos grupos de género fueron asociados significativamente ($R = 0,286$, $p = 0,000$ en macho y $R = 0,484$, $p = 0,001$ en mujeres).

Conclusión: alta de ácido úrico en suero fue asociado positivamente con la obesidad en el sobrepeso y la obesidad. Sin embargo, la asociación entre dos variables es débil porque el ácido úrico en suero influenciado la obesidad con otros factores conexos.

(Nutr Hosp. 2015;31:2407-2411)

DOI:10.3305/nh.2015.31.6.8734

Palabras clave: Ácido úrico en suero. Obesidad. Asociación. Estudiantes universitarios.

Introduction

The global public has paid close attention to the prevalence of obesity¹. Obesity was been studied that associated to many chronic diseases, for example, breast cancer², COPD³, depressive disorder⁴ and so on. In United States, the country has put in large invest to prevent youth obesity by promoting health eating and physical activity.

Serum uric acid is an end product which is produced by endogenous metabolism and exogenous urine in human beings⁵. In various populations, serum uric acid level was strongly linked to vary kinds of MS⁶⁻⁸. An independent risk factor for female abdominal obesity and MS is the elevated level of serum uric acid⁹. According to a epidemiological study on MS, serum uric acid were significantly related to several indices, such as body mass index (BMI)¹⁰, waist circumference¹¹, and dyslipidemia¹². However, there is still lack of study on association between obesity and serum uric acid among university students.

The aim of this study was to evaluate the overall of serum uric acid level and the association between serum uric acid and obesity.

Methods

Subjects and Methods

Participants

This cross-sectional study was based on school and conducted in a university student. Those students admitted routine health screening in 2013. And there were a total of 3529 subjects in this study, aged 16-26 year old. All subjects agreed to provide their personal information regarding the purpose and the procedures of our study, and written informed consent. This study was approved by local ethics committee.

Anthropometric measurements

Height was measured with a standard stadiometer following study protocols, and weight was measured in light clothing on an electronic scales. And body mass index (BMI) was calculated by dividing the weight (kg) by the height (m) squared. Staff trained for the survey measured anthropometry and supervised by school nurses. Serum uric acid was measured by the urinate method.

Definitions

The levels of BMI defined obesity categories which based on obesity references in China. The BMI cut-off

points are under 18.5 for underweight and 24 and 28 for overweight and obesity, respectively. And serum uric acid was defined on serum uric acid quartiles.

Data management

We performed R software to analyses data. Separate statistical analyses were performed for different gender, serum uric acid levels and obesity category groups. Two-sample t-test and wilcoxon rank sum test were used to compare age, biochemical and anthropometric parameters of subjects of both genders. Two line graphs were drawn for the prevalence of obesity categories and serum uric acid levels among university students by gender. Spearman rank correlation coefficients were used to evaluate the association between serum uric acid levels and obesity. Statistical significance was set at a probability level of 0.05.

Results

The serum uric acid and anthropometric measurements of the 3529 subjects for the two gender groups are shown in Table I, which include 1285 male (mean age, 19.8±1.3 years) and 2244 female (mean age, 19.9±1.3 years).

The data showed that male had higher serum uric acid level and BMI than that of female. And there were significant differences in serum uric acid, height, weight and BMI between two gender groups.

In Table II, subjects were categorized according to serum uric acid quartiles. Table II showed age, anthropometric measurements, serum uric acid and BMI for four serum uric acid quartiles groups. The serum uric acid quartile groups showed significant differences in gender, serum uric acid and anthropometric measurements.

Figure 1 shows the mean serum uric acid level according to serum uric acid quartiles by gender groups was showed. And mean serum uric acid level of male was higher than that of female in different groups.

Table I
Mean (±SD) of age, serum uric acid, height, weight and BMI of university students by gender

	Male	Female	P
Number	1285 (36.4%)	2244 (63.6%)	
Age (years)	19.8±1.3	19.9±1.3	0.700
UA (μmol/L)	375.6±79.7	286.1±58.8	0.000
Weight (kg)	64.4±11.6	52.1±7.1	0.000
Height (cm)	171.5±6.9	159.3±6.1	0.000
BMI (kg/m ²)	29.8±5.3	24.1±3.3	0.000

Table II
Subjects categorized in differences serum uric acid quartiles

	UA				c^2	p
	27.7-263	263-308.3	308.3-364.7	364.7-996.2		
Number	881	880	885	883		
Gender (male /female)	78/803	115/725	380/505	672/211	1040.092	0.000
Age (years)	19.9±1.4	19.9±1.2	19.8±1.4	19.9±1.3	3.412	0.332
UA ($\mu\text{mol/L}$)	228.9±29.7	285.8±13.0	334.5±16.2	425.2±58.5	3307.499	0.000
Height (cm)	160.4±7.4	161.2±7.8	164.4±8.3	169.0±8.3	610.072	0.000
Weight (kg)	51.4±7.1	53.3±8.0	56.7±9.1	64.8±12.7	776.141	0.000
BMI (kg/m^2)	23.8±3.3	24.8±3.7	26.2±4.2	30.1±5.8	781.164	0.000

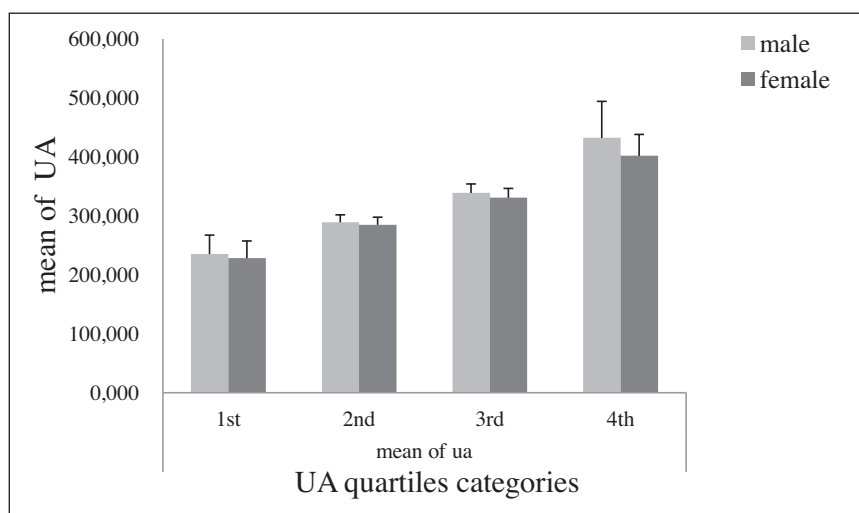


Fig. 1.—Mean of serum uric acid according to serum uric acid quartiles by gender.

Prevalence of serum uric acid according to obesity groups was shown in Table III. Majority of subjects in underweight and normal group had lower serum uric acid level (80% in underweight group, 38.3% in

normal group). However, in overweight and obesity group, most of subjects were in 2nd serum uric acid quartile group. And there was a trend finding in table 3 that with serum uric acid level growing, subjects was

Table III
The prevalence of serum uric acid for university students according body type

	Prevalence (%)				total	*	p
	underweight	normal	overweight	obesity			
Number	20	1251	1284	974	3529		
M UA(27.7-263 $\mu\text{mol/L}$)	0(0.0)	11(0.9)	35(2.7)	32(3.3)	78(2.2)	59.513	0.000
UA(263-308.3 $\mu\text{mol/L}$)	0(0.0)	25(2.0)	60(4.7)	70(7.2)	155(4.4)		
UA(308.3-364.7 $\mu\text{mol/L}$)	0(0.0)	51(4.1)	146(11.4)	183(18.8)	380(10.8)		
UA(364.7-996.2 $\mu\text{mol/L}$)	0(0.0)	36(2.9)	172(13.4)	464(47.6)	672(19.0)		
F UA (27.7-263 $\mu\text{mol/L}$)	16(80)	479(38.3)	260(20.2)	48(4.9)	803(22.8)	101.421	0.000
UA (263-308.3 $\mu\text{mol/L}$)	1(5)	367(29.3)	290(22.6)	67(6.9)	725(20.5)		
UA(308.3-364.7 $\mu\text{mol/L}$)	1(5)	222(17.7)	216(16.8)	66(6.8)	505(14.3)		
UA(364.7-996.2 $\mu\text{mol/L}$)	2(10)	60(4.8)	105(8.2)	44(4.5)	211(6.0)		

*Linear-by-linear Association by gender.

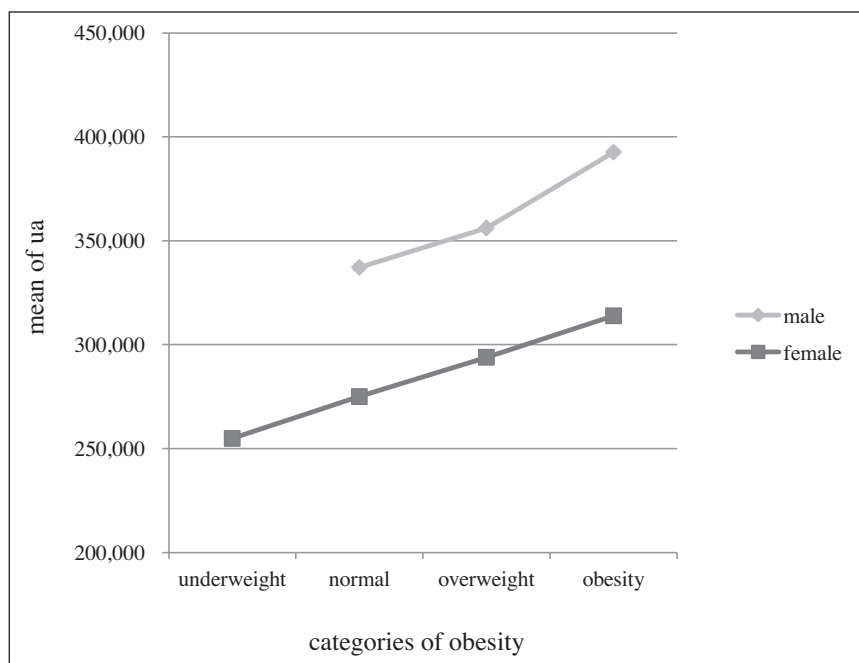


Fig. 2.—The changing trend of serum uric acid with different categories of obesity.

descending in each obesity group. But for underweight group, it might attribute to fewer subjects in this group. And serum acid uric was changing with obesity according to trend test.

Figure 2 was shown how serum uric acid in two gender groups changed with different obesity group. Serum uric acid was growing in both male and female according to different obesity groups. Serum uric acid was rising faster from overweight to obesity especially in male.

In figure 3, the trend of BMI with serum uric acid quartiles was shown. Mean of BMI was increasing with serum uric acid level in female but mild increasing trend in male group.

Discussion

Studies were well established and brought contributions to relationship between serum uric acid and MS

in different population^{13, 14}, however, this is the first study focused on serum uric acid and obesity. In present study, we explored the prevalence of serum uric acid and the potential associations with obesity.

In this study, a positive significant association between serum uric acid and obesity has been found, especially in high serum uric acid level in overweight and obesity group. Similar result could be found in different studies^{13, 15, 16}. And the association was stronger in females than males in both overweight and obesity group, which was consistent with findings in different populations such as people from Bangkok Thailand¹⁷, middle age Chinese^{9, 14} etc.

A previous study documented that males had higher serum uric acid level than females¹⁸ and the same result had been found in our study. According to this study, serum uric acid had liner correlation with obesity, and with BMI growing, serum uric acid level was elevating. As a result, increased serum uric acid may

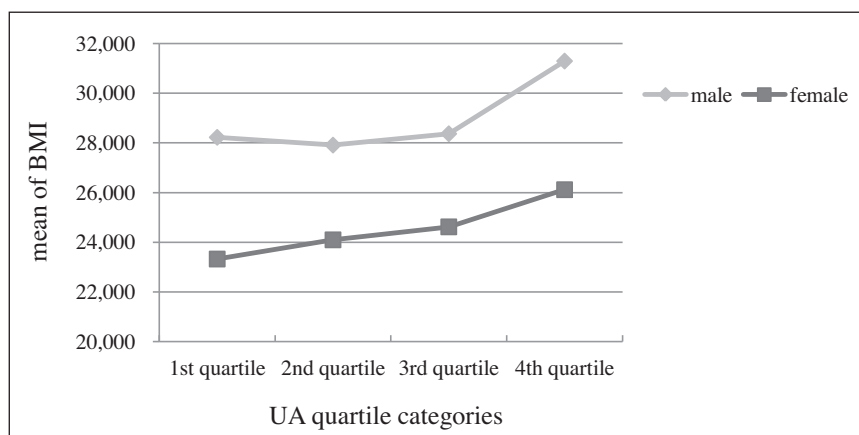


Fig. 3.—The changing trend of BMI with different serum uric acid quartile categories.

as an indicator of obesity, but in a obesity population from American demonstrated that serum uric acid influenced obesity but not independently impacted obesity¹⁹. And a cohort study from UK pointed out that a causal role was not been found whilst BMI and obesity¹⁶. Thus it is still uncertain whether serum uric acid can be an indicator of obesity.

Majority studies explored the relationship between serum uric acid and obesity combining various MS components together^{20, 21}. And in these studies, serum uric acid do had significant associations with BMI (obesity). In other words, serum uric acid associated with obesity based on the interaction of all related factors.

In conclusion, serum uric acid was strongly associated with obesity and further study should be established to explore deep relationship between serum uric acid and obesity by adding in more obesity related factors.

Conclusions

Serum uric acid maybe associated with obesity. However, the association also need research in future after adjust for confound factor.

Acknowledgment

This research was supported by the National Natural Science Foundation of China (81072367), the Anhui Provincial Natural Science Foundation (090413126 and 1308085MH135), and Wannan Medical key scientific research projects Engagement Fund (WK2013Z01)

Conflict of Interest

None declared.

References

- Wang, Y. and T. Lobstein, Worldwide trends in childhood overweight and obesity. *Int J Pediatr Obes*, 2006. 1(1): 11-25.
- Petekkaya, I., U. Sahin, G. Gezen, M. Solak, D. Yuce, O. Dizdar, et al., Association of breast cancer subtypes and body mass index. *Tumori*, 2013. 99(2): 129-33.
- Zhou, Y., D. Wang, S. Liu, J. Lu, J. Zheng, N. Zhong, et al., The association between BMI and COPD: the results of two population-based studies in Guangzhou, China. *COPD*, 2013. 10(5): 567-72.
- Opel, N., R. Redlich, D. Grotegerd, K. Dohm, W. Heindel, H. Kugel, et al., Obesity and major depression: Body-mass index (BMI) is associated with a severe course of disease and specific neurostructural alterations. *Psychoneuroendocrinology*, 2015. 51(0): 219-26.
- Choi, H.K., D.B. Mount, A.M. Reginato, P. American College of and S. American Physiological, Pathogenesis of gout. *Ann Intern Med*, 2005. 143(7): 499-516.
- You, L., A. Liu, G. Wuyun, H. Wu and P. Wang, Prevalence of hyperuricemia and the relationship between serum uric acid and metabolic syndrome in the Asian Mongolian area. *J Atheroscler Thromb*, 2014. 21(4): 355-65.
- Nagahama, K., T. Inoue, K. Kohagura, K. Kinjo and Y. Ohya, Associations between serum uric acid levels and the incidence of hypertension and metabolic syndrome: a 4-year follow-up study of a large screened cohort in Okinawa, Japan. *Hypertens Res*, 2014.
- Liu, P.J., F. Ma, H.P. Lou, Y.N. Zhu and Y. Chen, Relationship between serum uric acid levels and metabolic syndrome in Chinese postmenopausal women. *Climacteric*, 2014. 17(2): 148-54.
- Yin, X., J. Zhou, D. Yu, Q. Pan, X. Dong, F. Zheng, et al., [The correlation between serum uric acid level and abdominal obesity or metabolic syndrome]. *Zhonghua Nei Ke Za Zhi*, 2014. 53(1): 13-8.
- Kuriyama, S., T. Nakano, Y. Maruyama, N. Sugano, K. Takane, Y. Suetsugu, et al., [Relationship between serum uric acid levels and muscle strength/volume: a new insight from a large-scale survey]. *Nihon Jinzo Gakkai Shi*, 2014. 56(8): 1260-9.
- Qin, L., Z. Yang, H. Gu, S. Lu, Q. Shi, Y. Xing, et al., Association between serum uric acid levels and cardiovascular disease in middle-aged and elderly Chinese individuals. *BMC Cardiovasc Disord*, 2014. 14: 26.
- Rho, Y.H., J.H. Woo, S.J. Choi, Y.H. Lee, J.D. Ji and G.G. Song, Association between serum uric acid and the Adult Treatment Panel III-defined metabolic syndrome: results from a single hospital database. *Metabolism*, 2008. 57(1): 71-6.
- Chiou, W.K., D.H. Huang, M.H. Wang, Y.J. Lee and J.D. Lin, Significance and association of serum uric acid (UA) levels with components of metabolic syndrome (MS) in the elderly. *Arch Gerontol Geriatr*, 2012. 55(3): 724-8.
- Dai, X., J. Yuan, P. Yao, B. Yang, L. Gui, X. Zhang, et al., Association between serum uric acid and the metabolic syndrome among a middle- and old-age Chinese population. *Eur J Epidemiol*, 2013. 28(8): 669-76.
- Liu, M., Y. He, B. Jiang, L. Wu, S. Yang, Y. Wang, et al., Association between Serum Uric Acid Level and Metabolic Syndrome and Its Sex Difference in a Chinese Community Elderly Population. *Int J Endocrinol*, 2014. 2014: 754678.
- Palmer, T.M., B.G. Nordestgaard, M. Benn, A. Tybjaerg-Hansen, G. Davey Smith, D.A. Lawlor, et al., Association of plasma uric acid with ischaemic heart disease and blood pressure: mendelian randomisation analysis of two large cohorts. *BMJ*, 2013. 347: f4262.
- Jaipakdee, J., W. Jiamjarasrangsi, V. Lohsoonthorn and S. Lertmaharit, Prevalence of metabolic syndrome and its association with serum uric acid levels in Bangkok Thailand. *Southeast Asian J Trop Med Public Health*, 2013. 44(3): 512-22.
- Bindler, R.C., K.B. Daratha, R.J. Bindler and R. Short, Serum uric acid: relationships with biomarkers in adolescents and changes over 1 year. *J Pediatr Endocrinol Metab*, 2014. 27(5-6): 467-73.
- Ferrara, L.A., H. Wang, J.G. Umans, N. Franceschini, S. Jolly, E.T. Lee, et al., Serum uric acid does not predict incident metabolic syndrome in a population with high prevalence of obesity. *Nutr Metab Cardiovasc Dis*, 2014. 24(12): 1360-4.
- Ciarla, S., M. Struglia, P. Giorgini, R. Striuli, S. Necozone, G. Properzi, et al., Serum uric acid levels and metabolic syndrome. *Arch Physiol Biochem*, 2014. 120(3): 119-22.
- De Oliveira, A., H.H. Miranda Hermsdorff, P. Guedes Cocate, J. Bressan, A. Azevedo Novello, E. Cardoso dos Santos, et al., The impact of serum uric Acid on the diagnostic of metabolic syndrome in apparently healthy brazilian middle-aged men. *Nutr Hosp*, 2014. 30(3): 562-9.



Original/*Obesidad*

Iron status and dietary intakes of iron in normal-weight and obese young Mexican women

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Abstract

Introduction: obesity is reported to be a predictor of iron deficiency. In Mexico, 45.5 % of women older than 20 years have obesity, and the prevalence of anemia is 10.2 % in women 20 to 29 years.

Objective: to investigate the relation between body mass index (BMI), percentage of body fat (% BF), dietary intakes and iron status of healthy normal-weight and obese young women.

Methods: a total of 86 women [normal-weight ($n = 46$) and obese ($n = 40$)] completed the study. Intakes were evaluated by an 8-day food-record. Anthropometrics and blood collection (hemoglobin, hematocrit, ferritin and transferrin) were done on the luteal phase of menstrual cycle; menstrual characteristics were also reported. Iron status was determined according to stages of iron depletion. T-test and Mann-Whitney U test were used to compare groups' variables. Pearson correlation was used to determine relationships between variables. An odds ratio (OR) analysis was used to measure the association of BMI, % BF and dietary intakes with iron status.

Results: biomarkers of iron were similar between groups. There was a positive correlation between % BF and ferritin ($r = 0.222$; $p = 0.032$). Similar intakes and menstrual periods may be the reason of similar iron status. BMI, % BF or dietary intakes were not independent contributors to stages of iron depletion.

Conclusion: guidance on dietary intakes is suggested for this population to avoid future iron deficiency complications.

(Nutr Hosp. 2015;31:2412-2418)

DOI:10.3305/nh.2015.31.6.8687

Key words: *Obesity. Body fat. Iron status. Dietary intake. Women.*

RESERVAS DE HIERRO E INGESTA DIETÉTICA DE HIERRO EN MUJERES JÓVENES MEXICANAS CON NORMOPESO Y OBESIDAD

Resumen

Introducción: la obesidad se ha reportado como predictor de la deficiencia de hierro. En México, el 45,5% de las mujeres mayores de 20 años tienen obesidad, y la prevalencia de anemia es de 10,2% en mujeres de 20 a 29 años.

Objetivo: investigar la relación entre índice de masa corporal (IMC), porcentaje de grasa (%GC), ingesta dietética y reservas de hierro en mujeres jóvenes sanas con normopeso y obesidad.

Métodos: ochenta y seis mujeres [normopeso ($n = 46$) y obesidad ($n = 40$)] completaron el estudio. La ingesta fue evaluada por un diario de registro de 8 días. La antropometría y obtención de sangre (hemoglobina, hematocrito, ferritina y transferrina) se consiguieron en la fase lútea del ciclo menstrual; se reportaron las características de la menstruación. Las reservas de hierro se determinaron según etapas de depleción. Pruebas de T y Mann-Whitney U se usaron para comparar variables entre grupos. La correlación de Pearson se usó para determinar relaciones entre variables. La razón de momios se utilizó para medir la asociación de IMC, %GC e ingesta dietética con las reservas de hierro.

Resultados: los marcadores de hierro fueron similares entre grupos. Se encontró una relación positiva entre %GC y ferritina ($r = 0.222$; $p = 0.032$). La similitud en ingesta y periodos menstruales puede ser la razón de que existan reservas de hierro similares. El IMC, %GC e ingesta dietética no contribuyeron independientemente a las etapas de depleción de hierro.

Conclusión: se sugiere guía dietética para esta población con el fin de evitar complicaciones por deficiencia de hierro.

(Nutr Hosp. 2015;31:2412-2418)

DOI:10.3305/nh.2015.31.6.8687

Palabras clave: *Obesidad. Grasa corporal. Reservas de hierro. Ingesta dietética. Mujeres.*

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Recibido: 20-I-2015.
1.ª Revisión: 2-III-2015.
Aceptado: 9-III-2015.

Introduction

Obesity and iron deficiency have become frequent conditions that are reported to be linked to each other^{1,2}. It has been suggested a multifactorial etiology including inadequate bioavailable iron relative to body weight and diminished iron absorption found in subjects with excess of adiposity². In Western societies, these conditions are prevalent among young and adult population. In Mexico, 45.5 % of women older than 20 years have obesity, and the prevalence of anemia is 10.2 % in women 20 to 29 years³. Women are at high risk of iron deficiency mainly due to menstruation losses and having a diet with low iron bioavailability⁴ or unbalanced and inadequate micronutrient intake⁵. Effects of iron deficiency could be detrimental, for example anemia during pregnancy and lactation^{6,7} or health concerns such as memory disorders⁸. There is a study that examined the relation between iron status and BMI in Mexican women, which reported obesity as a predictor of low iron status⁹; however, data utilized was from years 1998 and 1999. Besides this, other authors had studied similar conditions and their association in women of childbearing age; however, the ranges of age analyzed had been too wide from 13 to 51 years⁸⁻¹¹. Therefore, the aim of this study was to investigate the relation between BMI, % BF and dietary intake of iron and iron status of normal-weight and obese Mexican women aged 18 to 30 years. We hypothesized that in young women, a higher BMI and % BF would relate to a low iron status.

Methods

Subjects and design

This was a prospective case-control study involving healthy young women that aimed to investigate the relation between BMI, % BF and dietary intake of iron and iron status. All participants recruited were undergraduate students living in the northeast of Mexico. Women with irregular menstrual cycles, pregnant or lactating, presenting hemorrhage, blood donors, or those who had taken iron supplements or drugs likely to modify iron status were not enrolled. Eligible participants were women 18 to 30 years of age, BMI 18.50-24.99 and ≥ 30.00 , with regular menstrual cycles (having one menstrual cycle per month).

A total of 118 women informed consent; 10 women withdrew, 10 were taking supplements, 5 were BMI < 18.5, 6 had irregular menstrual cycles, and 1 was pregnant, thus the final analysis included $n = 86$, who completed their participation after two sessions; (1) recruitment and eligibility procedures and (2) anthropometric and blood collection, at the Nutritional Biochemistry Laboratory of the Center of Research in Nutrition and Public Health (CINSP, for its Spanish abbreviation) in

the School of Public Health and Nutrition (FaSPyN, for its Spanish abbreviation), University Autonomous of Nuevo Leon (UANL).

Subjects information was collected during the first session, including age, school's name, city of origin and smoking habits. A criterion questionnaire was applied to confirm the eligibility to participate. Once approving the eligibility, a second session was scheduled on day 20, considering day 1 as the first day of menstruation.

All procedures were reviewed and approved in 2012 by the Committee for Ethical Review of Research of FaSPyN, UANL. All subjects provided written informed consent before participating in this study.

Anthropometric data

Anthropometric measurements and blood collection were conducted in the second session after a 12-hour fast, from 7:30 to 9:00 a.m., to prevent from diurnal variations of iron indicators¹²; This session was scheduled based on the menstrual cycle of each subject, on the late luteal phase (day 20), considering day 1 as the first day of menstruation, this in order to prevent from variations in iron status during the menstrual cycle¹³. If day 20 was a weekend day, days 18 to 22 were also appropriate.

Body weight and % BF were measured by a body composition monitor BC-545 (Tanita Corporation of America, Inc., USA). Height was measured with a stadiometer Seca 213 (Seca, USA). BMI was calculated as kg/m^2 . Subjects were grouped into normal or obese according to the World Health Organization (WHO) database of BMI¹⁴. Ranges of body fat for women aged 18 to 30 were considered as: 17.0 – 32.9 %, 33.0 – 38.9 % and ≥ 39.0 %, adapted from the Body Fat Ranges for Standard Adults and Children (Tanita Corporation of America, Inc.) and Gallagher et al. (2000)¹⁵⁻¹⁶.

Dietary intakes

The dietary intake was evaluated by an 8-day food-record, in order to obtain a reliable iron intake¹⁷. The subjects were given instructions on how to record all foods and drinks they consumed during each day, the preparation method, and the portion sizes; especially on the recording of the different foods used in mixed dishes. Day one was set as the first day of the menstrual cycle for all participants to prevent variances of eating patterns¹⁸. The subjects were also instructed to continue their regular diet during the study protocol. A food record booklet was given to all subjects, who were telephoned twice during the recording timeframe to follow-up. After completion, the booklet was brought to the Laboratory and revised by trained interviewers. Intakes of energy, total iron, heme and non heme iron, and vitamin C were analyzed using the

Food Processor[®] (version 10.12.0, ESHA Research, Salem, Oregon, USA), updated by adding specific Mexican food products consumed by the participants. Intakes were compared to recommendations of intake for the Mexican population^{19,20}.

Menstrual characteristics and iron status

The age at menarche, duration of menstrual period (days) and the length of the menstrual cycle (days) was reported by subjects. Blood samples were drawn from an antecubital vein immediately after the anthropometric measurements (late luteal phase). Hemoglobin was determined in blood by the portable photometer HemoCue (Ängelholm, Sweden). Hematocrit was measured in blood by centrifugation at 10,000 rpm during 6 minutes in the AutoCrit Ultra 3 (BioSurplus, USA). Ferritin was determined in serum by spectrophotometry at 540 nm in the Evolution 300 UV (Thermo Scientific, USA). Transferrin was determined in serum at 540nm in the A25 Autoanalyser (BioSystems, Spain).

Iron status was determined according to the stages of iron depletion, defined as: (1) iron storage depletion (ISD), (2) iron deficient erythropoiesis (IDE), and (3) iron deficiency anemia (IDA). ISD was defined as normal hemoglobin (12-16 g/dL), hematocrit (37-47 %), serum transferrin (200-360 mg/dL) and low serum ferritin (< 12 µg/L). IDE was defined as normal hemoglobin and hematocrit and high serum transferrin (> 360 mg/dL). IDA was defined as low hemoglobin (< 12 g/dL), hematocrit (< 37 %) and high serum transferrin (> 360 mg/dL)²¹⁻²³.

Statistical analyses

To test normality assumptions, the data were evaluated by Shapiro-Wilk, and Kolmogorov-Smirnov tests, indicating normality for all variables, except for dietary intakes. The continuous variables are shown as frequency, percentage or means $\pm$ standard deviation (SD); dietary intakes are shown as median, and 25th and 75th percentiles. An independent T-test was used to show differences on normal variables between normal and obese groups; and a Mann-Whitney U test to determine differences between groups on nonnormal variables. Nonnormal variables were transformed to normality for further statistical analysis. One-tailed Pearson correlation was used to determine relationships between BMI, % BF and dietary intakes and biomarkers of iron status. An odds ratio (OR) analysis was used to measure the association of ranges of BMI, % BF and dietary intakes of iron with the stages of iron depletion of subjects. All statistical analyses were performed with the SPSS statistical software for Windows (version 15.0; SPSS Inc, USA). Significance was set at $p < 0.05$.

Results

Subjects characteristics

Women included in this study were divided into normal-weight ($n = 46$) and obese ($n = 40$) groups based on the WHO database of BMI (2014). Women in the obese group (21.25 ± 2.71 y) were older than those in the normal-weight group (19.90 ± 1.53 y) ($p = 0.017$). Subjects were predominantly living in Monterrey city or its metropolitan area (87 %). Of participants, 11 (12.8 %) reported smoking (data not shown).

Anthropometrics

Weight, BMI and % BF were different between normal vs. obese groups ($p < 0.001$), while height was similar ($p = 0.339$). The mean BMI were 20.89 ± 1.29 and 34.37 ± 4.89 kg/m², for the normal and obese groups, respectively. The mean % BF of the obese group was almost the double of the normal-weight group (41.86 vs. 21.09 %; $p < 0.001$) (Table I).

Dietary intakes

Dietary intakes are depicted in Table II. There was no statistical difference between groups on the dietary intakes reported for total energy, total iron, heme and non heme iron, iron density or vitamin C; however, median intakes are somewhat higher in the obese group. In contrast, total energy based on body weight (kcal/kg/d) resulted statistically lower in the obese group ($p < 0.001$). Median total iron intakes were 14.50 and 16.02 mg/d for normal-weight and obese women, respectively, while the recommendation for Mexican women is 21 mg/d of total iron²⁰. Of the 86 women, only 16.3 % had iron intakes according to the recommendation or above and 41.9 % had intakes below 15 mg/d (data not shown). In addition, median intakes of vitamin C were lower than the recommendation (75 mg/d) in both groups¹⁹. Of participants, 55.8 % had an intake of vitamin C below the recommendation (data not shown).

Table I
Anthropometrics

	<i>Normal</i> (<i>n</i> = 46)	<i>Obese</i> (<i>n</i> = 40)	<i>p</i> -value
Height (m)	1.58 $\pm$ 0.06	1.60 $\pm$ 0.05	0.339
Weight (kg)	52.47 $\pm$ 4.23	90.58 $\pm$ 11.97	<0.001*
BMI (kg/m ²)	20.89 $\pm$ 1.29	34.37 $\pm$ 4.89	<0.001*
Body fat (%)	21.09 $\pm$ 4.42	41.86 $\pm$ 4.92	<0.001*

* Significance at $p < 0.05$.

Table II
Dietary intakes of participants^a

	<i>Normal</i> (n = 46)	<i>Obese</i> (n = 40)	p-value
Total energy (kcal/d)	1572.19 (1350.81, 1866.34)	1642.45 (1240.60, 2155.40)	0.776
Total energy (kcal/kg/d)	30.21 (24.99, 36.05)	18.52 (13.19, 23.57)	<0.001*
Iron total (mg/d)	14.50 (11.70, 20.24)	16.02 (12.10, 20.12)	0.711
Heme iron (mg/d)	2.14 (1.04, 3.86)	2.48 (0.98, 3.57)	0.648
Non heme iron (mg/d)	12.94 (10.56, 17.50)	13.00 (10.08, 16.98)	0.701
Iron density (mg/1000 kcal)	6.07 (5.40, 7.41)	7.09 (5.01, 9.83)	0.261
Vitamin C (mg/d)	42.81 (27.70, 72.11)	55.88 (30.60, 82.66)	0.357

^a Expressed as median (25th, 75th percentiles).

* Significance at $p < 0.05$.

Menstrual characteristics and iron status

Menstrual characteristics and iron status indicators are presented in Table III. The age at menarche was different between normal and obese groups (12.82 vs. 12.09 y; $p = 0.035$); obese women were younger than normal weight at the age at menarche. The duration of the menstrual period (days) and the length of the menstrual cycle (days) were similar for both groups ($p = 0.177$) and ($p = 0.703$), respectively. Biochemical indicators of iron status were statistically similar for both groups. Although, the mean of serum ferritin was higher in the obese group (39.51 vs. 32.37 $\mu\text{g/L}$; $p = 0.105$) and the mean of serum transferrin was lower in the obese group (302.06 vs. 314.25 mg/dL; $p = 0.378$).

The frequency of subjects in stages 2 and 3 was 19.7 % (data not shown). The stage 2 or iron deficient erythropoiesis (IDE) was predominant (15.1 %) in comparison to stage 1 (0.0 %) and stage 3 (4.6 %). A total of 9 women in the normal weight group (19.6 %) and 4 women in the obese group (10.0 %) presented IDE, while 2 subjects in the normal weight group (4.3

%) and 2 in the obese group (5.0 %) presented iron deficiency anemia or stage 3.

Influence of BMI, % BF, and dietary intake of iron on iron status

A significant, positive correlation was found between % BF and serum ferritin ($r = 0.222$; $p = 0.032$) (**Fig. 1**). No significant relationship was detected between BMI or dietary intake of iron and iron status. According to the odds ratio analysis, in this group of young women ($n = 86$), none of the ranges of % BF contributed to any stage of iron deficiency (**Table IV**), neither those of BMI or dietary intakes.

Discussion

This prospective case-control study provide evidence on the relation between BMI, the % BF and dietary intake of iron and iron status in healthy young women, living in the northeast of Mexico. Iron status

Table III
Menstrual characteristics and biomarkers of iron status^a

	<i>Normal</i> (n = 46)	<i>Obese</i> (n = 40)	p - value
Age at menarche (y)	12.82 $\pm$ 1.43	12.09 $\pm$ 1.39	0.035*
Duration of menstrual period (d)	5.20 $\pm$ 1.04	4.83 $\pm$ 1.18	0.177
Length of menstrual cycle (d)	28.50 $\pm$ 1.81	28.67 $\pm$ 2.08	0.703
Hemoglobin (g/dL)	13.58 $\pm$ 0.94	13.25 $\pm$ 0.82	0.136
Hematocrit (%)	41.92 $\pm$ 2.40	41.25 $\pm$ 2.55	0.264
Ferritin ($\mu\text{g/L}$)	32.37 $\pm$ 17.80	39.51 $\pm$ 18.58	0.105
Transferrin (mg/dL)	314.25 $\pm$ 61.93	302.06 $\pm$ 50.89	0.378

^a Expressed as median $\pm$ standard deviation.

* Significance at $p < 0.05$.

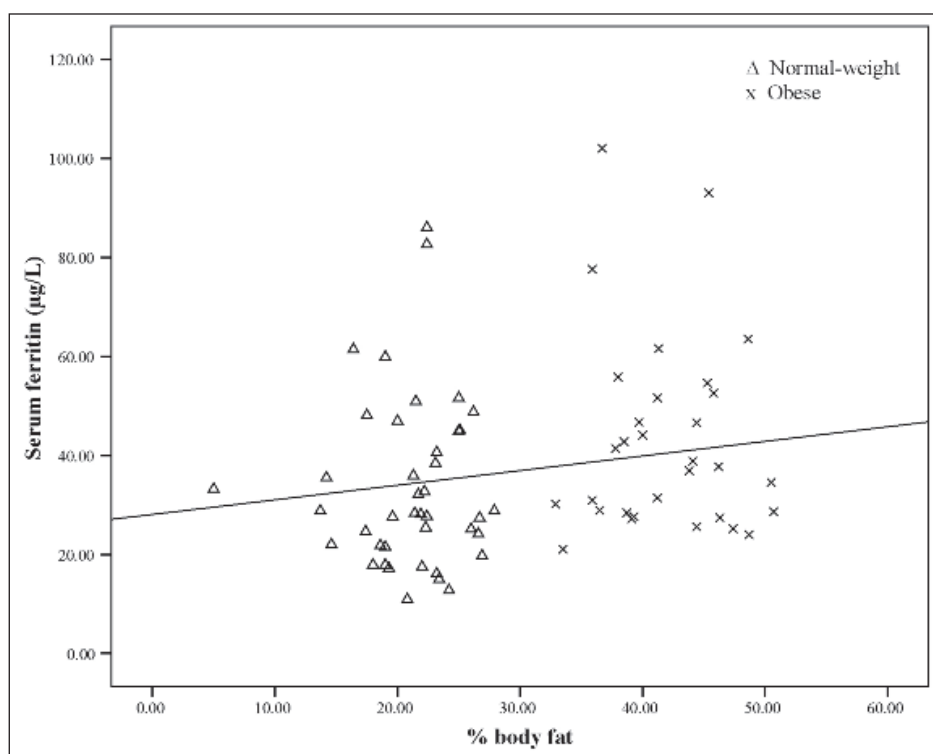


Fig. 1.—Positive relationship between serum ferritin ($\mu\text{g/L}$) and percentage (%) of body fat in young Mexican women in both normal-weight and obese groups ($n = 86$). ($r = 0.222$; $p = 0.032$).

Table IV

Odds ratios and 95% confidence interval for ranges of percentage of body fat which relate to iron status in young women ($n = 86$)

Percentage of body fat ^a	Stage 2 IDE	Stage 3 IDA
17.0 – 32.9 %	8.207 (0.953 – 70.671)	1.250 (0.306 – 5.009)
33.0 – 38.9 %	0.982 (0.106 – 9.067)	2.245 (0.387 – 13.013)
$\geq 39.0\%$	0.0	0.647 (0.123 – 3.406)

^a Adapted for women ages 18 to 30 y from Tanita Corporation of America, Inc. and Gallagher et al. 2000.

* Significance at $p < 0.05$.

in a young female population should be considered as of relevance in order to decrease the risk of anemia in terms of possible future gestations and lactation^{6,7} and other health concerns as university students such as memory⁸. Biomarkers of iron status were not statistically different between normal-weight vs. obese groups as others had previously reported²⁴; however, serum ferritin levels were somewhat higher in obese than in normal-weight women (39.51 vs. 32.37 $\mu\text{g/L}$; $p = 0.105$).

The results of this study indicate that BMI was not related to neither iron status indicators or to stages of iron depletion in young women. It has been reported that obesity was a significant independent predictor

of iron deficiency in Mexican adult women (18 – 50 y) (OR = 1.92 (95% CI: 1.23 – 3.01)⁹. In contrast, a study in Colombian women (13 – 49 y) reported that overweight and obesity were associated with a lower likelihood of anemia [OR = 0.8 (95% CI 0.7, 0.9) and OR = 0.8 (95% CI 0.6, 1.0), respectively, in comparison to normal-weight¹¹. Chambers et al (2006) suggests the inconsistency of results due to the use of different biomarkers of iron status²⁵. In our study, the percentage of body fat was a positive correlate with serum ferritin ($r = 0.222$; $p = 0.032$), similar to other study results where serum ferritin of older Japanese adults was correlated with visceral fat ($r = 0.254$, $p < 0.0001$) and subcutaneous fat ($r = 0.231$, $p < 0.0005$)²⁶. As the % BF was correlated with serum ferritin, we considered an odds ratio (OR) analysis to measure how different ranges of % BF may contribute to stages of iron depletion; however, this results (Table IV) showed no statistical significance, neither those of BMI or dietary intake of iron, indicating that this variables may not be independent contributors to stages of iron depletion as previously suggested¹⁰, thus other variables such as iron menstrual loss¹ should be of relevance to consider in this type of research.

In this study, although median dietary intakes were below the recommendation for Mexican women for iron and vitamin C, both normal-weight and obese participants had similar median intakes of total iron, heme, non heme-iron and vitamin C, 14.50 vs. 16.02 mg/d ($p = 0.711$), 2.14 vs. 2.48 mg/d ($p = 0.648$), 12.94 vs. 13.00 mg/d ($p = 0.701$) and 42.81 vs. 55.88 mg/d ($p = 0.357$), respectively, and no women was taking

vitamin or mineral supplements. In addition, small or absent body iron stores have been reported in young women with menstruation of 5 days or longer, intense menstrual bleeding or using intrauterine devices (IUD) without hormones⁴. In our subjects, the duration of the menstrual period was similar between normal-weight vs. obese groups, 5.20 vs. 4.83 d ($p = 0.177$). Although menstrual flow was not measured, both similar iron intake and menstrual periods may be the reason of similar results between groups in terms of biomarkers of iron status and frequencies in stages of iron depletion. As iron status may result impaired when blood is drawn during menses¹³ we considered the late luteal phase (day 20) of the menstrual cycle as the most adequate to determine iron status.

Our study has several limitations. Subjects were recruited in terms of BMI rather than in percentage of body fat; although, there was a clear difference in BMI (18.50 – 24.99 vs. ≥ 30.00 kg/m²) ($p < 0.001$). Besides, the % BF was not overlapped between normal-weight vs. obese women ($p < 0.001$); however, for further research it is suggested to have measures of body fat distribution. The use of an 8-day food record as the method to determine the intake of iron has the limitation that respondents may have reactivity as a result of the recording itself²⁷. To reduce error in this study, a trained interviewer instructed all subjects to follow a regular diet. Besides, subjects were telephoned twice in the 8 days to verify the diet recording process and remind participants to continue with their regular diets. Ferritin is a biomarker that may be affected by chronic inflammation process caused by the adipose tissue^{28,29} in both our normal weight and obese women, thus we also considered hemoglobin, hematocrit and transferrin as indicators to define iron status of participants.

It is also recommended for further research to determine biomarkers of inflammation or antioxidant status that may relate to iron status to consider the status of chronic inflammation while women present high percentages of body fat. It should also be noted that our subject population were healthy young women living in the northeast of Mexico, and thus results may not be representative for the Mexican population or for young women with preexisting iron-related disorders or other mental disorders such as altered eating behaviours, impulsiveness and depression, especially in those with obesity³⁰.

Conclusion

In conclusion, this study showed a positive relationship between serum ferritin and the % BF in young healthy normal-weight and obese women with similar dietary intakes and duration of menstrual periods. Despite this relationship, our hypothesis could not be supported in the study group. In addition, ranges of % BF were not independent contributors to stages of iron depletion. The use of several biomarkers for

assessing iron status of obese subjects should be reconsidered in further research due to inconsistency of results. Guidance on dietary intakes is suggested for this population in order to prevent iron deficiency and its complications.

Acknowledgements

This work was supported by the Support Program for Scientific and Technological Research (PAICYT, for its Spanish abbreviation) sponsored by the UANL.

We thank Hygeia of Mexico, Quaker of Mexico and Sigma Alimentos for their in-kind support. The authors have no conflict of interest to disclose.

References

1. Aigner, E, Feldman, A, Datz, C. Obesity as an Emerging Risk Factor for Iron Deficiency. *Nutrients* 2014; 6:3587–600.
2. Yanoff LB, Menzie CM, Denkinger B, Sebring NG, McHugh T, Remaley AT, et al. Inflammation and iron deficiency in the hypoferremia of obesity. *Int J Obes* 2007;31:1412–9.
3. Gutiérrez JP, Rivera-Dommarco J, Shamah-Levy T, Villalpando-Hernández S, Franco A, Cuevas-Nasu L, et al. Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública (MX); 2012. [http://ensanut.insp.mx/informes/ENSANUT2012Resultados Nacionales.pdf].
4. Milman N, Clausen J, Byg KE. Iron status in 268 Danish women aged 18–30 years: influence of menstruation, contraceptive method, and iron supplementation. *Ann Hematol* 1998;77:13–9.
5. Jaqueline Driemeyer Correia Horvath, Mariana Laitano Dias de Castro, Natália Kops, Natasha Kruger Malinoski and Rogério Friedman. Obesity coexists with malnutrition? adequacy of food consumption by severely obese patients to dietary reference intake recommendations. *Nutr Hosp* 2014;29(2):292–9.
6. Casanueva E, Pfeffera F, Drijanskia A, Fernández-Gaxiola AC, Gutiérrez-Valenzuela V, Rothenberg SJ. Iron and Folate Status before Pregnancy and Anemia during Pregnancy. *Ann Nutr Metab* 2003;47:60–3.
7. Perez EM, Hendricks MK, Beard JL, Murray-Kolb LE, Berg A, Tomlinson M, et al. Mother-Infant Interactions and Infant Development Are Altered by Maternal Iron Deficiency Anemia. *Am J Clin Nutr* 2009;89:946S–50S.
8. Dupont N, Preziosi P, Boutron-Ruault MC, Bertrais S, Galan P, Favier A, et al. Consequences of iron depletion on health in menstruating women. *Eur J Clin Nutr* 2003;57:1169–75.
9. Cepeda-Lopez AC, Osendarp SJM, Melse-Boonstra A, Aeberli I, Gonzalez-Salazar F, Feskens E, et al. Sharply higher rates of iron deficiency in obese Mexican women and children are predicted by obesity-related inflammation rather than by differences in dietary iron intake. *Am J Clin Nutr* 2011;93:975–83.
10. Fanou-Fogny N, Saronga NJ, Koreissi Y, Dossa RAM, Melse-Boonstra A, Brouwer ID. Weight status and iron deficiency among urban Malian women of reproductive age. *British Journal of Nutrition* 2011;105:574–9.
11. Kordas K, Fonseca-Centeno ZY, Pachón H, Jimenez-Soto AZ. Being Overweight or Obese Is Associated with Lower Prevalence of Anemia among Colombian Women of Reproductive Age. *J. Nutr* 2013;143:175–81.
12. Dale JC, Burrit MF, Zinsmeister AR. Diurnal Variation of Serum Iron, Iron-Binding Capacity, Transferrin Saturation, and Ferritin Levels. *Am J Clin Pathol* 2002;117:802–8.
13. Kim I, Yetley EA, and Calvo MS. Variations in iron-status measures during the menstrual cycle. *Am J Clin Nutr* 1993;58:705–9.

14. World Health Organization. Global database on body mass index. BMI classification. Last accessed: December 1, 2014. [http://apps.who.int/bmi/index.jsp?introPage=intro_3.html].
15. Body fat ranges for standard adults and children. Tanita Corporation of America, Inc. Last accessed: December 1, 2014. [http://www.tanita.com/data/File/Charts/BF%20wall%20chart.pdf].
16. Gallagher D, Heymsfield SB, Heo M, Jebb SA, Murgatroyd PR, Sakamoto Y. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. *Am J Clin Nutr* 2000;72:694–701.
17. Alves-Pereira R, Campos Araujo M, de Souza-Lopes T, Mas-sae Yokoo E. How many 24-hour recalls or food records are required to estimate usual energy and nutrient intake? *Cad Saúde Pública* 2010;26(11):2101–11.
18. Bryant M, Truesdale KP, Dye L. Modest changes in dietary intake across the menstrual cycle: implications for food intake research. *Br J Nutr* 2006;96(5):888–94.
19. Bourges H, Casanueva E, Rosado J. Recomendaciones de ingestión de nutrimentos para la población mexicana. Apéndice 2: Ingestión diaria recomendada (IDR) e ingestión diaria sugerida (IDS) de vitaminas para la población Mexicana. México: Panamericana; 2008, p. 188.
20. Bourges H, Casanueva E, Rosado J. Recomendaciones de ingestión de nutrimentos para la población mexicana. Apéndice 3. Ingestión diaria recomendada (IDR) e ingestión diaria sugerida (IDS) de nutrimentos inorgánicos para la población Mexicana. México: Panamericana; 2008, p. 190.
21. Elizondo LL, Hernández, CE, Zamora MT. Terapia nutricia médica en ginecología y obstetricia. México: McGraw Hill; 2011, p. 79–83.
22. Cook J. The nutritional assessment of iron status. *Arch Latin Nutr* 1999;49(2):11S–14S.
23. Romilda Castro de Andrade Cairo, Luciana Rodrigues Silva, Nadya Carneiro Bustani and Cibele Dantas Ferreira Marques. Iron deficiency anemia in adolescents; a literature review. *Nutr Hosp* 2014;29(6):1240–9.
24. Fricker J, Le Moel G, Apfelbaum M. Obesity and iron status in menstruating women. *Am J Clin Nutr* 1990;52:863–6.
25. Chambers EC, Heshka S, Gallagher D, Wang J, Pi-Sunyer X, Pierson RN. Serum iron and body fat distribution in a multiethnic cohort of adults living in New York City. *J Am Diet Assoc* 2006;106:680–4.
26. Iwasaki T, Nakajima, A, Yoneda M, Yamada Y, Mukasa, K, Fujita K, et al. Serum ferritin is associated with visceral fat area and subcutaneous fat area. *Diabetes Care* 2005;28:2486–91.
27. Thompson FE, Subar AF. Dietary assessment methodology. Chapter 1. In: Nutrition in the prevention and treatment of disease. 3rd Ed. Coulston AM, Boushey CJ, Ferruzzi MG, editors. USA: Elsevier Inc; 2013, p. 5–7.
28. McClung JP, Karl JP. Iron deficiency and obesity: the contribution of inflammation and diminished iron absorption. *Nutrition Reviews* 2009;67(2):100–4.
29. Mónica Andrews-Guzmán y Miguel Arredondo-Olguín. Association between ferritin, high sensitivity c-reactive protein (hsCRP) and relative abundance of Hcpidin mRNA with the risk of type 2 diabetes in obese subjects. *Nutr Hosp* 2014;30(3):577–84.
30. Irina Lazarevich, María Esther Irigoyen-Camacho and María del Consuelo Velázquez-Alva. Obesity, eating behaviour and mental health among university students in Mexico city. *Nutr Hosp* 2013;28(6):1892–9.



Original/*Obesidad*

Prevalence of underweight, overweight, general and central obesity among 8-15- years old Bulgarian children and adolescents (Smolyan region, 2012-2014)

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Abstract

Objective: the objective of this work is to investigate the distribution of underweight, overweight, the general and central obesity in 8-15-year-old Bulgarian children and adolescents, through the use of the anthropometric indices BMI and WHtR.

Materials and methods: subject of this study are 878 children and adolescents (437 boys and 441 girls) of Smolyan region, Bulgaria, at the age of 8 to 15 years. The study is cross-sectional and was conducted in the period 2012-2014. The body height, weight and waist circumference were measured. In addition, the body mass index (BMI) and waist to height ratio (WHtR) were calculated. Overweight and obesity were defined according to the cut-off points of BMI, recommended of IOTF and developed by Cole et al. (2000; 2007). The central obesity was defined according to the discriminatory values of 0.500 of WHtR. The collected data were analysed by statistical software packages STATISTICA 10.0 and SPSS 16.

Results: overweight occurs among 18.8 % of the boys and 17.0 % of the girls, and obesity occurs among 7.6 % of boys and 3.7 % of the girls. The underweight are 8.0 % of the boys and 10.4 % of the girls. Central obesity (WHtR $\geq$ 0.500) occur among average 12.75 % of all investigated children independently of their nutritional status (16.2 % of boys and 9.3 % of girls). With central obesity (WHtR $\geq$ 0.500) are on average 2.7% of all boys and girls with normal weight (n = 96) and an average 46.82% of all participants with overweight and with obesity (n = 205). With increased health risk (WHtR $\geq$ 0.500) are total of 2.01% (n=16) of all surveyed children (n = 793) from categories normal weight.

Conclusion: there has been an increase in prevalence of overweight and obesity among Bulgarian children and adolescents from Smolyan region during the over one last decade. The relatively high percentage of underweight children, especially among in group of the girls after

PREVALENCIA DE BAJO PESO, SOBREPESO, OBESIDAD CENTRAL Y GENERAL ENTRE 8-15 AÑOS DE EDAD LOS NIÑOS BÚLGAROS Y ADOLESCENTES (REGIÓN DE SMOLYAN, 2012-2014)

Resumen

Objetivo: el objetivo de este trabajo es investigar la distribución de peso insuficiente, demasiado pesado, la obesidad general y central en 8 niños búlgaros de 15 años y adolescentes, a través del uso de los índices antropométricos BMI y WHtR.

Materiales y métodos: el objeto de este estudio son 878 niños y adolescentes (437 niños y 441 niñas) de la región de Smolyan, Bulgaria, con edades de 8 a 15 años. El estudio es transversal y se llevó a cabo en el período 2012-2014. Se miden la altura, el peso y la circunferencia de la cintura, así como el índice de masa corporal. El sobrepeso y la obesidad se definen de acuerdo con los puntos de corte de BMI, recomendado por la IOTF y desarrollado por Cole et al. (2000;2007). La obesidad central fue definida de acuerdo con los valores discriminatorios de 0,500 de WHtR. Los datos obtenidos fueron analizados por los paquetes de software estadístico STATISTICA 10.0 y SPSS 16.

Resultados: el sobrepeso se produce entre el 18,8% de los chicos y el 17,0% de las niñas, y la obesidad entre el 7,6% de los varones y el 3,7% de las chicas. Presentan bajo peso el 8,0% de los chicos y el 10,4% de las chicas. La obesidad central (RCEst $\geq$ 0.500) se produce en promedio, en el 12,75% de todos los niños investigados, independientemente de su estado nutricional (16,2% de los varones y el 9,3% de las chicas). Presentan obesidad central (RCEst $\geq$ 0.500), en promedio, el 2,7% de todos los niños y niñas con peso normal (n = 96) y un promedio 46,82% de todos los participantes con sobrepeso y con obesidad (n = 205). Con el aumento de riesgo para la salud (RCEst $\geq$ 0.500) son total de 2,01% (n = 16) de todos los niños encuestados (n = 793) de las categorías de peso normal.

Conclusión: se ha producido un aumento de la prevalencia de sobrepeso y obesidad en niños y adolescentes búlgaros de la región de Smolyan durante más de una década. El porcentaje de insuficiencia ponderal entre los niños, es relativamente alto especialmente entre el grupo de las niñas después de la pubertad. La obesidad central,

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Recibido: 5-II-2015.

1.ª Revisión: 3-III-2015.

Aceptado: 12-III-2015.

puberty. The central obesity, as well as its combination with overweight or general obesity is more frequent in boys than in girls.

(*Nutr Hosp.* 2015;31:2419-2427)

DOI:10.3305/nh.2015.31.6.8805

Key words: *BMI. WHtR. Underweight. Overweight. Obesity. Central obesity. Children and adolescents.*

Abbreviations

BMI: Body mass index.

WHtR: Waist to height ratio.

NS: Nutritional status.

IOTF: International Obesity Task Force.

WHO: World Health Organization.

Introduction

Overweight and obesity are some of the most pressing challenges that humanity faces today. In literature, obesity ranks second only to smoking as a cause of premature death and a risk factor for development of cardiovascular diseases and metabolic disorders in adult and children¹⁻². The relative proportion of children with overweight and obesity in the world as well as in Bulgaria is on the increase³⁻⁶. According to the World Health Organization Bulgaria has one of the highest rates of mortality of the population (66 %) as a result of cardio-vascular diseases, whose etiology is associated with major behavioral risk factors such as smoking and lack of exercise, and metabolic risk factors such as high blood pressure, overweight and obesity⁷.

Worldwide, the most commonly used anthropometric measurement for diagnosis of both obesity and underweight is body mass index (BMI). But this index is not a panacea and its use has received a lot of criticism due to the fact that it is only a height/weight ratio, it does not give a very accurate idea which of the components of the body weight is responsible for the accumulation of body mass⁸. Another anthropometric indicator for assessment of obesity which has been recently used more frequently is the ratio between the waist circumference and height (WHtR). This indicator is a specific sensitive marker of fat accumulation in the upper part of the body and is also used for the assessment of the risk of some cardiovascular diseases and metabolic disorders associated with the central accumulation of fats⁹⁻¹⁰. According to a number of studies, WHtR correlates to a great extent with the risk of cardiovascular and metabolic diseases both in adults and children; thus it may be used as an alternative, universal, convenient, and inexpensive tool for the assessment of central obesity in clinical practice due to its independence of gender and age^{8,10,11-13}. Several authors think that the WHtR is even a more sensitive

así como su combinación con el sobrepeso o la obesidad, es más frecuente en niños que en niñas.

(*Nutr Hosp.* 2015;31:2419-2427)

DOI:10.3305/nh.2015.31.6.8805

Palabras clave: *BMI. WHtR. Bajo peso. Sobrepeso. Obesidad. Obesidad central. Niños y adolescentes.*

diagnostic indicator of overweight and obesity in children as compared with the BMI^{10,12,14}. The data for the distribution of overweight and obesity are important not only for science and for clinical practice, but also for the economy of any country.

In this regard, the **objective** of this work is to investigate the distribution of underweight, overweight, and the general and central obesity among the contemporary generation of 8-15-year-old Bulgarian children and adolescents (Smolyan region), through the use of the anthropometric indices BMI and WHtR.

Material and methods

Sampling technique. The subjects of this study are 878 children and adolescents, aged from 8 to 15 years, of which 437 boys and 441 girls. The study is cross-sectional and was carried out in the period 2012-2014 at eight public schools in Smolyan region, Bulgaria. The children and adolescents are distributed in eight age groups, the grouping carried out by Martin's method. Thus, for example, the group of 10-year-olds included children from the age of 9 years, 6 months and 0 days to 10 years 5 months and 29 days (Table I).

Study design. The study design included three directly measured anthropometric indices - height (cm), weight (kg) and waist circumference (cm). On this base two additional indexes were calculated - body mass index (BMI, kg/m²), and waist to height ratio (WHtR).

The anthropometric measurements were carried out under the classical methodology of Martin-Saller¹⁵. The height was measured with original anthropometer with an accuracy of 1 mm ("GPM Antropologisches Instrumente"). The weight was measured with the analyzer of body composition "Tanita BC 453" with a precision of 0,05 kg. The waist circumference was measured with millimetre line with an accuracy of 1 mm.

Evaluation of body nutritional status was made according to cut-off points of BMI for children from 2 to 18 years, recommended of International Obesity Task Force (IOTF) and developed by Cole et al.¹⁶⁻¹⁷. The four groups of children were separated- underweight, with normal weight, overweight and obese.

For evaluation of central obesity the discriminatory values of 0.500 for WHtR were used. The two groups of children were separated -the first group included children with WHtR < 0.500 i.e without central obesity, and the second group included children with WHtR

≥ 0.500 i.e. with central fat distribution and central obesity¹⁰.

Statistical analysis. The collected data were analysed by statistical software packages STATISTICA 10.0 and SPSS 16. Mean and standard deviation for each of the anthropometric measurements and indexes were calculated. Also the frequency distribution of children of each sex and age into BMI and WHtR categories was made. The statistical significance between age- and sex groups was evaluated through T-test of Student on p-level 0.05. The evaluation of differences between groups of children according to categories of body nutritional status and WHtR was made by χ^2 criteria on p-level 0.05.

Results

Data on the distribution of subjects participating in the study according to age and their gender are presented in Table I.

Table II presents the statistical characteristics of BMI and WHtR (mean, standard deviation, and significance of inter-age and inter-sex differences), according to age and sex.

The values of the BMI rise during the growth. The mean value of the BMI for 8-year-old boys is 17.2 ± 2.7 kg/m², while with the 15-year-olds it is 21.6 ± 3.9 kg/m². As for the girls, the values of BMI increase from 16.5 ± 2.1 kg/m² with the 8-year-olds to 20.5 ± 3.2 kg/m² with the 15-year-old girls. In both sex groups the values of BMI increase insignificantly ($p > 0.05$) in the all age period, with the exception of the period 9th-10th year of age when 10-year-old girls have statistically significantly highest BMI values ($p < 0.05$) than 9-year-old girls.

The boys have higher values of the BMI than girls in all ages with the exception of the period 11th-13th year

Table I Simple characteristics according to age and sex		
Age (years)	Boys (n)	Girls (n)
8	55	50
9	69	62
10	65	70
11	51	69
12	64	55
13	62	49
14	36	50
15	35	36
TOTAL:	437	441

of age when both sexes have the same value of this index. During the whole period, however, no statistically significant differences between the sexes ($p > 0.05$). For both sexes, the greatest accumulation of body mass per unit of height was observed between 9th-10th year of age and the 13th-14th year of age, i.e. in the period of pre-puberty and puberty.

Unlike the BMI, the values of WHtR gradually decreased over the period of survey. Thus, the average value of the ratio is 0.454 ± 0.03 for the 8-year-old boys. Up to the 10th year of age, these values increase to 0.464 ± 0.05 , then follow decreases and in the 15th year of age to 0.435 ± 0.04 . With the 8-year-old girls, WHtR is 0.445 ± 0.03 respectively, and increases to 0.450 ± 0.04 with the 10-year-olds. After that, WHtR decreases in the same way as with the boys, and at the end of the period it reaches values of 0.424 ± 0.05 . In

Table II
Statistical data of body mass index (BMI, kg/m²) and waist to height ratio (WHtR) of participants according to their age and sex

	Boys								Girls								Intersex differences	
	BMI				WHtR				BMI				WHtR				BMI	WHtR
	N	Mean	SD	IAD p	Mean	SD	IAD p		N	Mean	SD	IAD p	Mean	SD	IAD p		p	p
8	55	17.2	2.7		0.454	0.03			50	16.5	2.1		0.445	0.03			0.14	0.16
9	69	17.6	3.2	0.46	0.458	0.04	0.67		62	17.1	2.6	0.18	0.444	0.03	0.85		0.32	0.04*
10	65	18.7	3.4	0.06	0.464	0.05	0.49		70	18.4	3.4	0.01*	0.450	0.04	0.38		0.65	0.11
11	51	18.7	4.1	0.92	0.445	0.06	0.07		69	18.7	3.4	0.67	0.436	0.05	0.07		0.93	0.35
12	64	19.3	3.8	0.36	0.442	0.05	0.80		55	19.0	2.9	0.61	0.428	0.05	0.34		0.61	0.11
13	62	20.0	4.3	0.33	0.445	0.06	0.82		49	19.9	4.3	0.20	0.428	0.05	0.97		0.90	0.14
14	36	20.9	3.6	0.29	0.437	0.05	0.49		50	20.1	2.9	0.82	0.418	0.03	0.23		0.20	0.03*
15	35	21.6	3.9	0.47	0.435	0.04	0.84		36	20.5	3.2	0.53	0.424	0.05	0.54		0.18	0.31

Note: N-number, Mean-average value, SD-standard deviation, IAD- inter-age differences; ISD – inter-sex differences; p- level of significance, * $p < 0.05$.

both sex groups the values of WHtR decreases insignificance ($p > 0.05$) in the all age period.

The boys have insignificance higher values of the WHtR than girls in all ages, with the exception of the 9th and 14th year ($p < 0.05$), when the values of WHtR of boys are significance higher than in girls.

In Table III are present the results of the percentage distribution of the children and adolescents being surveyed according to the different type of body nutritional status.

The results showed that of the all surveyed 878 children and adolescents of both sexes 32.7 % have deviations from normal body nutritional status- 9.2 % of all are underweight, 17.9% are overweight, and 5.6% are obese. The distribution according to sex showed that 65.6 % of the boys have normal body nutritional status, 8 % are underweight, 18.8% are overweight and 7.6 % are obese. 67.3% of all investigated boys and girls have normal weight.

In group of the boys 65.6 % of all surveyed are with normal weight, 8.0 % are underweight, 18.8 % are overweight and 7.6 % are obese. In terms of age dis-

tribution, the results show that the highest percentage of underweight boys is observed at the 11th (15.8 %), the 13th (12.9 %) and the 14th year of age (11.1 %). Overweight has the highest share among 10-year-olds (24.6 %), the 14-year-olds (27.8 %), and most often obesity occurs with 11-year-olds (11.9 %).

As for the girls, the results showed that 68.9 % are with normal weight, 10.4 % are underweight, 17.0 % are overweight and 3.7 % are obese. Underweight is most commonly encountered in 15-year-old girls, when it reaches 22.2 %; overweight is more often occurs between the 10th-12th year of age (20.0-23.6 %) and obesity in the 13th year of age (6.1 %).

Table IV presents the results for the percentage distribution of the children and adolescents in different categories of WHtR.

With the all boys and girls, normal fat distribution ($WHtR < 0.500$) is observed average among 87.3 % of the all participants, while with abnormal central fat distribution and central obesity ($WHtR \geq 0.500$) are average 12.7 % of all investigated boys and girls ($WHtR \geq 0.500$). The highest average percentage cen-

Table III
Prevalence of different categories body nutritional status in boys and girls. according to their ages based on IOTF BMI cut-off points (Cole et al. 2000; 2007)

Age (years)	Underweight		Normal weight		Overweight		Obese		Total	
	n	%	n	%	n	%	n	%	n	%
Boys										
8	1	1.8	40	72.7	10	18.2	4	7.3	55	100
9	6	8.7	46	66.7	12	17.4	5	7.2	69	100
10	3	4.6	42	64.6	16	24.6	4	6.2	65	100
11	8	15.8	30	58.8	7	13.7	6	11.7	51	100
12	4	6.2	44	68.8	12	18.8	4	6.2	64	100
13	8	12.9	40	64.5	8	12.9	6	9.7	62	100
14	4	11.1	20	55.5	10	27.8	2	5.6	36	100
15	1	2.9	25	71.4	7	20.0	2	5.7	35	100
All	35	8.0	287	65.6	82	18.8	33	7.6	437	100
Girls										
8	4	8.0	38	76.0	7	14.0	1	2.0	50	100
9	7	11.3	43	69.4	10	16.1	2	3.2	62	100
10	4	5.7	48	68.6	14	20.0	4	5.7	70	100
11	8	11.6	42	60.9	15	21.7	4	5.8	69	100
12	5	9.1	36	65.5	13	23.6	1	1.8	55	100
13	4	8.2	37	75.5	5	10.2	3	6.1	49	100
14	6	12.0	38	76.0	5	10.0	1	2.0	50	100
15	8	22.2	22	61.1	6	16.6	0	0.0	36	100
All	46	10.4	304	68.9	75	17.0	16	3.7	441	100
TOTAL	81	9.2	591	67.3	157	17.9	49	5.6	878	100

Table IV <i>Distribution (%) of participants in different categories of waist to height ratio (WHtR) by age and sex</i>									
Age (years)	8 y.	9 y.	10 y.	11y.	12 y.	13 y.	14 y.	15 y.	All
Boys	(n=55)	(n=69)	(n=65)	(n=51)	(n=64)	(n=62)	(n=36)	(n=35)	(n=437)
WHtR < 0. 500 (%)	89.1	85.5	76.9	82.4	82.8	82.3	85.2	91.4	83.8 (366)
WHtR ≥ 0. 500 (%)	10.9	14.5	23.1	17.6	17.2	17.7	14.8	8.6	16.2 (71)
Girls	(n=50)	(n=62)	(n=70)	(n=69)	(n=55)	(n=49)	(n=50)	(n=36)	(n=441)
WHtR < 0. 500 (%)	92.0	91.9	82.9	88.4	90.9	91.8	100.0	91.7	90.7 (400)
WHtR ≥ 0. 500 (%)	8.0	8.1	17.1	11.6	9.1	8.2	0.0	8.3	9.3 (41)
TOTAL	(n=105)	(n=131)	(n=135)	(n=120)	(n=119)	(n=111)	(n=86)	(n=71)	(n=878)
WHtR < 0. 500 (%)	75.5	88.7	79.9	85.4	86.8	87.1	92.6	91.6	87.3 (766)
WHtR ≥ 0. 500 (%)	9.5	11.3	20.1	14.6	13.2	12.9	7.4	8.4	12.7 (112)

tral obesity is observed among 10-year-olds (20.1 %) children.

In group of boys, normal fat distribution (WHtR < 0.500) is observed among 83.8 % of the all participants surveyed. 16.2 % of the boys have central accumulation of fat i.e central obesity (WHtR ≥ 0.500). The percentage of central obesity among boys various from 8.6 % to 23.1 % during investigated age period.

With the girls the results are as follows: a total of 90.7 % are without central obesity (WHtR < 0.500) and 9. 3% have central obesity (WHtR ≥ 0.500). The

percentage of central obesity among girls is lower than in boys in all age groups, and various between 0.0 % to 17.1 %. The highest proportion of girls with central obesity is observed among 10-year-olds girls also. (17.1 %).

As far as age is concerned, the percentage of adolescents of both sexes with central obesity (WHtR ≥ 0.500) significantly increases between the 9th-10th year of age: ranging from 14.5 % to 23.1 % in boys, and from 8.1 % to 17.1 % in girls.

Table V presents the results of the prevalence of WHtR categories in children and adolescents accor-

Table V <i>Prevalence (%) of WHtR categories in children and adolescents according to their body nutritional status</i>					
BMI categories	Numbers with WHtR < 0.500 n (%)	Numbers with WHtR ≥ 0.500 n (%)	Total in BMI categories n (%)	% of participants at risk by WHtR, but without risk according to BMI	% of participants at risk by BMI, but without risk according to WHtR
Boys					
Normal weight	278 (97.2 %)	8 (2.8 %)	286 (100 %)	1.99 % (8/401)	
Overweight	49 (59.8 %)	33 (40.2 %)	82 (100 %)		12.2 % (49/401)
Obese	3 (9.1 %)	30 (90.9 %)	33 (100 %)		0.75 % (3/401)
Girls					
Normal weight	294 (97.4 %)	8 (2.6 %)	302 (100 %)	2.04 % (8/392)	
Overweight	54 (72 %)	21 (28 %)	75 (100 %)		13.8 % (54/392)
Obese	3 (20 %)	12 (80 %)	15 (100 %)		0.76 % (3/392)
All					
Normal weight	572 (97.3%)	16 (2.7 %)	588 (100 %)	2.01% (16/793)	
Overweight	103 (65.6%)	54 (34.4 %)	157 (100 %)		12.98 % (103/793)
Obese	6 (12.5 %)	42 (87.5 %)	48 (100 %)		0.75 % (6/793)
TOTAL (excludes 81 children with underweight)	681 (85.9 %)	112 (14.1%)	793 (100 %)		

Note: WHtR < 0.500 - without central obesity; WHtR ≥ 0.500 - with central obesity.

ding to their nutritional status. The table does not include data for 81 boys and girls who are underweight.

Without central obesity ($\text{WHtR} < 0.500$) are total 85.9 % of all participants with normal weight, overweight and obesity ($n=793$) and with central obesity ($\text{WHtR} \geq 0.500$) are total 14.1 % of all boys and girls.

In group of children and adolescents with normal weight the values of $\text{WHtR} < 0.500$ i.e. without central obesity are on average 97.3 % of all 588 girls and boys in this group (97.2 % of boys and 97.4 % of girls) and with central obesity ($\text{WHtR} \geq 0.500$) are on average 2.7 % (2.8 % of boys and 2.6 % of girls). In group of children with overweight on average 34.4 % of participants from both sexes all are with central obesity (40.2 % of the boys and 8 % of the girls). Among group of obese participants average 87.5 % are with simultaneously general and central obesity (90.9 % of the boys and 80 % of the girls).

Generally with central obesity ($\text{WHtR} \geq 0.500$) are total 2.7 % ($n=16$) of all surveyed ($n=588$) children with normal status according BMI criteria, and average 46.82 % ($n=96$) of children who are overweight and obese ($n=205$).

The percentage of children from both sexes at risk according to IOTF BMI criteria, but without risk according to WHtR criteria are total 13.73 % ($n = 109$) of 793 (100 %) participants. In other hand, the percentage of children at risk according to WHtR investigated children with normal nutritional status.

Discussion

The average values of BMI of contemporary generation of children and adolescents obtained in the present study are higher compared to those of children and adolescents from the region examined by the leading author in the period 1999-2001¹⁸. The BMI of the boys surveyed is 1.3 to 2.6 index units (IU) higher in the period from the 8th to the 14th year of age as compared with that of their peers from more than a decade ago. There are practically no differences only in the age group of 15-year-old boys. The trend is similar for the girls: the girls surveyed have BMI which is higher by 0.4 to 2.5 IU than that of girls their age during the period from the 9th to the 15th year of age. The girls from the two generations have almost identical values of the index only in their 8th year.

According to the our results obtained, the values of WHtR increase between the 8-10 year in both sexes, then follows a gradual fall until the 15th year of age (Table II). This fact is due to the different growth rate of height and waist circumference in this period. This our results confirmed the results of Mc Carthy, Ashwell¹⁰ for British children and adolescents. In addition, our results also confirmed earlier obtained data for lower values of WHtR in girls¹⁰, which is due to their lower height during a greater part of the period, as well

as to their smaller waist circumference, especially in their 14th-15th year.

The our results about prevalence of different types of body nutritional status among contemporary generation Smolyan's children and adolescents, Bulgaria (Table III) show increase of prevalence of overweight and obesity during the period 2001 to 2014, based on the old data of nutritional status in children from the same region¹⁸. From 12.9 % in 2001 the overweight increase to 17.9 % in 2014. Obesity has increased from 3.1 % to 5.6 % between 2001-2014. These our findings confirm other authors' data showing an increase in the percentage of Bulgarian children and adolescents with overweight and obesity in different periods of growth^{5, 19-20}, as well as an increase in the percentage of children with overweight and obesity in other countries of Europe and the world^{3-4, 6, 21-23}.

The results on the distribution of the various categories of nutritional body status showed that the frequency of occurrence of underweight in 8-15-year-old Smolyan adolescents of both sexes was slightly higher than that of Plovdiv's children and adolescents while the frequency of occurrence of overweight and obesity is lower than that of Plovdiv's children and adolescents¹⁹.

The present our results do not confirm the data from the National survey of the nutritional status of students in Bulgaria made by Konstantinova et al. in 2011, the results of which are cited in the report of WHO for Bulgaria "Nutrition, Physical activity and Obesity. Bulgaria"²⁴, in which it is reported that overweight among Bulgarian boys aged 10 to 13 years is 38.3%, while among girls it is 30.1 %. Obesity in the 10-13-year-old adolescents, according to data from this report is 17.1 % for boys and 10.8 % for girls²⁴. Our results showed a lower percentage of overweight and obesity, estimated on the basis of the discriminatory values for BMI of IOTF¹⁶⁻¹⁷ for Bulgarian adolescents of both genders in this and other age periods. Similar results about the lower percentage of Bulgarian children and adolescents with weight and obesity are finding from other Bulgarian anthropologists^{19-20, 25-26}.

At the same time, a lower percentage of overweight and obesity has been observed in the Bulgarian children and adolescents examined, and a slightly higher percentage of underweight as compared to those in the 7-14-year-old peers from Kisela Voda municipality, Macedonia according to Gontarev and Kalac²². The our results for overweight and obese Bulgarian children are lower compare of those for the Greek adolescents, aged from 12 to 15 years²³.

The children and adolescents examined by us have similar distribution of overweight and obesity to that of their peers from Jagodina, Central Serbia²⁷. Thus, in the period from the 8th – 15th year, the average incidence of occurrence of overweight among Serbian boys (21.5 %) is only 2.7% higher than that of our boys (18.8 %), while obesity among Serbian boys (6.2 %)

is, on the average, only 1.4% less than that of the Bulgarian boys (7.6 %). The tendency is similar with the girls - overweight among Serbian 8-15-year-old girls (19.4 %) is, on average, more frequently distributed, by 2.2 % than that among the Bulgarian girls (17.1 %), while obesity is more frequent, by 2.4 % respectively. More significant differences between the two groups of children have been observed in the distribution of overweight and obesity in the different ages.

Also, independently of some differences in the age of the investigated persons it appears that in Bulgaria the percentage of children and adolescents with overweight and obesity is similar to this percent for children and adolescents from Ankara, Turkey²⁸, higher than in China²⁹ and Brazil³⁰, but lower than in the United States⁶.

Differences in the distribution of underweight and overweight among the various territorial groups of Bulgarian children and adolescents, as well as between them and their peers from other countries are associated with genetic differences and differences in their eating habits, physical activity, the quality and style of life, as well as in the socio-economic status of their families.

Our results in terms of body nutritional status have also shown that the greatest percentage of surveyed individuals with underweight, overweight and obesity has been observed among the 10-11 and 13-14-year-old boys and among the 10-15-year-old girls, i.e. in the period of the pre-puberty and puberty. Similar trends are reported by other authors^{22-23,25-27,31}.

In both sexes, these periods coincide with pre-puberty and puberty changes in the body, with great hormonal changes that affect the body composition and morphology. Understandably, the increase of the percentage of adolescents with underweight and overweight in the pre-puberty and puberty periods are associated with the hormonal changes accompanying the growth, and with the differences in eating habits, physical activity, socio-economic status of the families as well as with the way of life. In Bulgaria, as in the developed countries, the modern "urban" lifestyle has become the predominant trend in the family. In their hectic daily routine, preoccupied with their work, parents and especially mothers spend less time in preparing homemade food and providing healthy nutrition for their children. Nowadays, Bulgarian students spend the greater part of the day in school, eating mainly fast food, purchased at the school, such as pizza, hot-dog, sandwiches, crisps, snacks, waffles, biscuits, chocolates, soft drinks. This is one of the main reasons for the increased incidence of overweight and obesity among Bulgarian children³². Moreover, another important reason for this alarming trend is hipodynamics. Children spend increasingly less time in outdoor sports and physical activities at the expense of time spent in front of the computer and TV³². Similar trends as reasons for the increase in the incidence of overweight and obesity are reported by other authors³³.

Another trend observed in this study is the increase of the frequency of occurrence of underweight simultaneously with overweight and obesity among children and adolescents studied. Throughout the whole age period, the percentage of underweight boys generally varies from 1.8 % to 8.6 % until the 10th year, reaching 15.7 % in the 11th year. With the girls, the greatest number of underweight cases is observed in the 9th, 11th, 14-15th year of age, and the highest the percentage of underweight, a total of 22.4 % has been observed in 15-year-old girls. In both sexes, during these periods the intensive growth velocity and pre-puberty and puberty "jump" of height and weight are observed which are connected with changes in the body composition. Another significant reason for the high percentage of girls with underweight in the period of their 14-15th year is their desire to be slim and their wish to follow fashion trends and to look up to their fashion idols. Other authors report similar trends as well³⁴.

Our findings showing an increase of the frequency of occurrence of students with underweight are confirmed by the results of other authors^{19-20,25-26,31}.

Another important result of this study is the more frequent distribution of overweight and obesity in boys, which is observed to occur in all age periods. These results confirm earlier received similar data for Macedonia²², Greece²³, China²⁹, as well as for children from other Bulgarian territorial groups^{5,19,25}.

For the first time in this study, there are data for the central obesity of Bulgarian children and adolescents, assessed on the basis of the WHtR.

Our results indicate that 87.25 % of the surveyed children and adolescents of both sexes have normal fat distribution and lack central obesity (WHtR < 0.500), and those with central obesity (WHtR ≥ 0.500) are 12.75 % respectively (Table IV) independently of their nutritional status. In terms of gender comparison, 17.1 % of the boys and 9.3 % of the surveyed girls have central obesity, which is considerably less than the distribution of central obesity among children in Yemen³⁵ and slightly higher than this distribution of Pakistani children¹³.

The results we derived for the percentage of the children with different nutritional status and central obesity are very important for the clinical practice (Table V). A total of 2.7 % of all the examined children with normal weight and an average of 46.82 % of the studied obese children (overweight and obesity) have central obesity (WHtR ≥ 0.500). Our results show a lower percentage for Bulgarian children and adolescents with normal weight and central obesity (2.7 %), but a higher percentage of surveyed children with overweight and general obesity but without central obesity (53.17 %) as compared to the data for children and adolescents from Bogalusa Heath study¹¹.

A total of 14.1 % of all tested boys and girls with normal and excessive body nutritional status are with

increased health risk (WHtR ≥ 0.500). With normal weight and without risk according to the IOTF BMI criteria, but with risk according to WHtR criteria (WHtR ≥ 0.500) are 2.01 % of the surveyed children (Table V). Yet, this small percentage of children and adolescents must be taken seriously as they do not fall in the risk categories subject to monitoring during the screening of general obesity on the basis of BMI¹⁴.

Another important result regarding central obesity shows more frequent distribution among boys as compared to girls, which has been observed in all age periods. These data obtained by us confirm the earlier results by Mc Carthy, Aswell¹⁰ for British children, as well as the results by Mushtaq et al.¹³ for Pakistani children, who also reported more frequent distribution of central obesity in males. Bamoshmoosh et al.³⁵ in their study of Yemeni children and adolescents reported a trend opposite to ours and also a predominance of girls with central obesity.

The combination of overweight or obesity with central accumulation of fat in the researched age period occurs more often among boys as compared to girls, which probably shows that ever since pre-puberty the Bulgarian boys are prone to higher cardio-metabolic risk compared to the girls, with this trend continuing into adulthood.

Conclusion

The results of this study showed that for last over one decade there has been an increase in prevalence of overweight and obesity among Bulgarian children and adolescents from Smolyan region. The disturbing fact is the relatively high percentage of underweight children, especially among in group of the girls after puberty. The greatest percentage of individuals with underweight, overweight and obesity has been observed in the period of the pre-puberty and puberty. The central obesity, as well as its combination with overweight or general obesity is more frequent in boys than in girls. This indicates confirm the greater “eco-sensitivity” and higher cardio-metabolic risk for Bulgarian boys, which starts in the period of growth.

Conflicts of interest statement

The authors declare no conflict of interest related to this manuscript.

Acknowledgements and funding

This manuscript was developed with the financial support of the Fund “Scientific Research” at Plovdiv University “ Paisii Hilendarski”, Bulgaria, Grant N° SR13 FS 007.

References

1. Dias Pitangueira JC, Rodrigues Silva L, Portela de Santana ML, Monteiro da Silva Mda C, de Farias Costa PR, D'Almeida V, de Oliveira Assis AM. Metabolic syndrome and associated factors in children and adolescents of a Brazilian municipality. *Nutr Hosp.* 2014; 29(4):865-872.
2. Nascimento-Ferreira MV, De Moraes AC, Carvalho HB, Moreno LA, Gomes Carneiro AL, Dos Reis VM, Torres-Leal FL. Prevalence of cardiovascular risk factors, the association with socioeconomic variables in adolescents from low-income region. *Nutr Hosp.* 2015; 31(1): 217-224.
3. Wang Y, Lobstein T. Worldwide trends in childhood overweight and obesity. *Int J Pediatr Obes* 2006, 1:11-25.
4. Kosti RI, P. D. The epidemic of obesity in children and adolescents in the world. *Cent Eur J Pub Health* 2006, 14, 4: 151-159.
5. Mitova Z, Stoev R, Yordanova L. Nutritional Status in 9-15-years old Schoolchildren from Sofia, Bulgaria (1984-2002). *Acta Morphologica et Anthropologica* 2012, 19: 246-249.
6. Ogden C, Carroll M, Kit B, Flegal K. Prevalence of Obesity and Trends in Body Mass Index Among US Children and Adolescents, 1999-2010. *JAMA*, 2012, 307, 5:483-490.
7. World Health Organization. Noncommunicable Diseases Country Profile, 2011, 40-41.
8. Freedman D, Wang J, Maynard L, Thornton J, Mei Z, Pierson R, Dietz W, Horlick M. Relation of BMI to fat and fat-free mass among children and adolescents. *Int. J. Obes. Lond.* 2005, 29, 1:1-8.
9. Hsieh SD, Yoshinaga H, Muto T. Waist-to-height ratio, a simple and practical index for assessing central fat distribution and metabolic risk in Japanese men and women. *Int J Obes* 2003, 27: 610-616.
10. Mc Carthy HD, Ashwell M. A study of central fatness using waist-to-height ratios of UK children and adolescents over two decades supports the simple message – ‘keep your waist circumference to less than half your height’ . *International Journal of Obesity* 2006, 30: 988-992.
11. Mokha J, Sathanur S, Pronabesh DM, Camilo F, Wei Ch, Jihua X, Gerald B . Utility of waist-to-height ratio in assessing the status of central obesity and related cardiometabolic risk profile among normal weight and overweight/obese children: The Bogalusa Heart Study. *BMC Pediatrics* 2010, 10:73
12. Yan W, Bingxian H, HuaY, Jianghong D, Jun C, Dongliang G, Yujian Z, Ling L, Yanying G, Kaiti X, Xiaohai F, Da D. Waist-to-Height Ratio is an Accurate and Easier Index for Evaluating Obesity in Children and Adolescents. *Obesity* 2007,15 (3): 748-752.
13. Mushtaq MU, Gull S, Abdullah HM, Shahid U, Shad MA, Akram J. Waist circumference, waist-hip ratio and waist-height ratio percentiles and central obesity among Pakistani children aged five to twelve years. *BMC Pediatr* 2011, 11:105.
14. Ashwell M, Gibson S. A proposal for a primary screening tool: ‘Keep your waist circumference to less than half your height’. *BMC Medicine* 2014, 12:207.
15. Martin R, Saller K. Lehrbuch der Anthropologie. Stuttgart: Gustav Fisher Verlag, 1957, 1- 661.
16. Cole T, Bellizzi M, Flegal K, Dietz W. Establishing a standard definition for child overweight and obesity worldwide: international survey. *British Medical Journal.* 2000; 320(7244):1240-1243.
17. Cole T, Flegal K, Nicholls D, Jackson A. Body mass index cut offs to define thinness in children and adolescents: international survey. *British Medical Journal.* 2007; 335(7612):194-197.
18. Mladenova S, Nikolova M. Distribution of overweight and obesity among Smolyan children and adolescents. *Proceedings with scientific reports from Jubilee National Conference with International Participation “20 years of Union of Scientists in Smolyan”*, part Biology and Medicine. Smolyan, 2006, 1025 – 1034 (In Bulgarian)
19. Nikolova M, Tineshev S. Comparison of the body mass index to other methods of body fat assessment in Bulgarian children and adolescent. *Biotechnol. & Biotechnol. EQ.* 2010. 24/SE : 329-337.

20. Nacheva A, Gecheva Y, Yankova I, Filcheva Z, Mitova Z, Yordanov Y. Physical development of children and adolescents in the borderline between XX and XXI century. *Monographs. Prof Marin Drinov Academic Publishing House* 2012, 1-417 (In Bulgarian)
21. Jehn ML, Gittelsohn J, Treuth MS, Caballero B. Prevalence of overweight among Baltimore city schoolchildren and its associations with nutrition and physical activity. *Obesity*, 2006, 14 (6): 989-993.
22. Gontarev S, Kalac R. Association between obesity and socioeconomic factors in Macedonian children and adolescents. *Advanced in Life Sciences and Health* 2014, 1 (1): 55-63.
23. Grammatikopoulou M, Poulimeneas D, Gounitsioti I, Gerothanasi K, Tsigga M, Kiranas E. Prevalence of simple and abdominal obesity in Greek adolescents: the ADONUT study. *Clinical obesity*, 2014, (4): 303-308.
24. World Health Organization. Regional Office for Europe, 2013. Nutrition, Physical Activity and Obesity. Bulgaria. //Country profiles covering developments in nutrition, physical activity and obesity in the WHO European Region. Available online at: <http://www.euro.who.int/en/nutrition-country-profiles>.
25. Mitova Z. Anthropological characteristics of physical development, body composition and body nutritional status in 9-15-years old children and adolescents from Sofia city. Sofia, Bulgaria. *Autoref. PhD thesis*, 2009 (In Bulgarian).
26. Tineshev S. Anthropological characteristics of children and adolescents. Plovdiv, Bulgaria, (In Bulgarian).
27. Pavlica T, Rakic R, Djuricanin A, Korovljevic D, Srdic B. Growth and nutritional status of children and adolescents from 7 to 19 Years of age in the town of Jagodina (Central Serbia), *HealthMed* 2012, 6 (1): 284-293.
28. Kurtulus E. Obesity: In World and Turkey. I wanna learn wch that how often obesity to be seen in the World and Turkey. *EAA Summer School eBook* 2007 (1): 175-179.
29. He L, Ren X, Chen Y, Jin Y, Pan R, Wei N, Qiu S, Lu W, Ding L, Guo D, Wang L, Nie Z, Yao Y. Prevalence of overweight and obesity among primary school children aged 5 to 14 years in Wannan area, China. *Nutr Hosp*. 2014;30(4):776-781.
30. Ferreira Marques CD, Ribeiro Silva Rde C, Machado ME, Portela de Santana ML, Castro de Andrade Cairo R, Pinto Ede J *et al*: The prevalence of overweight and obesity in adolescents in Bahia, Brazil. *Nutr Hosp* 2013, 28(2):491-6
31. Yankova I, Zhecheva Y, Nacheva A, Yordanov Y. Underweight in Bulgarian Boys and Girls from 3 till 17 years of Age living on the Borderline between 20th and 21st century. *Acta morphologica et anthropologica* 2010, 16: 65-75.
32. Mladenova, S. Physical development and lifestyle of schoolchildren from Smolyan region (preliminary data). *Conference proceedings of International Conference "Innovations, Challenges and Tendencies in Postmodern Education"*, Stara Zagora, 2013. Available online at: <http://pf-conference.info/bg/rapports> (In Bulgarian).
33. Hills A, Andersen L, Byrne N. Physical activity and obesity in children. *British Journal of Sport Medicine* 2011, 45(11): 866-70.
34. Permyakova E. 2010. Contemporary tendencies in fat development in urban and rural children and adolescents. Scientific Research Institute and Museum of Anthropology, Moscow State University "Mikhail Lomonosov", Moscow. *Autoref. PhD Thesis* 2013 (In Russian).
35. Bamoshmoosh M, Massetti L, Aklan H, Al-Karewany M, Al-Goshah H, Amedeo Modesti P. Central obesity in Yemeni children: A population based cross-sectional study. *World J Cardiol* 2013, 5(8): 295-304.



Original/*Obesidad*

Effect of calorie restriction on energy expenditure in overweight and obese adult women

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Abstract

Energy expenditure (EE) may decrease in subjects on hypocaloric diets, in amounts that exceed body mass loss, favoring weight regain.

Objective: to verify if a short-term caloric restriction lowers Resting Energy Expenditure (REE) and Total Energy Expenditure (TEE) more than predicted by changes in body composition, and if this reduction of EE is related with compliance to the diet.

Methods: twenty-two women aged 23-44 years with a body mass index (BMI) of 25-32 kg/m², underwent a three-month calorie restriction treatment (20 kcal / kg initial weight) and were encouraged to increase their physical activity. At the beginning and end of the intervention, body composition (DEXA), REE, Physical Activity Energy Expenditure (PAEE) and TEE were assessed, through a combination of indirect calorimetry and actigraphy. Participants, who lost more or equal than 5% of their initial weight were considered compliant with the diet.

Results: in the compliant group, REE decreased, when expressed in absolute numbers or when adjusted by fat free mass (FFM) [-164 ± 168 kcal/day (10,6%) and -4,3 ± 4,6 kcal/kg FFM (10,5%)]. This decline was significantly greater than that observed in the non-compliant group [-6,2 ± 1,42 Kcal/day (0,16%) and -0,5 ± 3,4/Kg FFM (0,96%)]. FFM did not change in any of the two groups. At baseline, there was a significant correlation between FFM and REE ($r = 0,56$ $p < 0,05$), which was lost at the end of the intervention.

Conclusions: compliant women showed a significant reduction in both absolute and adjusted REE, which together with the loss of correlation between REE and FFM at the end of the intervention suggests a metabolic adaptation.

(Nutr Hosp. 2015;31:2428-2436)

DOI:10.3305/nh.2015.31.6.8782

Key words: *Energy expenditure. Adaptive thermogenesis. Calorie restriction. Obesity.*

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Recibido: 3-II-2015.

1.ª Revisión: 3-III-2015.

Aceptado: 13-III-2015.

EFFECTO DE LA RESTRICCIÓN CALÓRICA SOBRE EL GASTO ENERGÉTICO EN MUJERES ADULTAS CON SOBREPESO U OBESIDAD

Resumen

El gasto energético (GE) puede disminuir en sujetos sometidos a dietas hipocalóricas, en una magnitud que excede la reducción explicada por los cambios en la composición corporal; dificultando la mantención del peso perdido.

Objetivo: verificar si el Gasto Energético en Reposo (GER) y Total (GET) experimentan una disminución mayor a lo atribuible a cambios en la composición corporal y dependen de la adherencia al tratamiento dietario.

Metodología: veintidós mujeres (23-44 años) con Índice de Masa Corporal (IMC) entre 25 y 32 kg/m² fueron sometidas a tres meses de restricción calórica (20 kcal/kg de peso inicial) y motivadas a aumentar su actividad física. Al inicio y al final se evaluó: peso, masa grasa (MG) y masa libre de grasa (MLG) con DEXA, GER (calorimetría indirecta), Gasto Energético por Actividad Física (GEAF) y GET (actigrafía). Las participantes que perdieron ≥ 5% del peso inicial fueron consideradas como adherentes a la dieta.

Resultados: el grupo adherente tuvo una disminución significativa del GER absoluto [-164 ± 168 kcal/día (10,6%) y -4,3 ± 4,6 kcal/kg MLG (10,5%)]. Esta disminución fue significativamente mayor que la observada en el grupo no adherente [-6,2 ± 1,42 kcal/día (0,16%) y -0,5 ± 3,4/kg FFM (0,96%)]. La MLG no cambió en ninguno de los dos grupos. Existió asociación significativa entre MLG y GER ($r = 0,56$; $p < 0,05$) solo al inicio en el grupo total.

Conclusiones: las mujeres adherentes a la restricción calórica mostraron una reducción en el GER tanto absoluto como ajustado por la MLG, lo cual, junto con la pérdida de correlación entre el GER y la MLG al final de la intervención, sugieren adaptación metabólica.

(Nutr Hosp. 2015;31:2428-2436)

DOI:10.3305/nh.2015.31.6.8782

Palabras clave: *Gasto energético. Termogénesis adaptativa. Restricción calórica. Obesidad.*

Abbreviations

EE: Energy Expenditure.
REE: Resting Energy Expenditure.
TEE: Total Energy Expenditure.
PAEE: Physical Activity Energy Expenditure by.
BMI: Body Mass Index.
FM: Fat Mass.
FFM: Fat Free Mass.
CR: Calorie restriction.
TSH: thyroid stimulating hormone.
EV: Expiratory Volume.
VO₂: Oxygen Volume.
VCO₂: carbon dioxide volume.
DLW: Double labeled water method.

Introduction

Caloric restriction (CR) is one of the most commonly used interventions for the management of overweight and obesity. It seems to be ineffective in the long term because individuals experience stabilization and recovery of weight, which appears to derive mainly from a metabolic adaptation or adaptive thermogenesis, which involves a decrease in Resting or other components of Energy Expenditure. These adaptations appear to be independent of the reduction in fat and fat free mass, and could represent an adaptive defense mechanism to protect depots from energy depletion^{1,2,3}.

The mentioned metabolic adaptations have been demonstrated by comparison of measured versus predicted resting energy expenditure (REE) or total energy expenditure (TEE), using formulas derived from linear regressions that consider REE, fat free mass (FFM) or initial fat mass (FM)^{1,4-7}. FFM is the metabolically active mass and it is the main determinant of REE. It explains between 60 to 80% of its variability, while FM only contributes between 5 to 7%⁴. Other studies have used the REE /FFM ratio considering a decrease of this value as a possible indicator of metabolic adaptation⁸⁻¹⁰.

Studies in lean and obese subjects undergoing weight loss through caloric restriction have observed metabolic adaptations either through a fall of REE or 24 hours EE. Astrup A et al, comparing a group of former obese subjects with non-obese individuals who underwent a program of calorie restriction found a 4.1% decrease in adjusted REE among the former not observing changes in the non-obese group¹¹. Menozzi R et al observed a decrease of 6.5% in REE in obese women, after 1 month of severe caloric restriction (700 calories), considering FFM as the factor that explained 80% of its variability¹². Johannsen D et al, employed a plan of calorie restriction and vigorous exercise in morbidly obese subjects, observing a decline of 6% of REE adjusted by FFM in the first 6 weeks of the intervention and 22% at week 30, when the study finished¹⁰. Camps S et al, in moderately obese subjects following

a very low calorie diet, found a decrease of 4% in REE adjusted by FFM and FM in both the restriction and the maintenance of weight phases¹³. After 2 years of caloric restriction in normal weight subjects, Weyer et al observed a 6% decrease in 24 hours-TEE adjusted by the change in FFM and FM⁵. Similar findings were found in a longer study (6 months) in overweight subjects subjected to 25% calorie restriction with or without exercise, showing that despite the prescription of exercise the 24 TEE decreased more than expected by changes in body composition⁶. Goele K, et al, reported a similar decline in REE adjusted by FFM (5.6%) only among women who were adherent to a 14-week intervention diet of 1000 calories/day⁹.

Thus, according to the mentioned evidence, most of the studies have showed that after weight reduction induced by calorie restriction, there is a metabolic adaptation detected mainly by the decrease in REE, but there are few reports associating this decrease in REE with adherence to the intervention. Our aim was to verify whether a significant metabolic adaptation occurs in overweight or obese premenopausal women after a short-term caloric restriction (3 months), depending on compliance to the treatment. We expected to find a decrease in both REE and TEE higher than that expected by changes in body composition.

Subjects and methods

Subjects: Twenty two premenopausal women aged between 25 and 45 years with a body mass index (BMI) between 25 and 32 kg/m² and interested in losing weight, were initially screened at Centro de Diagnóstico de INTA (CEDINTA). Exclusion criteria were: diabetes mellitus, hypothyroidism, history of cancer, liver or kidney failure, pregnancy, use of medications that could alter the measurements, such as beta-blockers, anticonvulsants and psychotropics and a weight variation in the last months of more than 2 kg. Twenty five started the study but three women dropped out for personal reasons, so 22 completed the study. The study protocol was approved by the Ethics Committee of INTA. Each participant signed the informed consent before beginning the study. The study is registered at clinicaltrials.gov number NCT01508091.

Intervention and follow-up: The intervention consisted in the prescription of a low calorie Mediterranean type Diet (MD) (20 Kcal/Kg baseline body weight), with 5 daily meals during 3 months. Distribution of macronutrients was 50% carbohydrates, 25-30% lipids and 20 to 25% protein. The research team, to enhance compliance, provided one of these meals, to be ingested 1 to 3 times a week. It consisted in adequate portions of dried fruits (175 Kcals/serving of 30 grams), cereal bars (69 Kcals/serving of 20 grams) or whole grain cookies (153 Kcals/serving of 3 cookies). Patients were followed weekly by the research dietitian or physician, recording weight and compliance

Table I
Characteristics of the study population at baseline (n=22)

	<i>Variables</i>	<i>Mean*, SD, range</i>
Anthropometric	Age (years)	32,2 ± 6,3 (23 - 44)
	Height (cm)	160,7 ± 6,3 (146 - 173)
	Weight (kg)	74,4 ± 7,9 (56 - 91,7)
	BMI (Kg/m ²)	28,1 ± 2,1 (24,4 - 31,7)
	Waist circumference (cm)	94,6 ± 6,9 (81 - 100)
Body composition	Fat Free Mass (Kg)	38,9 ± 4,2 (28,2 - 48,4)
	Fat Free Mass (%)	53,5 ± 3,1 (47,9 - 60,5)
	Apendicular FFM (kg)	17,5 ± 2, 3 (12,3 - 22,0)
	ApFFMI (FFMMap/Height m ²)	6,8 ± 0,7 (5,8 - 8,2)
	Fat Mass (Kg)	31,6 ± 4,4 (23,9 - 39,1)
	Fat Mass (%)	43,4 ± 3,1 (36,1 - 48,4)
Metabolic	Matsuda Index	8,3 ± 4,7 (2,3 - 19,9)
	Triglycerides (mg/dL)**	94,5 (77-139)
	TSH (μU/mL)	2,3 ± 0,8 (0,65 - 4,05)
	Total T3 (ng/ml)	1,5 ± 0,4 (0,97 - 2,36)
	Free T3 (pg/mL)	3,3 ± 0,6 (2,2 - 4,9)
Energy expenditure	REE(Kcal/day)	1478 ± 130 (1524 - 1793)
	REE/Kg	20,0 ± 1,9 (17,0 - 24,8)
	REE/ Kg FFM	38,3 ± 3,8 (32,9 - 49,2)
	PAEE (Kcal/day)	681 ± 275,1 (242 - 1174)
	TEE (Kcal/day)	2418 ± 327 (1892 - 2960)
	TEE/Kg	32,7 ± 4,7(24,7 - 42,7)
	TEE/Kg FFM	62,8 ± 10,5 (49,3 - 84,7)
	PAL (TEE/REE)	1,6 ± 0,2 (1,3 - 2,0)

*Mean, SD: Standar Deviation, **Median (interquartile range).BMI: Body Mass Index, REE; Resting Energy Expenditure, PAEE: Physical Activity Energy Expenditure, TEE: Total Energy Expenditure, ApFFMI: Apendicular FFM Index (Arms FFM+ Legs FFM/ Height m²)

with dietary recommendations, encouraging healthy lifestyles and an increase in physical activity.

Compliance was arbitrary defined according to changes in body weight, considering compliant those participants who achieved a reduction of ≥ 5% of their initial weight and non-compliant those who did not achieve this goal. Dietary recalls were not performed due to lack of precision and under-reporting^{14,15}.

Measurements:

Anthropometry and body composition: Each participant underwent anthropometric measurements (height, weight, waist circumference and BMI) and body composition measurements (total, bone, fat, lean body mass and appendicular lean body mass) using a Lunar Encore double beam densitometer (DEXA), at the start and the end of the dietetic intervention.

Metabolic parameters: At baseline and after the 3-month intervention, fasting blood samples were

withdrawn for the measurement of glucose, insulin, thyroid hormones, and lipoproteins and an oral glucose tolerance test (OGTT), measuring glucose and insulin levels 60, 90 and 120 min following a 75 g glucose challenge. Insulin resistance was evaluated by calculating the Matsuda-DeFronzo index¹⁶.

Energy expenditure: REE was measured using an indirect calorimeter (Sensor Medics Vmax Encore 29) after fasting for 8-11 hours in the supine position, in thermoneutral conditions, using a transparent canopy. For about 20 minutes, the oxygen consumption and CO₂ production was measured, obtaining REE after the calorimeter showed steady state, defined as a period of 5 consecutive intervals during which the change in the volume of oxygen (VO₂) and Expiratory Volume (EV) was 10% or less and the variation of the Respiratory quotient (RQ) was 5% or less.

Table II <i>Change in characteristics of the study population after 3 months of calorie restriction (n=22)</i>			
	<i>Variables</i>	<i>Δ (End-Baseline)*</i>	<i>p value</i>
Anthropometrics	Weight (Kg)	-3,9 ± 3,18 (-12,6 - 1,7)	0,000†
	Weight change (%)	-5,3 ± 4,3 (-15,83 - 2,4)	0,001†
	Waist circumference (cm)	-4,9 ± 3,2 (-11 - 0)	0,000†
Body composition	Fat Free Mass (Kg)	0,3 ± 0,8 (-1,7 - 1,7)	0,13
	Fat Free Mass (%)	2,5 ± 1,9	0,000†
	Apendicular (FFM) (Kg)	0,2 ± 1,07	0,40
	ApFFMI (FFMap/Height m ²)	0,08 ± 0,4	0,38
	Fat Mass (Kg)	-2,7 ± 2,4 (-8,8 - 0,6)	0,00†
	Fat Mass (%)	-2,3 ± 1,9	0,000†
Metabolic	Matsuda Index	0,7 ± 7,7 (-16 - 24)	0,59
	Triglycerides (mg/dL)**	-18,5 (-11 - 40)	0,02††
	TSH (μU/mL)	-0,1 ± 1,2 (-3,2 - 3,4)	0,69
	Total T3 (ng/ml)	-0,2 ± 0,3 (-0,9 - 0,3)	0,01†
	Free T3 (pg/mL)	-0,1 ± 0,6 (-1,05 - 1,0)	0,30
Energy expenditure	REE(Kcal/day)	-92 ± 173 (-543 - 191)	0,02†
	REE/Kg	-0,2 ± 2,3 (-6,3 - 3,2)	0,69
	REE/ Kg FFM	-2,6 ± 4,5 (-13,6 - 4,9)	0,013†
	PAEE (Kcal/day)	283 ± 434 (-362 - 1264)	0,006†
	TEE (Kcal/day)	178 ± 430 (-460 - 1037)	0,06
	TEE/Kg	4,4 ± 5,7 (-5,4 - 18,0)	0,0017†
	TEE/Kg FFM	3,9 ± 11,2 (-15,4 - 26,9)	0,11
	PAL (TEE/REE)	0,3 ± 0,4 (-0,3 - 1,3)	0,004†

*All values are presented as mean±SD, (min-max).

**Median and interquartile range

† Difference between baseline and after treatment: p<0,05 (Paired two samples Student's t-test) †† Wilcoxon test

REE: Resting Energy Expenditure, PAEE: Physical Activity Energy Expenditure, TEE: Total Energy Expenditure, ApFFMI: Apendicular FFM Index (Arms FFM+ Legs FFM/ Height m²)

Physical Activity Energy Expenditure (PAEE) was determined through the use of an Actiheart® accelerometer. The individual calibration of the device was carried out after performing an exercise calorimetry using a cycle ergometer to create an individual energy expenditure-heart rate (HR) curve¹⁷. The device is placed in the subject's chest according to manufacturer's instruction. HR, heartbeat interval and the frequency and intensity of horizontal, vertical and oblique movements, by means of an internal accelerometer. Recording was carried out every 60 seconds for a period of 3 days during weekdays and weekends. TEE was calculated through Actiheart® software data. The physical activity level (PAL) was calculated as the TEE/REE ratio. PAL between 1.4 and 1.69 is considered sedentary activity, a PAL between 1.77 to 1.99 moderate activity and PAL between 2.0 to 2.4 vigorous activity¹⁸.

Statistical analysis: Data are expressed as mean ± standard deviation (SD) or median and interquartile range for variables with normal distribution or not normally distributed, respectively. Normality was assessed using Shapiro-Wilk test. The association between REE or TEE with FM, FFM and T3 was evaluated through Pearson correlation coefficients. Paired two samples Student's t-test was used to analyze the changes in variables with normal distribution and Wilcoxon test otherwise. Analyses were performed using the statistical program STATA 12 (Data Analysis and Statistical Software).

Results

Anthropometric, body composition, metabolic and EE characteristics at baseline are shown in table I. The

Table III
Change of anthropometric and body composition characteristics after 3 months of calorie restriction by compliance

Variables		Compliant (n=12)		Non-compliant (n=10)	
		Δ End- Baseline*	p value	Δ End-Baseline*	p value
Anthropometric	Weight (Kg)	-6,1 $\pm$ 2,3 (-12,6 - -3,8)	0,000†‡	-1,3 $\pm$ 1,5 (-3,5 - 1,7)	0,003†
	Weight change(%)	-8,3 $\pm$ 3,1 (5,1 - 15,8)	0,000†‡	-1,6 $\pm$ 2,1 (-2,4 - 4,3)	0,000†
	Waist circumference (cm)	-6,7 $\pm$ 3,0 (-11 - -2)	0,000†‡	-2,9 $\pm$ 1,9 (-7 - 0)	0,001†
Body composition	Fat Free Mass (Kg)	0,1 $\pm$ 0,8 (-1,7 - 1,2)	0,61	0,4 $\pm$ 0,7 (-0,5 - 1,7)	0,08
	Fat Free Mass (%)	3,8 $\pm$ 1,5 (1,6 - 6,2)	0,000†‡	0,9 $\pm$ 0,7 (-0,5 - 2,1)	0,004†
	Apendicular FFM (Kg)	-0,2 $\pm$ 0,5 (-1,2 - 0,5)	0,23	-0,2 $\pm$ 1,5 (-4,5 - 0,8)	0,67
	Ap FFMI (FFMap/Height m ²)	-0,8 $\pm$ 1,9 (-4,4 - 1,6)	0,19	-0,9 $\pm$ 6,2 (-1,8 - 3,1)	0,66
	Fat mass (Kg)	-4,4 $\pm$ 2,0 (-8,8 - -0,4)	0,000†‡	-0,7 $\pm$ 0,7 (-1,5 - 0,6)	0,007†
	Fat mass (%)	-3,6 $\pm$ 1,6 (-6,0 - -0,13)	0,000†‡	-0,8 $\pm$ 0,8 (-2,0 - 0,6)	0,014†

* All values are presented as mean $\pm$ SD, (min - max).

**Median and interquartile range

† Difference between baseline and after treatment: p<0,05 (Paired two samples Student's t-test)

†† Wilcoxon test.

‡: difference between baseline and after treatment means between groups (unpaired t test)

effect of 3 months of caloric restriction on the total group is shown in table II. Weight decreased by 5.3 $\pm$ 4.3% (p<0.05), with a fat loss of 2.3 $\pm$ 1.9% (p<0.05), without changes in FFM and appendicular FFM. There was a significant reduction in waist circumference, triglyceride and total triiodothyronine levels (p<0.05). REE and REE/kg FFM significantly decreased from baseline (5,6% and 6,2% respectively, p<0,05). At baseline, there was a significant correlation between FFM and REE (r = 0,56 p<0,05), which was not present at the end of the intervention (r= 0.30, p>0,05).

Twelve participants were considered compliant with dietary restriction (54%), as defined in material and methods. The effect of 3 months of caloric restriction according to the compliance to the treatment is shown in tables III and IV. Weight and fat loss were significant in both groups; the compliant group achieved a weight loss of 8.3% and a fat loss of 3.6 $\pm$ 1.6%. FFM did not change in any of the groups. Absolute and REE/Kg FFM significant decreased only in the compliant group by -164 $\pm$ 168 kcal/day (10.6%), and

-4.3 $\pm$ 4.6 kcal/kg FFM (10.5%), respectively p<0.05. PAEE significantly increased only in the non-compliant group, whereas TEE and PAL increased significantly only in this group (p<0.05). When adjusting TEE/kg of body weight a significant increase was observed in both groups (p<0.05). A positive association between REE and FFM was observed only at baseline in the compliant group (r = 0.65, p<0.05).

Discussion

The significant decrease in weight, FM and both absolute (10.6%) and adjusted by FFM REE (10.5%) shown in women who complied with a low calorie Mediterranean Diet type for 3 months, are even higher than those reported by Goelle K et al, whose intervention was similar in population and duration to ours⁹. With a diet of 1000 calories women who were compliant, showed significant decrease in absolute REE and REE/Kg FFM by 5.7% but those patients did not

Table IV
Change in metabolic and energy expenditure characteristics after 3 months of calorie restriction by compliance

Variables		Compliant (n=12)		Non-compliant (n=10)	
		Δ End- Baseline*	p value	Δ End-Baseline*	p value
Metabolic	Matsuda Index	1,1 $\pm$ 10,2 (-16 - 24,6)	0,639	0,2 $\pm$ 3,2 (-2,9 - 8,5)	0,833
	Triglycerides (mg/dL)**	-17,5 (-42,5- 5,5)	0,136	-20 (-37-11)	0,092
	TSH μ U/mL	-0,4 $\pm$ 1,1 (-3,2 a 0,8)	0,272	0,2 $\pm$ 1,3 (-1,5 a 3,4)	0,616
	Total T3 (ng/ml)	-0,2 $\pm$ 0,3 (-0,9 a 0,3)	0,06	-0,1 $\pm$ 0,2 (-0,5 a 0,3)	0,09
	Free T3 (pg/mL)	-0,2 $\pm$ 0 ,6(-1,1 a1,0)	0,3606	-0,09 $\pm$ 0 ,6 (-1,0 a 0,9)	0,6385
Energy expenditure	REE (Kcal/day)	-164 $\pm$ 168 (-543 a 45)	0,006$\dagger$¶	-6,2 $\pm$ 142 (-219 a 191)	0,893
	REE/ Kg	-0,6 $\pm$ 2,7 (-6,3 a 3,2)	0,45	0,3 $\pm$ 1,8 (-2,3 a 3,1)	0,62
	REE /Kg Fat Free Mass	-4,3 $\pm$ 4,6 (-13,6 a 0,9)	0,008¶	-0,5 $\pm$ 3,4 (-5,5 a 4,9)	0,67
	PAEE (Kcal/day)	230 $\pm$ 489(-362 a1264)	0,13	346,5 $\pm$ 374 (-362 a 907)	0,01$\dagger$
	TEE (Kcal/day)	68 $\pm$ 415 (-460 a 800)	0,58	309 $\pm$ 431 (-460 a 1037)	0,04$\dagger$
	TEE/kg	3,9 $\pm$ 5,3 (-4,0 a 13,1)	0,02$\dagger$¶	5,0 $\pm$ 6,4 (-5,4 a 18,0)	0,03$\dagger$
	TEE/Kg FFM	1,0 $\pm$ 10,2(-14,2a 17,3)	0,74	7,4 $\pm$ 11,8 (-15,5 a 26,9)	0,07
	PAL (TEE/REE)	0,3 $\pm$ 0,4 (-0,3 a 1,3)	0,06	0,3 $\pm$ 0,3 (-0,3 a 0,7)	0,02$\dagger$

* All values are presented as mean $\pm$ SD, (min - max).

**Median and interquartile range.

$\dagger$ Difference between baseline and after treatment: p<0,05 (Paired two samples Student's t-test) $\dagger\dagger$ Wilcoxon test.

¶: difference between baseline and after treatment means between groups (unpaired t test).

REE: Resting Energy Expenditure, PAEE: Physical Activity Energy Expenditure, TEE: Total Energy Expenditure.

preserve FFM as in the present study⁹. Another longer term study (6 months) in obese population undergoing a low calorie diet without exercise, showed a loss of FFM and a significant decrease in REE (3%) after adjusting for FFM and FM¹⁹. In our study we also observed a fall in total triiodothyronine, which is one of the factors involved in the metabolic adaptation to caloric restriction. Similar findings have been reported by several studies^{5,6,10,20}.

Comparably to the present study, Johansenn D et al found a decrease of adjusted REE in morbidly obese population, employing a 30% caloric restriction accompanied by a plan of vigorous exercise for 7 months. After the initial 6 weeks, FFM was preserved and REE/FFM decreased only 6%. At the end of the study (30 weeks) there was a loss of FFM and the decrease of REE/Kg FFM reached 20%¹⁰. Lazzer S et al, in their

study with a moderate caloric restriction accompanied by aerobic and anaerobic exercise for 9 months in obese adolescents who did not lose FFM, also showed a decrease of 6% in REE adjusted by changes in FFM²¹.

The preservation of FFM observed in our study could be due to increased physical activity (significant in non-compliant group). Studies have shown that weight reduction interventions accompanied by moderate and intense physical activity can contribute to the preservation of FFM especially strength endurance exercise or the combination of aerobic exercise plus strength exercise. In fact, it seems that the resistance exercise has better results than aerobic in overweight and obese people, given the physical constraints and that these patients have poor compliance to protocols of aerobic exercise and better compliance to resistance exercise²².

Another factor that can contribute to the preservation of FFM is related with the macronutrient content of the diets, specifically with the protein content. We prescribed a high protein content [20 to 25% of Total Caloric Value (TCV) or 1.0 to 1.3 g/kg of initial weight]. Dietary protein is necessary to synthesize skeletal muscle and an increased intake may enhance nitrogen retention and muscle hypertrophy²². Recent studies have shown that caloric restriction with high protein intake aid in FFM maintenance. Soenen S et al, in overweight and obese men and women determined the effect of the protein content in the preservation of FFM, comparing two hypocaloric diets with different protein content (0,8 g/kg vs. 1,2 g/kg) by 6 months. Both diets showed a FFM-sparing effect, which was initially stronger in the diet with higher protein content²³. In contrast, there are interventions combining very low calorie and low protein diets with resistance exercise that has shown loss in FFM²².

One possible explanation of the preservation of FFM is because the metabolic profile of the macronutrients. The hormonal responses associated with high-carbohydrate, low protein diets may induce physiological events favoring FFM catabolism. A high intake of carbohydrates produces a rise in insulin which promotes the uptake of glucose and triacylglycerol in the liver and adipose tissue, reduces glycogenolysis and lipolysis and suppresses the post-absorptive appearance of glucose and fatty acid. This produces the release of counterregulatory hormones inducing catabolism of lean mass. With the intake of a high protein diet, there is a less insulin release, which together with a delayed postprandial rate of disposal for amino acids appear to stabilize the glycemic environment and may conserve lean tissue. Also, amino acids as leucine and the branched-chain amino acids have a role in muscle protein synthesis²². Other studies report that high protein diets allow greater weight loss, provide greater satiety, produce more food thermogenesis, especially if the protein is of high biological value and help to preserve FFM²⁴.

Nevertheless a recent study shows that with a high carbohydrates-low fat, high protein diet, it is also possible to preserve muscle mass and produce anabolism. Bonfanti N et al, compared the effect of two hypocaloric diets (restriction of 40% of calories compared to the usual intake): Mediterranean diet (50% carbohydrates, 30% fat, 20-22% protein) and high carbohydrate-low fat diet (55-58% CHOS, 20% fat, 20-22% protein), with or without exercise, on GER and body composition. Thirty-six subjects obese, over 50 years of both sexes, were randomized to one of four intervention groups: low-calorie Mediterranean type diet, low-calorie, high carbohydrate-low fat diet, low-calorie mediterranean diet with exercise and low calorie, high carbohydrate-low-fat diet²⁵.

The main results of this study were: weight loss decreased significantly in all groups being higher in the groups that included exercise. Among these groups,

the group hypocaloric, high carbohydrate-low fat diet had the largest decrease. Related to body composition, fat mass also decreased in all groups and it was higher in the groups that included exercise. Within these, also the hypocaloric, high carbohydrate-low fat diet had the largest decrease. Muscle mass had a significantly greater decrease in both Mediterranean diet groups. It also was greater in the exercise group compared with both groups of hypocaloric, high-carbohydrate, low fat diet²⁵.

The researchers attribute this result to the lower content of carbohydrates in Mediterranean diet. They say that carbohydrates are essential because it stimulates insulin secretion. Insulin is the main anaerobic hormone, essential for the recovery of muscle glycogen used in the exercise or for muscle protein synthesis²⁵.

Regarding GER, there was a significantly greater decrease in the exercise groups than without exercise ones. Additionally, the decrease was greater in the Mediterranean diet exercise group than in the hypocaloric, high-carbohydrate, low fat diet exercise group. It can be related with the loss of muscle mass²⁵.

So, the authors of this study suggest that the intervention with a hypocaloric, high carbohydrate, low fat and high protein diet mixed with a regular exercise program might be the best option because it produced greater weight loss, had less decrease of REE and FFM. However, the authors highlight the benefits of the Mediterranean diet on factors risk of metabolic syndrome. Nevertheless, this study has a small sample size does not allow to extrapolate the results²⁵.

Therefore, it seems to be relevant take into account not only the caloric restriction but also, the macronutrient distribution within a restricted diet in order to prevent loss of FFM.

Previous studies showing metabolic adaptation found correlations coefficients of REE or TEE with FFM ranging from $r = 0.77$ to $0.86^{5-7,10}$. In our study, the correlation between REE and FFM at baseline was significant but low ($r = 0.56$, $p < 0.05$), which did not allow preforming a prediction of REE from FFM. However, Johansenn D et al and Goele K et al studies have shown that the decrease in REE/Kg FFM similar to the observed in our study is suggestive of metabolic adaptation^{9,10}. In addition, the fact that the association between REE and FFM is lost at the end of study, may suggest the presence of metabolic adaptation because REE decreased despite the preservation of FFM.

The method used to assess body composition (DEXA) could also have influenced the lack of correlation between REE and FFM at the end of the study. DEXA, can lead to errors due to assuming a constant density of minerals, protein and water of FFM. Because of FFM measurement by DEXA is dependent on the state of hydration of the tissue, changes in body water could lead to inaccurate measurements^{26,27}. However, fluctuations in body fluids occur only in the early stages of weight reduction²⁷. In the case of our study, it is unlikely that after three months, there were still fluid

fluctuations interfering with body composition assessment.

Unlike the reports by Weyer et al and Heilbronn L et al of a decreased TEE adjusted by FFM and FM after caloric restriction, we found a significant increase in this parameter in the compliant group^{5,6}. This unexpected finding was probably due to an increase in physical activity according to actigraphy. The discrepancy may be due to methodological differences to assess TEE. The mentioned studies used a whole respiratory chamber where subjects are free to move within the place, eat and perform sedentary type activities, but cannot exercise as free living subjects. Measurements are made in a single day, which is not precise to assess the actual individual TEE²⁸. The gold standard for measuring TEE is the doubly labeled water (DLW), allowing assess energy expenditure for several days without interfering with normal life. Its main limitation is its high cost. In the present study we determined TEE through Actiheart[®] accelerometers. Although they are not as accurate as DLW, there are reports of an acceptable level of agreement in children and adults²⁹⁻³².

The main strength of this study was that moderate caloric restriction with adequate nutrient balance and good acceptability had a significant level of adherence (54%), which is difficult to achieve especially in overweight and obese population³³. Several reasons contribute to the loss of adherence to weight loss programs among which are the lack of motivation, accompanying, and the pursuit of short-term results. Therefore, the medical team must use different strategies to achieve the objectives as implementing physical activity, educate about healthy eating habits or teach about weight self-monitoring³⁴.

Another strength is that through motivation in weekly follow-up appointments, it was possible for participants to increase their level of physical activity. This fact, together with the prescription of a high protein diet probably allowed to avoid the loss of FFM, one of undesired effects of weight loss induced by calorie restriction. Further studies should be carried out to study whether these metabolic changes are persist over time while the subject maintain weight.

These results should be seen in light of the limitations of the study, such as small sample size and the low correlation between baseline REE and FFM which did not allow to predict REE using changes in body composition, which is the most recommended way to evaluate the metabolic adaptation. Also, the study did not have a weight maintenance phase, therefore could not assess whether the energy expenditure remains low over time.

Conclusions

The findings of this study showed that women compliant with a short-term calorie diet had a significant reduction in both absolute and adjusted REE, which

along with the loss of correlation between REE and FFM at the end of the intervention suggests a metabolic adaptation. However, we emphasize that although REE decreased, increased physical activity and a high protein content diet, could have contributed to preserve FFM, avoiding the decrease in TEE.

References

1. Major GC, Doucet E, Trayhurn P, Astrup A, Tremblay A. Clinical significance of adaptive thermogenesis. *Int J Obes* [Internet]. 2007/01/30 ed. 2007;31(2):204–12. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=17260010
2. Tremblay A, Royer MM, Chaput JP, Doucet E. Adaptive thermogenesis can make a difference in the ability of obese individuals to lose body weight. *Int J Obes* [Internet]. 2012/08/01 ed. 2012;37(6):759–64. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=22846776
3. Rosenbaum M, Leibel RL. Adaptive thermogenesis in humans. *Int J Obes* [Internet]. 2010/10/12 ed. 2010;34 Suppl 1:S47–55. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=20935667
4. Dulloo AG, Jacquet J, Montani JP, Schutz Y. Adaptive thermogenesis in human body weight regulation: more of a concept than a measurable entity? *Obes Rev* [Internet]. 2012/11/01 ed. 2012;13 Suppl 2:105–21. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=23107264
5. Weyer C, Walford RL, Harper IT, Milner M, MacCallum T, Tataranni PA, et al. Energy metabolism after 2 y of energy restriction: the biosphere 2 experiment. *Am J Clin Nutr* [Internet]. 2000/09/30 ed. 2000;72(4):946–53. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11010936
6. Heilbronn LK, de Jonge L, Frisard MI, DeLany JP, Larson-Meyer DE, Rood J, et al. Effect of 6-month calorie restriction on biomarkers of longevity, metabolic adaptation, and oxidative stress in overweight individuals: a randomized controlled trial. *JAMA* [Internet]. 2006/04/06 ed. 2006;295(13):1539–48. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=16595757
7. Martin CK, Heilbronn LK, de Jonge L, DeLany JP, Volaufova J, Anton SD, et al. Effect of calorie restriction on resting metabolic rate and spontaneous physical activity. *Obes* (Silver Spring) [Internet]. 2008/01/17 ed. 2007;15(12):2964–73. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=18198305
8. Ravussin E, Bogardus C. Relationship of genetics, age, and physical fitness to daily energy expenditure and fuel utilization. *Am J Clin Nutr* [Internet]. 1989/05/01 ed. 1989;49(5 Suppl):968–75. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=2655422
9. Goele K, Bosy-Westphal A, Rumcker B, Lagerpusch M, Muller MJ. Influence of changes in body composition and adaptive thermogenesis on the difference between measured and predicted weight loss in obese women. *Obes Facts* [Internet]. 2010/01/08 ed. 2009;2(2):105–9. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=20054213
10. Johannsen DL, Knuth ND, Huizenga R, Rood JC, Ravussin E, Hall KD. Metabolic slowing with massive weight loss despite preservation of fat-free mass. *J Clin Endocrinol Metab* [Internet]. 2012/04/27 ed. 2012;97(7):2489–96. Available from:

- http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=22535969
11. Astrup A, Gotzsche PC, van de Werken K, Ranneries C, Toubro S, Raben A, et al. Meta-analysis of resting metabolic rate in formerly obese subjects. *Am J Clin Nutr* [Internet]. 1999/06/05 ed. 1999;69(6):1117–22. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=10357728
12. Menozzi R, Bondi M, Baldini A, Venneri MG, Velardo A, Del Rio G. Resting metabolic rate, fat-free mass and catecholamine excretion during weight loss in female obese patients. *Br J Nutr* [Internet]. 2000/12/05 ed. 2000;84(4):515–20. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11103222
13. Camps SG, Verhoef SP, Westerterp KR. Weight loss, weight maintenance, and adaptive thermogenesis. *Am J Clin Nutr* [Internet]. 2013/03/29 ed. 2013;97(5):990–4. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=23535105
14. Kipnis V, Subar AF, Midthune D, Freedman LS, Ballard-Barbash R, Troiano RP, et al. Structure of dietary measurement error: results of the OPEN biomarker study. *Am J Epidemiol* [Internet]. 2003/07/02 ed. 2003;158(1):14–6. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=12835281
15. Kipnis V, Midthune D, Freedman L, Bingham S, Day NE, Riboli E, et al. Bias in dietary-report instruments and its implications for nutritional epidemiology. *Public Heal Nutr* [Internet]. 2003/03/14 ed. 2002;5(6A):915–23. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=12633516
16. Matsuda M, DeFronzo RA. Insulin sensitivity indices obtained from oral glucose tolerance testing: comparison with the euglycemic insulin clamp. *Diabetes Care*. 1999;22:1462–70.
17. Brage S, Brage N, Franks PW, Ekelund U, Wong M-Y, Andersen LB, et al. Branched equation modeling of simultaneous accelerometry and heart rate monitoring improves estimate of directly measured physical activity energy expenditure. *J Appl Physiol*. 2004;96:343–51.
18. Erik DB. Serie de estudios estadísticos y prospectivos. Principios y aplicación de las nuevas necesidades de energía según el Comité de expertos FAO/OMS. Nac Unidas CEPAL. 2007;
19. Pourhassan M, Bösby-Westphal A, Schautz B, Braun W, Gluer CC, Müller MJ. Impact of body composition during weight change on resting energy expenditure and homeostasis model assessment index in overweight nonsmoking adults. *Am J Clin Nutr* [Internet]. 2014/02/07 ed. 2014; Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=24500156
20. Bösby-Westphal A, Schautz B, Lagerpusch M, Pourhassan M, Braun W, Goele K, et al. Effect of weight loss and regain on adipose tissue distribution, composition of lean mass and resting energy expenditure in young overweight and obese adults. *Int J Obes* [Internet]. 2013/02/06 ed. 2013;37(10):1371–7. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=23381557
21. Lazzar S, Boirie Y, Montaurier C, Vernet J, Meyer M, Vermorel M. A weight reduction program preserves fat-free mass but not metabolic rate in obese adolescents. *Obes Res* [Internet]. 2004/02/26 ed. 2004;12(2):233–40. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=14981215
22. Stiegler P, Cunliffe A. The role of diet and exercise for the maintenance of fat-free mass and resting metabolic rate during weight loss. *Sport Med* [Internet]. 2006/03/11 ed. 2006;36(3):239–62. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=16526835
23. Soenen S, Martens EA, Hochstenbach-Waelen A, Lemmens SG, Westerterp-Plantenga MS. Normal protein intake is required for body weight loss and weight maintenance, and elevated protein intake for additional preservation of resting energy expenditure and fat free mass. *J Nutr* [Internet]. 2013/03/01 ed. 2013;143(5):591–6. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=23446962
24. Soenen S, Hochstenbach-Waelen A, Westerterp-Plantenga MS. Efficacy of alpha-lactalbumin and milk protein on weight loss and body composition during energy restriction. *Obes* (Silver Spring) [Internet]. 2010/06/26 ed. 2011;19(2):370–9. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=20577225
25. Bonfanti N, Fernández JM, Gomez-Delgado F, Perez-Jiménez F. Efecto de dos dietas hipocalóricas y su combinación con ejercicio físico sobre la tasa metabólica basal y la composición corporal. *Nutr Hosp* 2014; 29 (3): 635–643.
26. Baracos V, Caserotti P, Earthman CP, Fields D, Gallagher D, Hall KD, et al. Advances in the science and application of body composition measurement. *JPEN J Parenter Enter Nutr* [Internet]. 2012/01/12 ed. 2011;36(1):96–107. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=22235108
27. Siervo M, Faber P, Gibney ER, Lobley GE, Elia M, Stubbs RJ, et al. Use of the cellular model of body composition to describe changes in body water compartments after total fasting, very low calorie diet and low calorie diet in obese men. *Int J Obes* [Internet]. 2010/02/10 ed. 2010;34(5):908–18. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=20142822
28. Ravussin E, Burnand B, Schutz Y, Jequier E. Twenty-four-hour energy expenditure and resting metabolic rate in obese, moderately obese, and control subjects. *Am J Clin Nutr* [Internet]. 1982/03/01 ed. 1982;35(3):566–73. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=6801963
29. Butte NF, Wong WW, Adolph AL, Puyau MR, Vohra FA, Zakeri IF. Validation of cross-sectional time series and multivariate adaptive regression splines models for the prediction of energy expenditure in children and adolescents using doubly labeled water. *J Nutr* [Internet]. 2010/06/25 ed. 2010;140(8):1516–23. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=20573939
30. Plasqui G, Bonomi AG, Westerterp KR. Daily physical activity assessment with accelerometers: new insights and validation studies. *Obes Rev* [Internet]. 2013/02/13 ed. 2013;14(6):451–62. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=23398786
31. Crouter SE, Churilla JR, Bassett Jr. DR. Accuracy of the Actiheart for the assessment of energy expenditure in adults. *Eur J Clin Nutr* [Internet]. 2007/04/19 ed. 2008;62(6):704–11. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=17440515
32. Heymsfield SB, Harp JB, Reitman ML, Beetsch JW, Schoeller DA, Erond N, et al. Why do obese patients not lose more weight when treated with low-calorie diets? A mechanistic perspective. *Am J Clin Nutr* [Internet]. 2007/02/08 ed. 2007;85(2):346–54. Available from: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=17284728
33. Aguilar-Cordero M.J, Sanchez Lopez A.M, Guisado Barrilalo R, Rodriguez Blanque R, Noack Segovia J, Pozo Cano MD. Descripción del acelerómetro como método para valorar la actividad física en los diferentes periodos de la vida; revisión sistemática. *Nutr Hosp* 2014;29 (6): 1250-1261.
34. Goncalves Micali F, Cremonesi Japur C, Rodrigues de Oliveira F, Diez-Garcia RW. Weight and body composition variations in overweight women along outpatient nutritional treatment. *Nutr Hosp* 2014; 29(3): 526-530.



Original/*Obesidad*

Psychometric characteristics of the Eating and Appraisal Due to Emotions and Stress Questionnaire and obesity in Mexican university students

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Abstract

Introduction: emotional eating has been defined as eating in a response to negative emotions and it is associated with weight gain. The English version of Eating Appraisal Due to Emotions and Stress Questionnaire (EADES) was developed to assess how individuals use food in order to cope with stress and emotions.

Objective: to analyze psychometric characteristics of Spanish version of EADES and to identify whether the constructs of EADES were associated with obesity in university students.

Methods: the EADES (Spanish version) was administered to 232 Mexican university students from 18 to 29 years old. Body Mass Index (BMI) was calculated. A test-retest evaluation was conducted with 75 participants.

Results: Cronbach's alpha of EADES was 0.92; the interclass correlation coefficient was 0.88. Regarding BMI and EADES results, the subscale Emotion and Stress Related Eating was significantly associated with obesity ($p = 0.026$). Through factor analysis of the instrument, three factors were extracted and items that showed factor loading < 0.40 were eliminated. 40 items remained in the questionnaire. With regard to obesity and the 40-items version of the instrument, a statistically significance association was found for the total score ($OR = 0.973$, $p = 0.020$) and for the factor Self-confidence related to Emotional Eating component ($OR = 0.940$, $p = 0.026$).

Conclusions: a good internal consistency and temporal stability of the Spanish version of the instrument were found; the 40-item EADES version was positively associated with obesity. This instrument could be useful in assessing emotional eating.

(Nutr Hosp. 2015;31:2437-2444)

DOI:10.3305/nh.2015.31.6.8960

Key words: *Eating behavior. Obesity. EADES questionnaire. Psychometric characteristics. Students.*

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Recibido: 13-III-2015.
Aceptado: 22-IV-2015.

CARACTERÍSTICAS PSICOMÉTRICAS DEL CUESTIONARIO SOBRE CONDUCTA ALIMENTARIA RELACIONADA A EMOCIONES Y ESTRÉS (EADES) Y OBESIDAD EN ESTUDIANTES UNIVERSITARIOS DE LA CIUDAD DE MÉXICO

Resumen

Introducción: la conducta alimentaria emocional se ha definido como el comer como respuesta a las emociones negativas y se ha asociado con el aumento de peso. El cuestionario Eating Appraisal Due to Emotions and Stress Questionnaire (EADES, Conducta Alimentaria Relacionada a Emociones y Estrés), fue desarrollado para la identificación y evaluación de las conductas relacionadas con la ingestión de alimentos como resultado del estrés y las emociones.

Objetivo: analizar las características psicométricas de la versión en español del EADES e identificar la posible asociación entre los constructos que conforman el EADES con la presencia de obesidad en estudiantes universitarios mexicanos.

Métodos: la versión traducida al español del EADES fue administrado a 232 estudiantes de 18 a 29 años. Se calculó el Índice de Masa Corporal (IMC). El análisis de confiabilidad (test-retest) se llevó a cabo con 75 participantes.

Resultados: el alfa de Cronbach de EADES en español fue de 0,92; el coeficiente de correlación intraclass fue de 0,88. Se observó una asociación significativa entre el puntaje del EADES, subescala Conducta Alimentaria Relacionada a Emociones y Estrés, y el IMC ($p = 0.026$). Mediante el análisis de factores del instrumento, tres factores fueron extraídos, y los ítems que mostraron cargas factoriales $< 0,400$ fueron eliminados, lo que dio por resultado una versión reducida del EADES, la cual se conformó por 40 ítems. Con respecto a la obesidad y el instrumento reducido, se encontró una asociación estadísticamente significativa para la puntuación total ($OR = 0,973$, $p = 0,020$) y para el factor de Autoconfianza en la Conducta Alimentaria Emocional ($OR = 0,940$, $p = 0,026$).

Conclusiones: se encontró una buena consistencia interna y estabilidad temporal del instrumento EADES en la versión en español; la versión reducida a 40-ítems se asoció positivamente con obesidad. Este instrumento puede ser útil para la evaluación de la conducta alimentaria emocional.

(Nutr Hosp. 2015;31:2437-2444)

DOI:10.3305/nh.2015.31.6.8960

Palabras clave: *Conducta alimentaria. Obesidad. Cuestionario EADES. Características psicométricas. Estudiantes.*

Introduction

Emotional eating has been defined as eating in a response to a range of negative emotions, such as anxiety, sadness or loneliness, and has been associated with weight gain¹⁻⁴.

The relationship between eating and negative emotions has been studied widely and it is well established that they tend to increase food consumption⁵⁻⁸. Eating has been recognized as a coping strategy for dealing with stress and anxiety; therefore, it was proposed that obese people might overeat in order to reduce psychological discomfort. This conclusion might also be valid for people with normal weight, but unlike overweight people, they will either increase or decrease their eating when stressed^{5,6,9-11}.

Regarding positive emotions, the information is less conclusive; nevertheless, Macht¹² have shown that positive emotions increase the pleasure related with food and the consumption of healthy food, while negative emotions (anger, fear and sadness) may increase impulsive eating.

Thus, individuals with normal weight, who eat with the intention of coping with stress, are at risk of becoming obese. Eating, as a coping mechanism for dealing with stress and emotions, is considered to be an attempt to diminish negative or fluctuating mood states, in the absence of another adaptive strategy¹¹.

In studies on emotional eating, different self-applied questionnaires have been developed. One of the earliest instruments is the Three Factor Eating Questionnaire (TFEQ) which assesses dietary restraint, disinhibition and hunger, as well as its abridged version TFEQ-R18^{13,14}. Among other questionnaires, that attempt to measure eating behavior in relation to emotions, it is important to mention the Mindful Eating Questionnaire, Dutch Eating Behavior Questionnaire, Emotional Eating Scale, Emotional Eater Questionnaire and also the Emotional Appetite Questionnaire^{2,15,16-18}. Some of them are too long, while others were designed to assess awareness of physical and emotional sensation associated with eating or specifically for obese people.

The Eating and Appraisal Due to Emotions and Stress (EADES) Questionnaire offers an integral evaluative approach and represents an untraditional method for assessing eating behavior along with individual strategies for coping and adaptation¹⁹. The instrument allows identifying individuals who use food in order to cope with emotions and stress, and it is based on the Transactional Model of Stress and Coping, which provides a framework for evaluating the coping process and helps to explain individual differences in coping responses²⁰. The model includes a series of phenomena, such as primary and secondary appraisals, resources, coping effort and adaptation outcomes. After the evaluation of the significance of a stressor or threatening event, the evaluation of the controllability of the stressor and the personal coping resources

follows (what can be done in response to a stressful situation, i.e., through adaptive or maladaptive reactions) and goes on to analyze coping efforts through a cognitive-evaluative process (a decision about specific personal coping strategies). Finally, adaptation outcomes are produced that can be positive or negative in relation to emotional well-being, functional status and health. According to this model, positive adaptation outcomes can produce healthy eating behavior, while unhealthy stress and emotions management can lead to overeating. Eating represents a maladaptive way to cope with emotions and stress, and being overweight represents a negative adaptation outcome^{19,20}.

Taking this into account, EADES is an instrument, which aims to assess eating behavior in relation to emotions and stress. The English version has been validated within a public university population that included only staff and faculty, with ages ranging from 18 to 83 years old; however, a validated Spanish version is not yet available. This self-applied questionnaire consists of 49 items divided into three subscales: a) Emotion and Stress-Related Eating, b) Appraisal of Ability and Resources to Cope and c) Appraisal of Outside Influences and Stressors. In addition, Ozier et al.³ have identified a relationship of the first two subscales with overweight and obesity.

The high prevalence of obesity worldwide has raised important questions about the role of emotions in the etiology of this health condition^{21,22}. Recent studies have shown that obesity represents a health issue accompanied by mental disorders, such as anxiety, depression and addictive behaviors, characterized by difficulties of emotion management²³⁻²⁷. In addition, previous studies have revealed that many people experience changes in eating behavior in response to emotional stress: 11% to 55% eat more, while 32% to 70% eat less¹¹. Epidemiological data indicates that stress-related eating is associated with increased body weight as well^{9,28}.

In Mexico, the National Health and Nutrition Survey reported that 35% of adolescents and 71.2% of adults over 20 years of age were overweight or obese²⁹. Studies have shown that eating habits among university students is a major issue^{28,30}. Young adults, who experience the transition into university life, are frequently exposed to stress and time restraints. Poor eating habits acquired at this age generally persist into adult life and may lead to being overweight or obese.

Given the high and increasing prevalence of overweight and obesity in Mexico, an understanding the role of emotional eating and nutrition education is particularly important in preventing weight gain during university years and the development of obesity in adulthood^{28,30}. As far as it was possible to investigate, there are no studies on the psychometric characteristics or validated questionnaires on emotional eating for Mexican people. Previous studies have focused on risk factors of eating disorders^{27,31-35}. For this reason, the aims of the study were to assess psychometric charac-

teristics of a Spanish version of EADES; as well as to identify if the questionnaire and its constructs were associated with overweight and obesity in Mexican students' population.

Methods

Sample

Application of the questionnaire was conducted from September 2013 to January 2014 in a public university of Mexico City; 232 students from a total population of 1,260 freshmen students (27.8% of the total population) participated in the study. The participants belong to three departments: Biological Science and Health, Social Sciences and Humanities and Science and Art Design. Students who did not attend the appointment for measurement of weight and height or who did not answer all the items of the questionnaire were excluded (17 students). Thus, the total sample was reduced to 215 participants.

A test-retest study was conducted with 75 participants. These students completed the EADES twice, with an interval period of three weeks.

Instrument

The Eating and Appraisal Due to Emotions and Stress Questionnaire (EADES) is a psychometric instrument that has been previously validated using exploratory factor analysis¹⁹. This self-applied instrument consists of 49 items divided into three subscales: Emotion- and Stress-Related Eating (24 questions, Cronbach's $\alpha=0.95$); Appraisal of Ability and Resources to Cope (20 questions, Cronbach's $\alpha=0.87$); and Appraisal of Outside Influences and Stressors (5 question, Cronbach's $\alpha=0.65$). Total Cronbach's alpha reliability coefficient of the original study was 0.949. Individuals respond to the questionnaire in accordance with their level of agreement from strongly agree to strongly disagree, on a scale of 1 to 5. Subscales from the EADES questionnaire were given a score with the following ranges: Emotion- and Stress-Related Eating from 24 to 120; Appraisal of Ability and Resources to Cope from 20 to 100; Appraisal of Outside Influences and Stressors from 5 to 25. Negatively toned questions (1-3, 6-8, 10, 12, 16-20, 22, 23, 30, 31, 33, 45-47) were reversed, so that the lower the number the more compromised is the ability to cope with emotions and stress by eating^{3,19}.

Procedures

The linguistic adaptation of the EDAES was obtained by a translation/back-translation method. A team

of experts and translators analyzed the appropriate wording equivalent of each item. Subsequently, the comprehensibility of each item was discussed with a sample of 32 university health science students. Finally, two bilingual teachers evaluated the degree of equivalence between the original English and the final Spanish versions. The Spanish version of the EDAES used in the present study was correctly understood by students^{36,37}.

Students, who participated in the study during school hours, filled out a paper-and pencil questionnaire. The questions were carefully explained by the nutritionists to ensure an understanding of the instrument. After completing the questionnaire, all students attended a workshop entitled "Eating and Emotions". It was decided that this was an opportune time to reflect on the issue of stress and emotion management, as well as to create awareness about the need of professional help in some cases. The average time for completing the questionnaire was 15 minutes. For the test-retest evaluation the questionnaire was applied to the students by the same trained nutritionists during school hours. Response rate to the questionnaire was 97%.

In addition, weight, height and body mass index (BMI weight/height^2) were recorded using a scale of Body Composition Analyzer (Tanita, model 418). Based on WHO criteria³⁸, the cutoff point for being overweight was $\text{BMI} \geq 25\text{kg/m}^2$, for being obese $\geq 30\text{kg/m}^2$ and for being underweight $< 18.5\text{kg/m}^2$.

Ethics

The study was carried out after project approval by the University Review Board, where the ethical aspects were revised. The protocol for human research of the Mexican Health Ministry was followed. The students participated on a voluntary basis and they signed the informed consent. Educational workshop on "Eating and Emotions" was given to all participants during the data collection.

Statistical analysis

Descriptive statistics were used to summarize the data. Internal consistency of the total questionnaire and of the subscales was estimated using Cronbach Alpha. Two factor analyses were performed: the first one using a varimax rotation and the second, an oblique rotation (promax). Factor loadings and uniqueness of the items, as well as correlation matrix among factors were obtained from the oblique matrix rotation. Pearson correlation coefficients were applied between three subscales of the questionnaire. A multiple logistic regression model was constructed for $\text{BMI} \geq 30\text{kg/m}^2$ (as a dependent categorical variable: obese and non-obese) and the total score of the instrument (as an independent variable), adjusted by sex and age; odds

rations (OR) were obtained. The significance level was set at $p < 0.05$. By studying the test-retest reliability, intraclass correlation coefficient (ICC) was calculated. STATA V 12 Statistical Package was used for data analysis (*Stata Statistical Software: Release 12*. College Station, TX: StataCorp LP).

Results

From a total of 215 students, 69 (32%) were men and 146 (68%) were women; 198 (92%) were single, 10 (4.7%) were married and 7 (3.3%) lived together. Mean age was 21.3 (SD=3.0) with a range from 17 to 29 years. The descriptive characteristics (sex, age, marital status, BMI, mean of a total Score of EADES and subscales means) are presented in Table I. No differences were observed in BMI and EADES scores by sex.

Analysis of the original scale (EADES)

By assessing the reliability, the Cronbach's alpha for the total scale was 0.92; for subscale 1: Emotion- and Stress- Related Eating was 0.88; for subscale 2: Appraisal of Resources and Ability to Cope was 0.91; for subscale 3: Appraisal of Outside Stressors and Influences was 0.54.

The Pearson's correlation between first and second subscales was significant ($r=0.496$, $p<0.0001$); the same was observed between the first and the third subscales ($r=0.354$, $p=0.0002$), as well as between the second and the third subscales ($r=0.654$, $p<0.0001$).

Test-retest reliability. To assess test-retest stability, 75 students twice filled out the questionnaire. The analysis showed an adequate intraclass correlation coefficient (ICC= 0.88, $p<0.01$).

Table I <i>Descriptive characteristics and mean scores of EADES of the college students (n=215)</i>	
<i>Variables</i>	<i>n (%)</i>
<i>Sex</i>	
Men	69 (32%)
Women	146 (68%)
<i>Age mean (SD)</i>	
<i>Marital Status</i>	
Single	21.3 (3.0)
Married	198 (92%)
Living together	10 (4.7%)
	7 (3.3%)
<i>BMI</i>	
Normal Weight	157 (73.1%)
Overweight	39 (18.1%)
Obese	19 (8.8%)
<i>Total Score EADES (Mean, SD)</i>	189.9 (21.7)
<i>Subscales</i>	
Emotion- and Stress- Related Eating	95.9 (11.8)
Appraisal of Ability and Resources to Cope	76.0 (10.9)
Appraisal of Outside Influences and Stressors	18.3 (3.0)

Factor analysis of EADES

Extracting three factors from varimax rotation of the items, it was shown that they explained 30.1% of the variance of the questionnaire ($F1=0.175$; $F2=0.116$; $F3=0.10$). In order to improve the explained variance, an oblique rotation (promax) was performed: Factor 1 accounted for .206 of the variance; Factor 2 for 0.157; Factor 3 for 0.142. Factor loading and uniqueness are presented in Table II (items that did not provide factor loading >0.400 were excluded).

The factor analysis of our data showed that Factor 1 included items of self-efficacy in emotion and stress related eating, and consisted of 12 questions, while Factor 2 included items of self-confidence in emotion and stress-related eating, and consisted of 9 questions (all of these questions belong to the original subscale Emotion-and Stress-Related Eating which consists of 24 items). Three items were eliminated from the original scale: "I am confident I can control my eating when I am tired", "I am confident I can control my eating when I am relieved", "I overeat when I socialize". In our data, Factor 3 was related to the ability to cope and consisted of 19 questions (the items of this factor were the same of those in the original subscale: Appraisal of Resources and Ability to Cope), only one item was eliminated ("when a problem arises, it is hard for me to make a plan of action and follow it"). The subscale: Appraisal of Outside Stressors and Influences was excluded during the factor extraction process (all items showed low factor loading). Thus, a total of 40 items from the EADES questionnaire (49 original items) were selected from the factor analysis. The correlation matrix of the promax rotation showed the highest value between factor 1 and 2 (0.392), followed by the correlation between factors 2 and 3 (0.355) and factor 1 and 3 (0.314), $p<0.05$.

Assessing internal consistency, the Cronbach's alpha reliability coefficient for the total 40-items instrument was 0.911; for Factor 1: Self-efficacy in Emotion- and Stress-related Eating was 0.867; for Factor 2: Self-confidence in Emotion- and Stress-related Eating was 0.839, and for Factor 3: Appraisal of Resources and Ability to Cope was 0.906.

Association between EADES and BMI

In the multivariate regression analysis (BMI as a dependent variable and total score, subscales scores of the original instrument, sex, and age as independent variables). The regression coefficient was significant for Subscale 1 (Emotion- and Stress-Related Eating, $\beta = -0.610$, $p=0.026$) and for age ($p=0.028$). However, for Subscale 3 (Appraisal of Outside Stressors and Influences), the regression coefficient (adjusted for age and sex) was positive $\beta=0.270$, $p=0.013$. The association with Subscale 2 and sex were not significant in this model, Table III.

Table II
Factor loadings and Cronbach's alpha for the 40-items version of EADES questionnaire^a

Factor and question number	Factor Loading	Uniqueness
Factor 1: Self-efficacy in Emotion- and Stress-Related Eating		
1. Utilizo los alimentos para manejar mis emociones (<i>I use food to cope with my emotions</i>)	0.715	0.455
2. Cuando estoy molesto conmigo mismo, como (<i>I eat when I am upset with myself</i>)	0.617	0.580
3. Cuando estoy ansioso, como (<i>I eat when I am anxious</i>)	0.655	0.557
6. Me consuelo con la comida (<i>I comfort myself with food</i>)	0.530	0.746
7. Cuando estoy frustrado, como (<i>I eat when I am frustrated</i>)	0.707	0.490
8. Cuando estoy triste, como (<i>I eat when I am sad</i>)	0.708	0.480
10. Cuando estoy enojado, como (<i>I eat when I am angry</i>)	0.572	0.632
12. Cuando estoy estresado, como en exceso (<i>I overeat when I am stressed</i>)	0.724	0.471
16. No me puedo controlar cuando como (<i>I feel out of control when I eat</i>)	0.571	0.649
18. Es difícil para mí dejar de comer aunque me sienta lleno (<i>It is hard to me to stop eating when I am full</i>)	0.520	0.724
19. Para evitar enfrentar los problemas, como (<i>I eat to avoid dealing with problems</i>)	0.563	0.649
20. No tengo control sobre la cantidad que como (<i>I do NOT have control over how much I eat</i>)	0.491	0.723
Factor 2: Self-confidence in Emotion- and Stress-Related Eating		
4. Considero que puedo controlar mi alimentación cuando estoy molesto conmigo mismo (<i>I am confident I can control my eating when I am upset with myself</i>)	0.755	0.429
5. Considero que puedo controlar mi alimentación cuando estoy molesto (<i>I am confident I can control my eating when I feel upset</i>)	0.819	0.318
9. Considero que puedo controlar mi alimentación cuando estoy frustrado (<i>I am confident I can control my eating when I am frustrated</i>)	0.713	0.464
11. Considero que puedo controlar mi alimentación cuando me siento triste (<i>I am confident I can control my eating when I am sad</i>)	0.662	0.447
13. Considero que puedo controlar mi alimentación cuando estoy ansioso (<i>I am confident I can control my eating when I am anxious</i>)	0.591	0.459
14. Considero que puedo controlar mi alimentación cuando estoy enojado (<i>I am confident I can control my eating when I am angry</i>)	0.747	0.360
15. Considero que puedo controlar mi alimentación cuando estoy cansado (<i>I am confident I can control my eating when I am tired</i>)	0.706	0.444
21. Considero que puedo controlar mi alimentación, cuando me libero de preocupaciones (<i>I am confident I can control my eating when I am relieved</i>)	0.428*	0.839
24. Considero que puedo controlar mi alimentación cuando me siento feliz (<i>I am confident I can control my eating when I feel happy</i>)	0.562*	0.695
Factor 3: Appraisal of Resources and Ability to Cope		
25. Soy capaz de satisfacer mis necesidades emocionales (<i>I am able to meet my emotional needs</i>)	0.620	0.476
26. Trato de resolver el problema cuando sé que hay algo mal en mi vida (<i>I try to resolve a problem when I know there is something wrong in my life</i>)	0.732	0.394
27. Generalmente puedo encontrar una solución a mis problemas (<i>I can usually work out a solution to my problems</i>)	0.759	0.379
28. Soy capaz de manejar situaciones estresantes (<i>I am capable of dealing with stressful situations</i>)	0.642	0.560
29. Tengo control sobre mi vida (<i>I have control over my life</i>)	0.648	0.520
30. NO me siento seguro en mi vida (<i>I do NOT feel secure in my life</i>)	0.557	0.612
31. Frecuentemente me siento triste (<i>I feel sad often</i>)	0.603	0.508
32. Soy capaz de manejar mis propios problemas (<i>I am capable of handling my own problems</i>)	0.615	0.547
34. Tengo control sobre mis emociones (<i>I have control over my emotions</i>)	0.542	0.554
35. Trato de pensar positivamente en tiempos difíciles (<i>I try to think positive when times are tough</i>)	0.557	0.706
36. Me ocupo de los problemas lo antes posible (<i>I deal with problems sooner rather than later</i>)	0.641	0.576
37. Considero los pros y contras de las situaciones antes de tomar decisiones sobre qué hacer (<i>I weigh the pros and cons of situations before I make decisions about what to do</i>)	0.665	0.517
38. Soy capaz de satisfacer mis necesidades espirituales (<i>I am able to meet my spiritual needs</i>)	0.619	0.551
39. Mis amigos me apoyan cuando tengo problemas (<i>My friends support me when I have problems</i>)	0.463	0.765
40. Soy capaz de decir "no" cuando tengo que hacerlo (<i>I am able to say no when I need to</i>)	0.473	0.742
41. Trato de analizar el problema para entenderlo mejor (<i>I try to analyze a problema to better understand it</i>)	0.698	0.468
42. Mi familia me apoya cuando tengo problemas (<i>My family support me when I have problems</i>)	0.688	0.560
43. Hablo de mis sentimientos (<i>I talk about my feelings</i>)	0.590	0.691
44. Trato de encontrar soluciones alternativas para mis problemas (<i>I try to find alternative solutions to my problems</i>)	0.715	0.438

Items that did not provide sufficient factor loading (< 0.400) in any of the subscales were eliminated.

Total Cronbach alpha = 0.911. Factor 1 Cronbach alpha = 0.867. Factor 2 Cronbach alpha = 0.839. Factor 3 Cronbach alpha = 0.906

*questions that were added in oblique rotation

Table III
Association between obesity and EADES scores^a

<i>Questionnaire</i>	<i>OR (95% CI)</i>	<i>p value</i>
Original questionnaire (49 items)¹		
<i>Total score</i>	0.98 (0.93 -1.01)	0.056
<i>Subscale 1</i> Emotion- and Stress-Related Eating	0.96 (0.92- 0.99)	0.024*
<i>Subscale 2</i> Appraisal of Ability and Resources to Cope	0.97 (0.93 - 1.01)	0.113
<i>Subscale 3</i> Appraisal of Outside Influences and Stressors	1.04 (0.89 – 1.20)	0.653
Spanish Version of EADES (40 items)²		
<i>Total score</i>	0.97 (0.90-0.99)	0.020*
<i>Factor 1</i> Self-Efficacy in Emotion and Stress Related Eating	0.96 (0.92-1.00)	0.081
<i>Factor 2</i> Self-Confident in Emotion and Stress Related Eating	0.94 (0.89-0.94)	0.026*
<i>Factor 3</i> Appraisal of Ability and Resources to Cope	0.95 (0.90-1.01)	0.120

^aLogistic Regression model for BMI ≥ 30 , adjusted for age and sex.

* $p < 0.05$.

¹ adjusted R^2 was 0.050.

² adjusted R^2 was 0.038.

In the multivariate regression (BMI as a dependent variable and total score of 40-item instrument, factor scores, sex and age as independent variables), statistical significance was found for factor 2: Self-confidence in Emotion- and Stress-related Eating, $\beta = -0.086$, $p = 0.019$ and for age, $p = 0.028$.

Considering obesity (BMI ≥ 30 kg/m²) as a dependent variable and the total score of the 40-item version as an independent (adjusted by sex and age), statistical significance was found for total score (OR=0.973, $p = 0.020$) and for factor 2: Self-confidence in Emotion- and Stress-Related Eating (OR=0.940, $p = 0.026$), Table III.

Discussion

The purpose of the present study was to evaluate psychometric characteristics of the EADES questionnaire and its association with BMI in Mexican university students. This instrument aims to assess eating behavior related to emotions and stress as well as coping strategies for problems and stress.

The results indicated a good internal consistency and temporal stability of the EADES questionnaire. The analysis showed high Cronbach's alpha coefficient for the full instrument that is consistent with prior results. However, similar to the data of Ozier et al.¹⁹, the internal consistency was high for the first subscale Emotion- and Stress-Related Eating and for the second Appraisal of Resources and Ability to Cope, and low

for the third subscale. Due to the recent creation of the questionnaire, there are no other studies to compare these results. In addition, EADES showed high test-retest stability in our study.

Prior results of the questionnaire applied at the University of Alabama, US, among students, staff and faculty¹⁹ revealed a three-factor model that was related to the original Transactional Model of Stress and Coping, from which the instrument was derived. In the analysis performed with our data, also three-factors were extracted, but factor grouping was different: the subscale Appraisal of Outside Stressors and Influences (original factor 3) was excluded in the factor extraction process (all items showed low factor loading). In addition, this subscale showed the lowest percentage of the total variance, both in our study and in the study of Ozier et al.¹⁹. The questions related to subscale Appraisal of Ability and Resources to Cope (original factor 2, which consisted of 20 questions) remained in one factor, except the item "when a problem arises, it is hard for me to make a plan of action and follow it". The original subscale Emotion- and Stress- Related Eating (which consisted of 24 questions) was divided into two factors in our study. It is worth mentioning that questions on Self-efficacy in Emotion- and Stress-Related Eating (12 items) and questions on Self-confidence in Emotion- and Stress-Related Eating (9 items), which formed the original first factor, were grouped into separate factors. In total, nine questions were excluded due to their low factor loading, and 40 items remained from

the original 49 items. Some items showed high uniqueness values indicating that they have a high variance that was not explained by other items of the questionnaire; thus some questions of the instrument may be related to other domains that should be studied more carefully in further research on emotional eating. Furthermore, the 40-item Spanish version had a good internal consistency.

Regarding EADES score and BMI, a significant association was found between original subscale Emotion-and Stress- Related Eating and BMI. Our findings partially corroborate the data of Ozier et al.³ who have identified a relationship between this subscale and obesity, as well as between poor stress management (subscale -Appraisal of Ability and Resources to Cope) and obesity. It is important to point out that subscale 3: Appraisal of Outside Stressors and Influences had an unexpected relationship with obesity in our study, showing that higher scores were associated with higher BMI, which is the opposite of the questionnaire's hypothesis (according to the questionnaire, the lower the score, the more compromised is the individual's ability to cope with emotions and stress by eating). This finding reinforced the advantage of using the version of 40-item. In addition, this subscale was not included in the Spanish version of the questionnaire obtained during the factor analysis.

The multivariate regression model, adjusted for age and sex, showed an association between obesity and the total score of the 40-items version of the instrument. In our study, it was found that body weight was increased with age, and the total score of the questionnaire was decreased with age, in both men and women. This suggests that the older the person the more compromised is his/her ability to cope with stress and emotions.

Regarding the association of our factors with BMI, a significant relationship was found with factor 2 (Self-confidence in Emotion- and Stress-Related Eating). This association suggests that maladaptive behavior in managing stress and emotions may represent a risk for weight gain.

Similarly, Green et al.³⁹ concluded that university students who scored high on an emotional eating had higher BMIs than students with lower emotional eating scores. Laitinen et al.⁹ and Ozier et al.³ also showed that emotion- and stress-related eating, as well as poor stress management were associated with increased body weight. As far as it was possible to investigate, there are no published studies on this problem in Mexican populations.

Some studies have examined the relationship between eating disturbances and coping behavior, which can be adaptive and maladaptive, e.g., using food as positive reinforcement^{9,15}. It is important to measure eating patterns along with coping strategies for problems and stress. Rational coping style (i.e., planning to solve a problem or thinking of an alternative way to solve it) generally is more effective than an emo-

tion-focused one (unless a problem is not changeable), and these skills have to be learned at an early age⁴⁰.

The transition to university life is a stressful experience for many young people. How emotions are managed during these formative years is critical for the development of healthful eating behaviors. Coping with stress through eating represents a significant challenge towards the goal of healthy eating. As young adults progress to adulthood, greater responsibilities and more stress are to be expected. Therefore, time planning and stress management skills should be taught for those who are susceptible to emotional eating¹.

Among the limitations, it should be noted that the study was carried out with a specific non-clinical population (university students) with fairly low prevalence of obesity. Thus, caution needs to be taken in extrapolating the results among other population groups. Further studies with different groups and larger samples are required to identify the external validity of the questionnaire, also the short version of the instrument should be considered.

In Mexico, there is a severe obesity problem, and a validated instrument to detect emotional eating is essential. Periodic follow-up studies are needed to more precisely assess emotional eating.

Conclusions

The results indicated a good internal consistency and a good temporal stability of the EADES questionnaire.

The 40-item version of EADES, obtained from this study, could be used in similar settings to assess emotional eating. More studies with different age groups and BMI scores are required in order to study the validity of this instrument.

A multidisciplinary intervention, focusing on emotion and stress management in addition to dietary behavior changes, should be developed in order to reduce the potential risk for weight gain in young adult populations.

References

1. Bennett J, Greene G, Schwartz-Bacort D. Perceptions of emotional eating behavior. A qualitative study of college students. *Appetite* 2013; 60: 87-92.
2. Garaulet M, Canteras M, Morales E, López-Guimera G, Sánchez-Carraced D et al. Validation of a questionnaire on emotional eating for use in cases of obesity; the Emotional Eater Questionnaire (EEQ). *Nutr Hosp* 2012; 27(2): 645-51.
3. Ozier AM, Kendrick OW, Knol LL, Leeper JD, Perko M et al. Overweight and Obesity Are Associated with Emotion- and Stress- Related Eating as Measured by the Eating and Appraisal Due to Emotions and Stress Questionnaire. *J Am Diet Assoc* 2008; 108: 49-56.
4. Geliebter A, Aversa A. Emotional eating in overweight, normal weight, and underweight individuals. *Eating Behaviors* 2003; 3: 341-7.

5. Canetti L, Bachar E, Berry EM. Food and emotion. *Behavioural Processes* 2002; 60: 157-64.
6. Match M, Simonds G. Emotions and eating in everyday life. *Appetite* 2000; 35: 65-71.
7. Spoor S, Bekker M, Van Strien T, van Heck G. Relation between negative effect, coping, and emotional eating. *Appetite* 2007; 9: 223-32.
8. Pascual-Jimeno A, Apodaca-Urquijo A, Etxebarria-Bilbao I, Cruz-Sáez MS. Diferencia en la frecuencia de experiencias emocionales positivas y negativas en mujeres con distintos tipos de trastornos de la conducta alimentaria. *Anales de Psicología* 2012; 28: 743-52.
9. Laitinen J, Ek E, Sovio U. Stress-related eating and drinking behavior and body mass index and predictors of this behavior. *Preventive Medicine* 2002; 34: 29-39.
10. Larrañaga Vidal A, García-Mayor RV. Alta frecuencia de trastornos de la conducta alimentaria inespecíficos en personas obesas. *Nutr Hosp* 2009; 24(6):661-6.
11. March M. How emotions affect eating: A five-way model. *Appetite* 2008; 50: 1-11.
12. Macht M. Characteristics of eating in anger, fear, sadness, and joy. *Appetite* 1999; 33: 129-39.
13. Karlsson J, Persson LO, Sjostrom L, Sullivan M. Psychometric properties and factor structure of the Three-Factor Eating Questionnaire (TFEQ) in obese men and women. Results from Swedish Obese Subjects (SOS) study. *Int J Obes* 2000; 24: 1715-25.
14. Stunkard AJ, Messick S. The Three Factor Eating Questionnaire to measure dietary restraint, disinhibition and hunger. *J Psychosom Res* 1985; 29: 71-83.
15. Arnow B, Kenardy J, Agras W.S. The Emotional Eating Scale: the development of a measure to assess coping with negative affect by eating. *Int J Eat Disord* 1995; 18: 79-90.
16. Framson C, Kristal A, Schenk J, Littman A, Zeliadt S et al. Development and validation of the mindful eating questionnaire. *J Am Diet Assoc* 2009; 109: 1439-44.
17. Nolan LJ, Halperin LB, Geliebter A. Emotional Appetite Questionnaire Construct validity and relationship with BMI. *Appetite* 2010; 54: 314-31.
18. Van Strein T, Frijters JER, Bergers GPA, Defares PB. The Dutch Eating Behaviour Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *Int J Eat Disord* 1986; 5: 295-315.
19. Ozier AD, Kendrick OW, Knol LL, Leeper JD, Perko M, Burnham J. The eating and Appraisal Due to Emotions and Stress (EADES) Questionnaire: Development and Validation. *J Am Diet Assoc* 2007; 107: 619-28.
20. Lazarus RS, Folkman S. Stress, Appraisal, and Coping. New York: Springer; 1984.
21. Corstorphine E, Mountford V, Tomlinson S, Waller G, Meyer C. Distress tolerance in the eating disorders. *Eating Behaviors* 2007; 8: 91-7.
22. Cruz-Sáez MS, Pascual A, Etxebarria I, Echeburúa EE. Riesgo de trastorno de la conducta alimentaria, consumo de sustancias adictivas y dificultades emocionales en chicas adolescentes. *Anales de Psicología* 2013; 29: 724-33.
23. Gariepy G, Nitka D, Schmitz N. The association between obesity and anxiety disorders in the population: a systematic review and meta-analysis. *Int J Obes* 2010; 34: 407-19.
24. Luppino FS, de Wit LM, Bouvy PF, Stijnen T, Cuijpers P et al. Overweight, obesity, and depression. A systematic review and meta-analysis of longitudinal studies. *Arch Gen Psychiatry* 2010; 67: 220-9.
25. Scott KL, Bruffaerts R, Simon GE, Alonso J, Angermeyer M et al. (2008). Obesity and mental disorders in the general population: results from the world mental health surveys. *Int J Obes* 2008; 32: 192-200.
26. Strine T, Mokdad A, Dube S, Balluz L, González O et al. The association of depression and anxiety with unhealthy behaviors among community-dwelling US adults. *Gen Hosp Psychiatry* 2008; 30: 127-37.
27. Ocampo Ortega R, Bojorquez Chapela I, Unikel-Santoncini C. Disordered eating behaviors and anxiety with unhealthy high-school students: the role of impulsivity. *Salud Ment* 2012; 35: 83-9.
28. Loría Kohen V, Gómez Candela C, Lourenco Nogueira T, Pérez Torrez, Castillo Rabaneda R, Villarino Marín M. Evaluation of the utility of a nutrition education program with eating disorders. *Nutr Hosp* 2009; 24(5):558-67.
29. Gutiérrez JP, Rivera DJ, Shamah LT, Villalpando HS, Franco A et al. Encuesta Nacional de Salud y Nutrición 2012. Datos Nacionales. México: Instituto Nacional de Salud Pública; 2012.
30. Ganasegeran K, Al-Dubai S, Qureshi A, Al-abed A, Rizal AM et al. Social and psychological factors affecting eating habits among university students in a Malaysian medical school: a cross-sectional study. *Nutr J* 2012; 11: 48-52.
31. Unikel-Santoncini C, Bojórquez-Chapela I, Carreño-García S. Validación de un cuestionario breve para medir conductas alimentarias de riesgo. *Salud Pública México* 2004; 46(6): 509-15.
32. Unikel-Santoncini C, Bojorquez Chapela I, Carreño García S, Caballero Romo A. Validación del Eating Disorder Inventory en una muestra de mujeres mexicanas con trastorno de la conducta alimentaria. *Salud Ment* 2006; 29(2): 44-51.
33. Franco Paredes K, Álvarez Rayon GL, Ramírez Ruelas RE. Instrumentos para trastornos del comportamiento alimentario validados en mujeres mexicanas: una revisión de la literatura. *Revista Mexicana de Trastornos Alimentarios* 2011; 2: 148-64.
34. Rodríguez Aguilar B, Oudhof van Barneveld H, González-Arratia NI, Unikel-Santoncini C. Desarrollo y validación de una escala para medir imagen corporal en mujeres jóvenes. *Salud Ment* 2010; 33: 325-32.
35. Saucedo-Molina T, Unikel-Santoncini C. Validez de un instrumento multidimensional para medir factores de riesgo asociados a trastornos de la conducta alimentaria en púberes mexicanas. *Rev Chil Nutr* 2010; 37(1): 60-9.
36. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine* 2000; 25: 3186-91.
37. Bullinger M, Alonso J, Apolone G, Leplege A, Sullivan M et al. Translating health status questionnaires and evaluating their quality: the IQOLA Project approach. International Quality of Life Assessment. *J Clin Epidemiol* 1998; 51: 913-23.
38. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. WHO Technical Report Series 894. Geneva: World Health Organization; 2000.
39. Green GW, Schembre SM, White AA, Hoerr AA, Lohse SL et al. Identifying clusters of college students at elevated health risk based on eating and exercise behaviors and psychosocial determinant of body weight. *J Am Diet Assoc* 2011; 111: 294-300.
40. Kelly MM, Tyrka AR, Price LH, Carpenter LL. Sex difference in the use of coping strategies: Predictors of anxiety and depressive symptoms. *Depression and Anxiety* 2008; 25: 839-46.



Original/Obesidad

Niveles de obesidad, glicemia en ayuno y condición física en escolares chilenos

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Resumen

Antecedentes: en Chile se han modificado drásticamente los patrones de alimentación y de actividad física. El principal problema nutricional que enfrenta la sociedad chilena es el exceso de peso, que se presenta en forma progresiva desde temprana edad. El objetivo del estudio es determinar el estado nutricional y comparar los niveles de condición física y glicemia en ayuno de los escolares.

Pacientes y métodos: se realizó un estudio descriptivo-comparativo de corte transversal, realizando una comparación por género y estado nutricional, con 100 escolares (56 hombres y 44 mujeres) de entre 12 a 15 años de edad. Se evaluó la composición corporal, la glucosa en ayuno y la condición física.

Resultados: las mujeres presentaron mayor prevalencia de sobrepeso y obesidad que los hombres (22,73% y 19,65%). En la comparación de género se reportaron diferencias estadísticas en una repetición máxima (1RM) ($p = 0,001$), resistencia abdominal ($p = 0,004$) y velocidad ($p = 0,001$); no existieron diferencias significativas en el índice de masa corporal (IMC) ($p = 0,24$) ni en glucosa en ayunas ($p = 0,99$). En la comparación del estado nutricional, en los escolares clasificados como obesos se observó un perímetro de cintura más elevado ($p = 0,001$) y mayor tiempo para recorrer 400 m ($p = 0,008$); no existieron diferencias significativas en las demás variables.

Conclusiones: las mujeres presentan una mayor prevalencia de sobrepeso y obesidad que los hombres. Los escolares obesos presentan un perímetro de cintura más elevado, mayor tiempo para recorrer 400 metros ($p < 0,05$) y poseen niveles aumentados de glucosa basal.

(Nutr Hosp. 2015;31:2445-2450)

DOI:10.3305/nh.2015.31.6.8932

Palabras clave: Obesidad. Escolares. Condición física. Glicemia.

LEVELS OF OBESITY, FASTING GLYCEMIA AND PHYSICAL CONDITION IN CHILEAN STUDENTS

Abstract

Background: Chile has drastically altered eating patterns and physical activity. The main nutritional problem faced by Chilean society is overweight, which arises progressively from an early age. The aim of this study is to determine the nutritional status and compare fitness levels and fasting glucose in students.

Patients and methods: a descriptive cross-sectional comparative study was conducted, making a comparison by gender and nutritional status, with 100 students (56 men and 44 women) aged 12-15 years old. Body composition, fasting glucose and fitness were evaluated.

Results: women had a higher prevalence of overweight and obesity than men (22.73% and 19.65%). In the comparison of gender differences statistics were reported in one repetition maximum (1RM) ($p = 0.001$), abdominal strength ($p = 0.004$) and velocity ($p = 0.001$), there were no significant differences in body mass index (BMI) ($p = 0.24$) and fasting glucose ($p = 0.99$). In the comparison of nutritional status, the students classified as obese had a higher waist perimeter ($p = 0.001$), more time to walk 400 m ($p = 0.008$). There were no significant differences in other variables.

Conclusions: women have a higher prevalence of overweight and obesity than men. Obese students have a waist circumference more elevated, more time to walk 400 meters ($p < 0.05$) and they have increased levels of basal glucose.

(Nutr Hosp. 2015;31:2445-2450)

DOI:10.3305/nh.2015.31.6.8932

Key words: Obesity. School children. Physical condition. Glycemia.

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Recibido: 9-III-2015.
Aceptado: 3-IV-2015.

Introducción

En Chile, la última encuesta nacional de salud (ENS) realizada en 2009-2010, encontró un 67 % de exceso de peso y un 88,6 % de sedentarismo en la población adulta¹. Los países en desarrollo muestran esta tendencia creciente², en los EE.UU por ejemplo, la obesidad ha aumentado dramáticamente en los últimos 30 años, y se ha convertido en una epidemia no sólo en los adultos, sino también en los niños³, constituyendo un problema de salud pública complejo^{4,5}, más aún, si se considera que el diez por ciento de los niños en edad escolar del mundo tiene exceso de grasa corporal⁶ y está relacionada con un aumento en el riesgo de hipertensión^{7,8}, hipercolesterolemia, hiperinsulinemia⁹ y síndrome metabólico, que en su conjunto, constituyen rasgos clínicos que conducen a un mayor riesgo de enfermedad cardiovascular y diabetes mellitus tipo 2 en ambos sexos¹⁰.

Un aspecto importante en la obesidad pediátrica es la definición que se utiliza para distinguir al niño obeso o adolescente de los otros¹¹. El índice de masa corporal (IMC) es una medida indirecta válida y factible, pero adolece de una serie de limitaciones, aunque existe un consenso cada vez mayor en el uso de puntos de corte del IMC para clasificar la obesidad¹², por otro lado, se han ido agregando medidas de adiposidad central como la circunferencia de la cintura y la relación cintura-cadera como predictores de riesgo cardiovascular¹³.

En la actualidad, la condición física y metabólica de los niños son temas de interés para la salud pública y los profesionales de las ciencias del deporte, la condición física incluye varios componentes, entre ellos la capacidad aeróbica y la fuerza muscular, la aptitud física se considera un indicador importante de salud en niños^{14, 15, 16}, la potencia aeróbica máxima es la capacidad del sistema cardiovascular y respiratorio de realizar ejercicio extenuante y prolongado¹⁷ y el desarrollo de la resistencia cardio-respiratoria en niños, adolescentes y jóvenes se asocia a la disminución de la prevalencia de enfermedades cardiovasculares¹⁸. Es importante destacar que la infancia es una época de rápidos cambios en la composición corporal, sin embargo, ha habido pocos estudios longitudinales que examinen los cambios en compartimentos de grasa específicos durante este proceso¹⁹. Asimismo, se ha visto una asociación positiva entre la edad y la presentación de diabetes mellitus tipo 2; encontrando que en la actualidad ésta se presenta en poblaciones cada vez más jóvenes y la obesidad severa tiene un papel destacado en la patogénesis de la diabetes tipo 2 en niños y adolescentes^{20, 21}, por lo que se hace fundamental contar con valoraciones tempranas que permitan aplicar estrategias de modificación de los factores de riesgo.

El objetivo del estudio es determinar el estado nutricional y comparar los niveles de condición física y glicemia en ayuno de escolares de la región de La Araucanía, Chile.

Material y métodos

El estudio corresponde a un paradigma cuantitativo, descriptivo, comparativo y transversal. El muestreo es de tipo no probabilístico, elegidos de manera no aleatoria y por conveniencia. Se evaluaron 100 escolares que presentaban entre 12 y 15 años de edad, pertenecientes al colegio Padre Bartolomé de la comuna de Padre Las Casas, Araucanía, Chile. Este estudio fue sometido a la aprobación del Comité de Ética de la Universidad Santo Tomás, cada apoderado o tutor debió firmar un consentimiento informado para que su hijo participara en la investigación.

Recolección de la información

Los padres y apoderados de los niños participantes fueron informados y concientizados respecto a la importancia y objetivos de la investigación, se recolectaron datos sociodemográficos (nivel y curso de estudio, edad y género), antropométricos (IMC y circunferencia de cintura), condición física (1RM, salto longitudinal, resistencia abdominal, velocidad, metros recorridos en 12 minutos) y metabólicos (niveles de glicemia basal GB).

Se calculó el índice de masa corporal (IMC) determinando el estatus de peso corporal de los participantes (bajo peso, normopeso, sobrepeso y obesidad) mediante puntos de corte del IMC según estándares internacionales²², el peso se determinó empleando una balanza digital de marca Tanita modelo UM 2204 precisión de 0,2 kilos con una capacidad máxima de 136 kilos, con los pies descalzos y con la menor cantidad de ropa posible, la circunferencia de cintura se midió empleando una cinta métrica, aplicando las técnicas validadas internacionalmente²³. Las concentraciones de glucosa sérica en ayuno sobre ≥ 100 mg/dl fueron consideradas como alteradas, para su medición se utilizó glucómetro y tiras reactivas marca "accu check performa nano". Las variables fueron categorizadas por terciles, considerando el tercil superior en las comparaciones.

Posterior a las evaluaciones antes mencionadas, se realizó la evaluación de la condición física (CF) compuestas por 6 test y pruebas físicas orientadas a las diversas capacidades motrices, los protocolos se describen a continuación:

Test de Salto: El objetivo de esta prueba es evaluar la fuerza explosiva del tren inferior aplicando las técnicas validadas nacionalmente descritas en el sistema de medición de la calidad de la educación²⁴

Resistencia aeróbica: se aplicó el Test de Cooper, siguiendo las instrucciones previamente descritas²⁵.

Fuerza máxima: se ejecutó la prueba curl de bíceps al fallo muscular, con pesos entre 3,5 y 5,5 kg, respecto a la edad, la fuerza dinámica máxima se estimó indirectamente a través de las fórmulas de Brzycki²⁶ con ejecuciones inferiores a 10 Repeticiones máximas (RM) y la de Wlday²⁷, para repeticiones iguales o mayores a 10 RM.

Resistencia abdominal: Se ejecutó el test de abdominales cortos en 1 minuto, previo a la evaluación se realizó un calentamiento general de baja intensidad.

Velocidad anaeróbica láctica: Se ejecutó la prueba de 400 metros, de manera previa se efectuó un calentamiento general de 5 minutos y uno específico de 1 minuto dirigido a los grupos musculares agonistas y de las fibras explosivas, tras 2 minutos de descanso se realizó la prueba.

Velocidad: Se ejecutó la prueba de 100 metros en velocidad, se realizó un calentamiento general de 5 minutos y específico de 2 minutos dirigido a los grupos musculares agonistas y a las fibras rápidas y explosivas, junto a un trabajo de característica elástico explosivo.

Análisis estadístico

En el análisis descriptivo, las variables nominales y categóricas fueron expresadas en porcentajes, las variables continuas que no presentaron distribución normal, se expresaron como medianas y percentiles 5 y 95, las variables con distribución normal se muestran como medias $\pm$ SD. Se realizó la prueba de Chi-cuadrado para la comparación de proporciones entre ambos grupos y las pruebas Mann Whitney y Kruskal-Wallis para comparar las variables cuantitativas, *t* de Student y ANOVA de un factor, según correspondiera. El análisis estadístico se llevó a cabo mediante el software STATA v.9.2.

Resultados

Las características generales de los participantes de acuerdo al género se presentan en la tabla I. La edad y las proporciones de bajo peso, normopeso, sobrepeso y obesidad fueron muy similares entre géneros. Entre las variables de condición física se observaron diferencias significativas, la mayoría de ellas fueron mayores en los escolares del sexo masculino, sin embargo en la evaluación del Test de Cooper no se mostraron diferencias significativas en relación a la distancia recorrida y la actividad aeróbica.

Considerando los resultados se procedió a analizar los datos de condición física de acuerdo al grupo de IMC, observando que los niños-adolescentes con obesidad presentan mayor perímetro de cintura, el recorrido de 400 m lo realizan en mayor tiempo, tienen una glicemia más elevada y recorren menos metros en el test de 12 minutos (Tabla II).

Discusiones

En la población de escolares de 13 años estudiada, se encontraron valores inferiores de sobrepeso u obesidad en comparación a datos reportados en un estudio efectuado por el Ministerio de Educación de Chile en una muestra nacional de escolares, donde el 40,2% de ellos presentaban alteraciones del peso²⁸. El género fe-

Tabla I
Características de la población estudiada de acuerdo al género.

<i>Características</i>	<i>Femenino (n=44)</i>	<i>Masculino (n=56)</i>	<i>Valor de p</i>
Edad (años)	12,8 $\pm$ 0,65	12,6 $\pm$ 0,69	0,20
Peso	53 (36-73)	52,5 (37-80)	0,61
Estatura	1,55 $\pm$ 0,07	1,57 $\pm$ 0,08	0,40
IMC (kg/m ²)	22,1 $\pm$ 3,76	21,3 $\pm$ 3,67	0,24
Bajo peso (<p5) n (%)	2 (4,55%)	2 (3,57%)	0,94
Normopeso (p5-<p85)	32 (72,73%)	43 (76,79%)	
Sobrepeso (p85-95)	8 (18,18%)	8 (14,29%)	
Obesidad (>p95)	2 (4,55%)	3 (5,36%)	
Circunferencia de cintura (cm)	72 (58-89)	74 (63-95)	0,59
1 RM	9,5 (2-23)	15 (4-31)	0,001
Abdominales (rep)	31,4 $\pm$ 9,05	37,3 $\pm$ 10,9	0,004
100 mts (s)	19,8 $\pm$ 2,15	17,6 $\pm$ 2,13	0,001
400 mts (min)	2,0 (1,44-2,3)	1,49 (1,27-2,4)	0,001
Salto de longitud (cm)	128,06 $\pm$ 21,3	148,8 $\pm$ 23,2	0,001
Distancia en 12 min (m)	1431 (1200-1950)	1512,5(1203-2154)	0,23
Glucosa en ayuna (mg/dL)	93,3 $\pm$ 8,52	93,3 $\pm$ 8,4	0,99

Los valores mostrados son mediana y percentiles (5-95) para las variables no paramétricas y media $\pm$ SD para las paramétricas. IMC=Índice de Masa Corporal, 1RM= Una repetición máxima.

Tabla II
Características de rendimiento físico de acuerdo al estado nutricional.

<i>Características</i>	<i>Bajo peso (n=4)</i>	<i>Normopeso (n=75)</i>	<i>Sobrepeso (n=16)</i>	<i>Obesidad (n=5)</i>	<i>Valor de P</i>
Edad (años)	12,5±1,0	12,7±0,70	12,7±0,47	13,0±0,70	0,73
Peso	36,5 (33-37)	50 (38-61)	65,5 (57-80)	83 (73-91)	0,001
Estatura	1,52±0,01	1,55±0,07	1,59±0,07	1,64±0,06	0,018
IMC (kg/m ²)	15,36±0,62	20,49±2,42	26,2±0,93	29,68±0,94	0,001
Circunferencia de cintura (cm)	63 (58-67)	72 (62-81)	84 (68-95)	95 (92-97)	0,001
1 RM	10 (2-11)	11 (2-25)	18,5 (3-32)	15 (4-40)	0,10
Abdominales (rep)	37,0±6,6	35,6±10,6	30,0±10,4	34,6±10,0	0,26
100 metros (s)	19,1±1,55	18,2±2,35	19,6±2,6	19,7±2,27	0,11
400 metros (min)	2,01 (1,53-2,45)	1,51 (1,31-2,27)	2,0 (1,27-2,53)	2,03 (1,58-2,3)	0,008
Salto de longitud (cm)	137,0±14,3	141,9±25,2	134,6±23,2	123,8±22,2	0,32
Distancia 12 min (m)	1551 (1200-2140)	1485 (1200-2154)	1395 (1030-2150)	1290 (1202-1530)	0,69
Glucosa en ayunas (mg/dL)	95,5±4,2	92,7±8,0	94,9±10,3	96,0±10,2	0,62

Los valores mostrados son mediana y percentiles (5-95) para las variables no paramétricas y media ±SD para las paramétricas. IMC=Índice de Masa Corporal, 1RM= Una repetición máxima. rep= número de repeticiones.

menino presenta una mayor prevalencia que los hombres, resultados similares a los presentados en niños sudafricanos de 14 años, pero que difieren con datos de adolescentes americanos de 12 a 19 años donde se presentan valores superiores en hombres^{29, 30}.

El promedio de IMC en los estudiantes de Padre Las Casas fue de 22,1 y 21,3 número superior al de una muestra de niños entre 12,5 y 13,4 años, que evidenciaron 20,4 y 19,7 en mujeres y hombres respectivamente³¹.

La Circunferencia de la cintura (CC) es un marcador de acumulación central de grasa corporal y está vinculada a un mayor riesgo de complicaciones metabólicas³². Distintas investigaciones reportaron resultados de circunferencia de cintura de 70,7 en escolares de 11 años, 65,9 y 67,2 en niños y niñas de 12,4 y 11,9 años respectivamente, otro estudio, describió promedios de 60,1 y 60,5 centímetros en damas y varones respectivamente^{33,34, 35}, valores inferiores a los hallazgos del presente estudio.

La obesidad abdominal se asocia con un perfil lipídico desfavorable en niños obesos, lo que puede estar relacionado con un mayor riesgo de evento cardiovascular posterior. Tanto el IMC como la CC son herramientas útiles para estudios clínicos y epidemiológicos en la adiposidad pediátrica, aumentando la necesidad de desarrollar intervenciones tempranas para mejorar la condición física en niños y para prevenir el aumento de la obesidad infantil^{36, 37, 38}, más aún, cuando los escolares chilenos presentan un patrón de actividad predominantemente sedentario, con más de 10 horas de actividades de bajo costo energético³⁹.

La distancia recorrida en el test de Cooper fue de 1431 y 1512 metros en mujeres y hombres respectivamente. Fjørtoft y colaboradores⁴⁰ describieron valores

de 984 metros en niños, pero utilizando una interesante modificación del test en un rectángulo de 9 x 18 metros durante seis minutos. En la comparación de género, no existieron diferencias significativas, lo que difiere a lo reportado en adolescentes españoles⁴¹.

Se ha observado en individuos obesos una disminución en el consumo máximo de oxígeno, el cual se relaciona con un deterioro en la capacidad funcional y una mayor morbilidad por causas cardiovasculares⁴², el estudio AVENA en adolescentes españoles establece que aquellos que cumplían con la realización de actividad física moderada a intensa durante 60 minutos/día, tenían una mayor posibilidad de tener una capacidad cardiovascular más alta⁴³, cabe destacar, que hoy existen estrategias de ejercicio de bajo volumen y alta intensidad para mejorar la capacidad cardio-respiratoria y parámetros relacionados con la salud. Lau y colaboradores aplicaron un programa de HIT en niños de 10 años con sobrepeso de 15 segundos de trabajo y 15 segundos de recuperación pasiva con 12 repeticiones al 120 % de la VAM, reduciendo la grasa corporal y aumentando la capacidad aeróbica⁴⁴, es así como niveles elevados de actividad física en la infancia o la adolescencia, especialmente de actividad física de alta intensidad, se asocian con una menor cantidad de grasa corporal total⁴⁵.

En una muestra de escolares españoles se estableció que los sujetos con un mayor nivel de condición física presentaban valores inferiores en el IMC. Es decir, aquellos escolares con un mayor nivel de condición física, presentaban una mayor tendencia a poseer un estado de peso saludable⁴⁶.

No se evidenciaron diferencias en fuerza (1RM), abdominales y salto de longitud. Mayorga⁴⁷ en una muestra de 72 niños de 10 a 12 años describió diferen-

cias significativas en el salto de longitud y no reporto diferencias en la fuerza medida a través de dinamometría manual.

Si bien, no se encontraron diferencias significativas en la comparación de estado nutricional y glucosa, los niños obesos presentan mayores niveles en ayuna. Investigaciones en niños y adolescentes muestran una asociación positiva entre el aumento de los percentiles del índice de masa corporal y el aumento de HOMA-IR, un índice de insulina resistencia que normalmente apunta hacia la hiperinsulinemia, en niños obesos⁴⁸.

En un estudio reciente en niños escolares mexicanos obesos, el 44,3 % presento Síndrome Metabólico, siendo la glucosa alterada en ayunas (40,6%) una alteración metabólica preponderante en esta población⁴⁹.

En conclusión podemos plantear que los escolares con obesidad y sobrepeso desde temprana edad comienzan a presentar menores niveles de condición física y mayores niveles de glicemia en ayuna, situación que disminuye considerablemente su calidad de vida y puede aumentar el riesgo de presentar enfermedades cardiovasculares en el futuro.

Referencias

- Ministerio de Salud de Chile, Pontificia Universidad Católica, Universidad Alberto Hurtado. 2011. Encuesta Nacional de Salud ENS Chile 2009-2010.
- Gupta N, Goel K, Shah P, Misra A. Childhood obesity in developing countries: epidemiology, determinants, and prevention. *Endocr Rev* 2012; 33: 48-70.
- Khan LK, Sobush K, Keener D, Goodman K, Lowry A, Kakietek J, Zaro S. Recommended community strategies and measurements to prevent obesity in the United States. *MMWR Recomm* 2009; 24 (58): 1-26.
- St-Pierre J, Bouchard L, Poirie P. The impact of obesity on cardiovascular structure and function: the fetal programming era. *Pediatric Health, Medicine and Therapeutics* 2012;3 1-8.
- Marín V, Rodríguez L, Buscaglione R, Aguirre M, Burrows R, Hodgson M, & Pizarro T. Programa MINSAL-FONASA para Tratamiento de la Obesidad Infanto-Juvenil. *Revista chilena de pediatría* 2011; 82 (1): 21-28.
- Lobstein T, Baur L, Uauy R IASO International Obesity Task Force. Obesity in children and young people: a crisis in public health. *Obes Rev* 2004; 5 (Suppl 1): 4-85.
- Bar-Or O, Foreyt J, Bouchard C, Brownell KD, Dietz WH, Ravussin E, et al. Physical activity, genetic, and nutritional considerations in childhood weight management. *Med Sci Sports Exerc* 1998; 30 (1): 2-10.
- Daniels SR, Arnett DK, Eckel RH, Gidding SS, Hayman LL, Kumanyika S, et al. Overweight in children and adolescents: pathophysiology, consequences, prevention, and treatment. *Circulation* 2005; 19; 111 (15): 1999-2012.
- Freedman DS, Dietz WH, Srinivasan SR, Berenson GS. The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics* 1999; 103 (6 Pt 1): 1175-82.
- Faloia E, Michetti G, De Robertis M, Luconi P, Furlani G, Boscaro M. Inflammation as a Link between Obesity and Metabolic Syndrome. *J Nutr Metab* 2012 (2012).
- Moreno LA, Mesana MI, Fleta J, Ruiz JR, González-Gross M, Sarriá A, Marcos A, Bueno M ; AVENA Study Group. Overweight, obesity and body fat composition in spanish adolescents. The AVENA Study. *Ann Nutr Metab* 2005; 49 (2): 71-6.
- Wang Y. Epidemiology of childhood obesity--methodological aspects and guidelines: what is new? *Int J Obes Relat Metab Disord* 2004; 28 Suppl 3: 21-8.
- Lee CM., Huxley RR, Wildman RP, Woodward M. Indices of abdominal obesity are better discriminators of cardiovascular risk factors than BMI: a meta-analysis. *J Clin Epidemiol* 2008; 61 (7) :646-53.
- Monyeki MA, Kemper HC. Is There a Positive Relationship between Physical Fitness and Physical Activity in Children? - *A Brief Review Journal of Exercise Science and Physiotherapy* 2007; 3 (1): 12-16.
- Ortiz I, Sánchez M, Notario B, Miota J, Fuentes R, Martínez V. Relación entre estatus ponderal, nivel de condición física y componentes de la presión arterial en mujeres de entre 18 y 30 años de edad. *Rev Esp Salud Publica* 2012; 86 (5): 523-531.
- Gulías R, Sánchez M, Olivas A, Solera M, Martínez V. Physical Fitness in Spanish Schoolchildren Aged 6-12 Years: Reference Values of the Battery EUROFIT and Associated Cardiovascular Risk. *J Sch Health* 2014; 84 (10): 625-35.
- Ortega FB, Ruiz JR, Castillo MJ, Sjöström M. Physical fitness in childhood and adolescence: a powerful marker of health. *Int J Obes (Lond)*. 2008; 32 (1): 1-11.
- Gómez R, Arruda M, Almonacid A, Holbold E, Amaral C, Gamero D, Cossio M. Capacidad cardio-respiratoria de niños escolares que viven a moderada altitud. *Rev chil Pediatr* 2014; 85 (2): 188-196.
- Huang TT, Johnson MS, Figueroa-Colon R, Dwyer JH, Goran MI. Growth of visceral fat subcutaneous abdominal fat, and total body fat in children. *Obes Res* 2001; 9: 283-9.
- Alvear M, & Laurell C. Consideraciones sobre el programa de detección de diabetes mellitus en población mexicana: el caso del Distrito Federal. *Cadernos de Saúde Pública* 2010; 26 (2): 299-310.
- Sinha R, Fisch G, Teague B, Tamborlane WV, Banyas B, Allen K, Savoye M, Rieger V, Taksali S, Barbetta G, Sherwin RS, Caprio S. Prevalence of impaired glucose tolerance among children and adolescents with marked obesity. *N Engl J Med* 2002; 346 (11): 802-10.
- Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatr Obes* 2012; 7 (4): 284-294.
- Marfell-Jones MJ, Olds T, Stewart AD, Carter L. International standards for anthropometric assessment. Potchefstroom University for CHE, Potchefstroom, South Africa: International Society for the Advancement of Kinanthropometry (ISAK); 2006.
- MINEDUC. SIMCE 2013 Educación Física, resultados para Docentes y Directivos. Santiago: Ministerio de Educación, 2013. Disponible en: https://s3-us-west-2.amazonaws.com/documentos-web/Educaci%C3%B3n+F%C3%ADsica/Estudio_Nacional_Educacion_Fisica_2013.pdf
- Cooper K H. A means of assessing maximal oxygen intake: correlation between field and treadmill testing. *JAMA* 1968; 203: 201-4.
- Brzycki M. Strength testing. Predicting a one-rep max from reps-to-fatigue. *Journal of Physical Education, Recreation & Dance* 1993; 64(1):88-90.
- Welday J. Should you check for strength with periodic max lifts? *Scholas Coach* 1988; 57:49-68.
- Ministerio de Educación (MINEDUC), Unidad de Currículum y Evaluación. Informe de resultados de Educación Física SIMCE 8 básico, 2010. Disponible en: http://www.simce.cl/fileadmin/Documentos_y_archivos_SIMCE/Informes_2010/Informe_de_Resultados_Educacion_Fisica.pdf
- Monyeki MA, Neetens R, Moss SJ, Twisk J. The relationship between body composition and physical fitness in 14 year old adolescents residing within the Tlokwe local municipality, South Africa: the PAHL study. *BMC Public Health*. 2012; 24: 12-374.
- Ogden C, Carroll M, Kit B, Flegal K. Prevalence of Obesity in the United States, 2009-2010. U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES. Centers for Disease Control and Prevention National Center for Health Statistics. 2012; (82): 1-8

31. Ayatollahi SM, Bagheri Z, Heydari ST. Agreement Analysis among Measures of Thinness and Obesity Assessment in Iranian School Children and Adolescents. *Asian J Sports Med* 2013; 4 (4): 272-80.
32. McCarthy D, Ellis S, Cole T. Central overweight and obesity in British youth aged 11-16 years: cross sectional surveys of waist circumference *BMJ* 2003; (22): 326:624
33. Savva SC, Tornaritis M, Savva ME, Kourides Y, Panagi A, Siliotiou N, Georgiou C, Kafatos A. Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. *International Journal of Obesity* 2000; 24 (11): 1453-1458.
34. Taylor RW, Jones IE, Williams SM., Goulding A. Evaluation of waist circumference, waist-to-hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dual-energy X-ray absorptiometry, in children aged 3-19. *Am J Clin Nutr* 2000; 72 (2):490-5.
35. Kriemler S, Puder J, Zahner L, Roth R, Meyer U, Bedogni G. Estimation of percentage body fat in 6- to 13-year-old children by skinfold thickness, body mass index and waist circumference. *Br J Nutr* 2010;104 (10): 1565-72.
36. Flodmark, C, Sveger T, Nilsson-Ehle P. Waist measurement correlates to a potentially atherogenic lipoprotein profile in obese 12-14-year-old children. *Acta Paediatr* 1994; 83 (9): 941-945.
37. Aeberli I, Gut-Knabenhans M, Kusche-Ammann RS, Molinari L, Zimmermann MB. A composite score combining waist circumference and body mass index more accurately predicts body fat percentage in 6- to 13-year-old children. *Eur J Nutr* 2013; 52 (1): 247-53.
38. Brunet M, Chaput JP, Tremblay A. The association between low physical fitness and high body mass index or waist circumference is increasing with age in children: the 'Quebec en Forme' Project. *Int J Obes (Lond)* 2007; 31:637-43.
39. Vázquez F, Díaz E, Lera L, Meza J, Salas I, Rojas P, et al. Efecto residual del ejercicio de fuerza muscular en la prevención secundaria de la obesidad infantil. *Nutr Hosp* 2013; 28 (2): 333-339
40. M Fjortoft I, Pedersen AV, Sigmundsson H, Vereijken B. Measuring physical fitness in children who are 5 to 12 years old with a test battery that is functional and easy to administer. *Phys Ther* 2011; 91(7): 1087-95
41. González-Gross M, Ruiz JR, Moreno LA, Rufino-Rivas P, Garaulet M, Mesana MI, Gutiérrez A. The AVENA Group. Body composition and physical performance of Spanish adolescents: the AVENA pilot study. *Acta Diabetol* 2003; 40: 299-301
42. Myers J, Prakash M, Froelicher V, Do D, Partington S, Atwood JE. Exercise Capacity and Mortality among Men Referred for Exercise Testing. *New England Journal of Medicine* 2002; 346(11): 793-801.
43. Ortega FB, Ruiz JR, Castillo MJ, Moreno LA, Urzanqui A, Gutiérrez A. Grupo AVENA. Health-related physical fitness according to chronological and biological age in adolescents. The AVENA study. *Journal of Sports Medicine and Physical Fitness* 2008; 48 (3): 371-379
44. Lau PW, Wong DP, Ngo JK, Liang Y, Kim CG, Kim HS. Effects of high-intensity intermittent running exercise in overweight children. *Eur J Sport Sci* 2014; 11:1-9.
45. Ortega FB, Ruiz JR, Castillo MJ. Physical activity, physical fitness, and overweight in children and adolescents: Evidence from epidemiologic studies. *Endocrinología y Nutrición* 2013; 60 (8): 458-69.
46. Gálvez A, Rodríguez P, Rosa A, García E, Pérez J, Tárraga M & Tárraga P. Nivel de condición física y su relación con el estatus de peso corporal en escolares. *Nutr Hosp* 2015;31(1):393-40.
47. Mayorga-Vega D, Brenes A, Rodríguez M, Merino R. Association of BMI and physical fitness level among elementary school students. *Journal of Sport and Health Research* 2012; 4 (3): 299-310.
48. Costa GB, Horta N, Resende Z, Souza G, Barreto L, Correia L. et al. Body mass index has a good correlation with proatherosclerotic profile in children and adolescents. *Arq Bras Cardiol* 2009; 93(3): 261-267.
49. Guzmán-Guzmán IP, Salgado-Bernabé AB, Muñoz Valle JF, Vences-Velázquez A, Parra-Rojas I. Prevalence of metabolic syndrome in children with and without obesity. *Med Clin (Barc)*. 2015;144:198-203.



Original/Obesidad

Association between serum Fe levels and obesity: a meta-analysis

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Abstract

The purpose of this study is to clarify the association between serum Fe levels and Obesity using a meta-analysis approach. We searched eligible papers on the relevance published between 2006 and 2014 from the PubMed and the Chinese National Knowledge Infrastructure. Review Manager software was used to collect and analysis the date cited in the papers. 6 eligible articles with 934 subjects from 40 case-control studies were identified. Overall, pooled analysis indicated that subjects with obesity had lower Fe levels than healthy controls [standardized mean difference (SMD) = -0.738, 95% confidence interval (CI) = (-1.228, -0.247)]. Thus, dietary supplement of Fe is recommended to prevent obesity.

(Nutr Hosp. 2015;31:2451-2454)

DOI:10.3305/nh.2015.31.6.9002

Key words: *Fe. Serum. Obesity. Meta-analysis.*

LA ASOCIACIÓN ENTRE LOS NIVELES SÉRICOS DE HIERRO Y LA OBESIDAD: UN METAANÁLISIS

Resumen

El objetivo de este estudio es determinar la asociación entre los niveles séricos de hierro y la obesidad mediante un metaanálisis. Hemos buscado los documentos sobre la pertinencia, publicados entre 2006 y 2014 por PubMed y China National Knowledge Infrastructure. El examen se utiliza para recoger y gestionar el software de análisis de la fecha citada en los documentos. Se eligieron seis artículos en los que se identificaron 934 sujetos de entre 40 estudios de casos y controles. En general, los encuestados indicaron que los sujetos con obesidad tenían menores niveles de hierro que los controles sanos [diferencia de promedios estandarizados (DPE) = - 0.738, 95% intervalo de confianza (IC) = (-1.228, -0.247)]. Por lo tanto, se recomienda un suplemento dietético de hierro para prevenir la obesidad.

(Nutr Hosp. 2015;31:2451-2454)

DOI:10.3305/nh.2015.31.6.9002

Palabras clave: *Hierro. Suero. Obesidad. Metaanálisis.*

Introduction

Obesity is a state that excess lipids accumulated in various body fat issues owing to a chronic imbalance between energy absorption and energy consumption, which is associated with diseases including hypertension, cardiovascular diseases, endocrine diseases and so on¹.

Serum Fe, as one of trace elements in the tissue, with the bio-availability has been estimated to be in the range of 14-18% for mixed diets², has a vital effect on the function of the immune response³, which influenced the biochemical metabolism of adipose cell indirectly⁴. Some

studies proved that obesity-associated inflammation is connected with Iron deficiency⁵. Some studies have reported that the obese patients were short of serum Fe on account of chronic depleting⁶, some studies suggested that lower Fe levels Iron deficiency due to obesity^{7,8}.

Meta-analysis is a vital tool for revealing the trends that may not be obvious. Therefore, we show a meta-analysis of the studies to present a more clear and evidence-based conclusion on the association between serum Fe levels and Obesity.

Materials and Methods

We researched the medical literature published in the PubMed and the Chinese National Knowledge Infrastructure. papers were conducted using the search terms "obesity", "serum Fe" and "China" in the Chinese language for the Chinese database and in English for the PubMed database with free text words. Eligible texts were retrieved from the above data.

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Recibido: 24-III-2015.

Aceptado: 23-IV-2015.

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Selection Criteria

Eligible studies should meet the following criteria: (1) human study, (2) case-control study or cohort study or randomized clinic trial, (3) subjects without drugs intake which influence the levels of Fe, (4) studies providing data of Fe levels for both subjects with Obesity and non-obesity controls.

Exclusion criteria included: (1) animal study, (2) review, (3) studies not providing Fe levels for either subjects with obesity or non-obesity controls.

Data extraction

We extracted data using a standard form. The following information was extracted from each included study: first author's family name, year of publication, number of patients, data on levels of Fe.

Statistical analysis

The extracted data were used to performed meta-analysis to obtain the standardized mean difference (SMD) and 95% confidence intervals (CI). The SMDs were calculated using either fixed-effects models or, in the presence of heterogeneity, random-effects models, -therefor, we selected the later. Heterogeneity in studies was tested through the I-square tests, if the I^2 value was greater than 50% and the p value was less than 0.05, the meta-analysis was considered as homogeneous.

Publication bias was measured using visualization of funnel plots. All statistical analyses were conducted with Review Manage.

Results

Basic information and assessment of quality

A total of 163 articles were from the online PubMed (147) and Chinese National Knowledge Infrastructure (16). In total, 93 papers were excluded after preliminary screening. Of these, 27 were review articles. A further 43 papers were investigations of the relationship between obesity and Fe levels. Another 37 papers lacked the necessary data or incomplete data, so were excluded. Assessment of quality was made by meta-analysis of observational studies. Finally, 6 papers were included⁹⁻¹⁴ (Fig. 1).

Meta-analysis of association between Fe levels and obesity

In the figure 2, heterogeneity testing was carried out for the association between Fe levels and

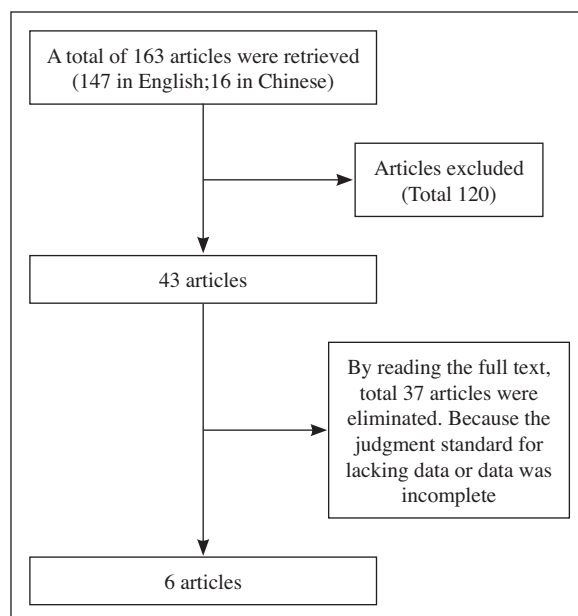


Fig. 1.—Flow chart for literature screening.

obesity, with a result of $I^2=89.8\%$ ($p<0.00001$), -suggesting that the research results for the papers were heterogeneous. A random-effects model was introduced to merge the data for meta-analysis. As shown by the forest plots, subjects with obesity had lower Fe levels than non-obesity controls in total. (SMD=-0.738, 95% confidence interval [CI]=[-1.228, -0.247]).

Publication bias

Publication bias refers to the tendency of a study to produce statistically significant results leading editors to accept them. This is a potential threat in meta-analysis, we could use it to test the possible bias in our literature selection (Figs. 3-4).

Discussion

In the present meta-analysis, the relationship between Fe levels and obesity was examined. It clearly demonstrated that the obese patients had lower levels of Fe than non-obese controls. It supported that there was some difference in levels of Fe between the obese patients and controls. Fe was a significant component of metabolic substances such as hemoglobin and myoglobin (16). Fe is postulated to influence glucose tolerance via its role as a cofactor for serum ferrites¹⁵, which contributes to increase the concentrations of ferrites which is good to decline the consumption of fatty body¹⁶.

However, our results showed strong heterogeneity among the studies. Heterogeneity indicates differences

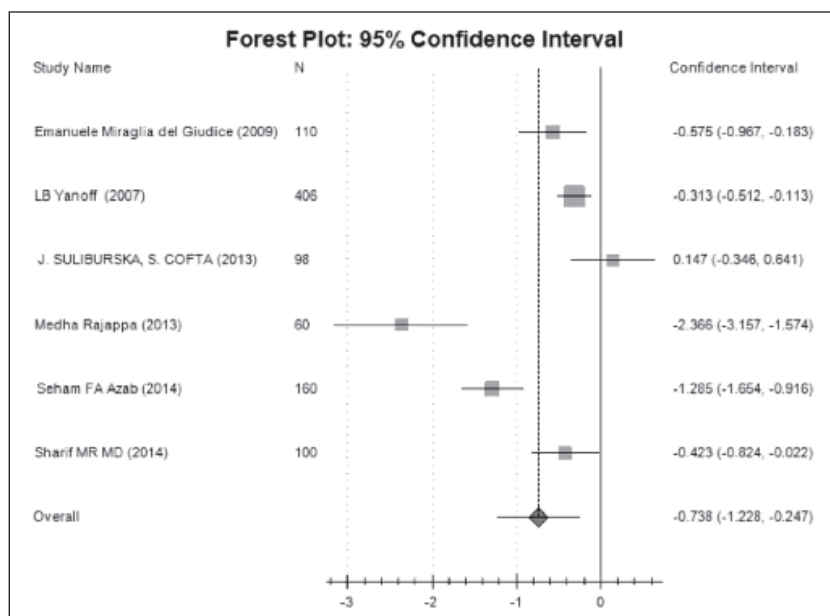


Fig. 2.—Forest plot for the relationship between serum Fe levels and obesity and confidence intervals for obesity in each study and overall in the meta-analysis.

in results across the studies. There are two sources of heterogeneity: one is within-study variability which means a difference within a study of estimating the same effect size and its always exists in meta-analysis is between-study variability which means differences among Studies in estimating effect size among different population. In the present study, the between-study variability was the main source of heterogeneity.

To the best of our knowledge, this is a meta-analysis to estimate the association between Fe levels and obesity. We ensure that minimize the bias by methods of study steps. We search PubMed and Chinese National Knowledge Infrastructure, besides; we inspected all

reference lists from relevant studies. The limitations of our study should be considered, owing to only 6 articles, we failed to perform the subgroup by geographical location which was the possible causes of heterogeneity.

Limitation

The following limitation cannot be ignored: for example, we selected the articles based on free, relevant samples are small size. Therefore, more and further studies are needed to explore.

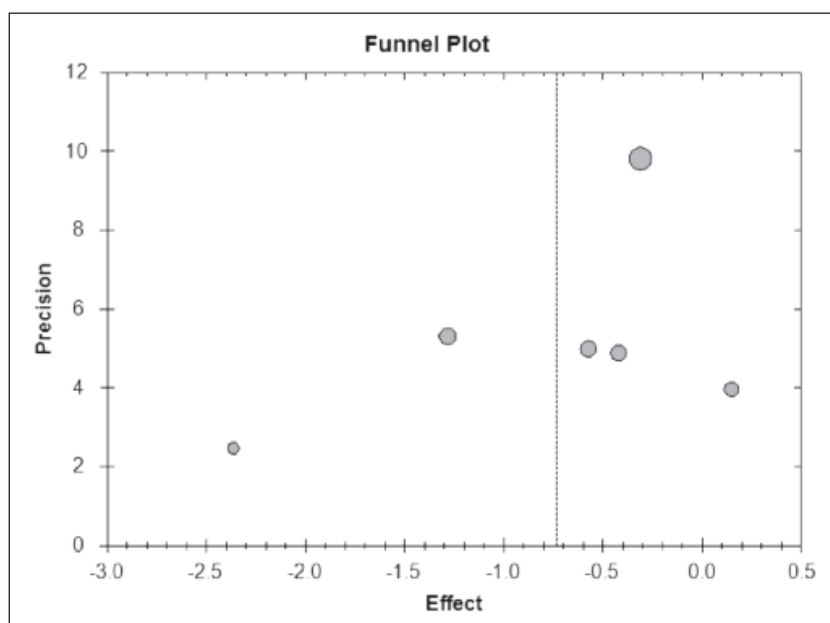


Fig. 3.—Funnel plot for overall in the meta-analysis.

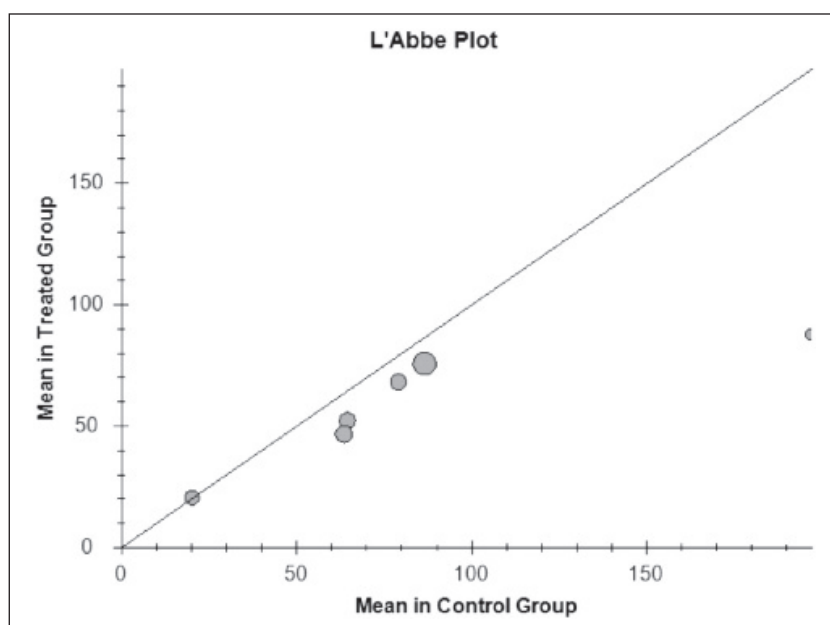


Fig. 4.—L'Abbe Plot for overall in the meta-analysis.

Conclusion

Our results suggested that the lower serum Fe levels maybe risk factor of obesity.

Acknowledgement

This research was supported by Undergraduate Scientific Research Foundation of Wannan Medical College (No.WK2014S18) and Provincial Natural Science Research Project of Anhui Colleges (No. KJ2012B205).

Conflict of interest

None.

References

1. Tan, T.C., D.H. Crawford, L.A. Jaskowski, V.N. Subramaniam, A.D. Clouston, D.I. Crane, et al., Excess iron modulates endoplasmic reticulum stress-associated pathways in a mouse model of alcohol and high-fat diet-induced liver injury. *Lab Invest*, 2013. 93(12): 1295-312.
2. Hurrell, R. and I. Egli, Iron bioavailability and dietary reference values. *Am J Clin Nutr*, 2010. 91(5): 1461S-67S.
3. Tussing-Humphreys, L., M. Pini, V. Ponemone, C. Braunschweig and G. Fantuzzi, Suppressed cytokine production in whole blood cultures may be related to iron status and hepcidin and is partially corrected following weight reduction in morbidly obese pre-menopausal women. *Cytokine*, 2011. 53(2): 201-6.
4. Sangani, R.G. and A.J. Ghio, Iron, human growth, and the global epidemic of obesity. *Nutrients*, 2013. 5(10): 4231-49.
5. Cheng, H.L., C.E. Bryant, K.B. Rooney, K.S. Steinbeck, H.J. Griffin, P. Petocz, et al., Iron, hepcidin and inflammatory status of young healthy overweight and obese women in Australia. *PLoS One*, 2013. 8(7): e68675.
6. Luciani, N., C. Brasse-Lagnel, M. Poli, R. Anty, C. Lesueur, M. Cormont, et al., Hemojuvelin: a new link between obesity and iron homeostasis. *Obesity (Silver Spring)*, 2011. 19(8): 1545-51.
7. Aigner, E., A. Feldman and C. Datz, Obesity as an emerging risk factor for iron deficiency. *Nutrients*, 2014. 6(9): 3587-600.
8. Manios, Y., G. Moschonis, G.P. Chrousos, C. Lionis, V. Mougios, M. Kantilafi, et al., The double burden of obesity and iron deficiency on children and adolescents in Greece: the Healthy Growth Study. *J Hum Nutr Diet*, 2013. 26(5): 470-8.
9. Del Giudice, E.M., N. Santoro, A. Amato, C. Brienza, P. Calabro, E.T. Wiegierinck, et al., Hepcidin in obese children as a potential mediator of the association between obesity and iron deficiency. *J Clin Endocrinol Metab*, 2009. 94(12): 5102-7.
10. Suliburska, J., S. Cofta, E. Gajewska, G. Kalmus, M. Sobieska, W. Samborski, et al., The evaluation of selected serum mineral concentrations and their association with insulin resistance in obese adolescents. *Eur Rev Med Pharmacol Sci*, 2013. 17(17): 2396-400.
11. Rajappa, M., R. Tagirasa, H. Nandeesh, A. Hamide, I. Sundar, P.H. Ananthanarayanan, et al., Synergy of iron, high sensitivity C-reactive protein and ceruloplasmin with oxidative stress in non-diabetic normo-tensive South Indian obese men. *Diabetes Metab Syndr*, 2013. 7(4): 214-7.
12. Azab, S.F., S.H. Saleh, W.F. Elsaed, M.A. Elshafie, L.M. Sherief and A.M. Esh, Serum trace elements in obese Egyptian children: a case-control study. *Ital J Pediatr*, 2014. 40: 20.
13. Sharif, M., M. Madani and F. Tabatabaie, Comparative Evaluation of Iron Deficiency among Obese and Non-obese Children. *Iran J Ped Hematol Oncol*, 2014. 4(4): 160-6.
14. Menzie, C.M., L.B. Yanoff, B.I. Denking, T. McHugh, N.G. Sebring, K.A. Calis, et al., Obesity-related hypoferrremia is not explained by differences in reported intake of heme and nonheme iron or intake of dietary factors that can affect iron absorption. *J Am Diet Assoc*, 2008. 108(1): 145-8.
15. Martinez-Garcia, M.A., M. Luque-Ramirez, J.L. San-Millan and H.F. Escobar-Morreale, Body iron stores and glucose intolerance in premenopausal women: role of hyperandrogenism, insulin resistance, and genomic variants related to inflammation, oxidative stress, and iron metabolism. *Diabetes Care*, 2009. 32(8): 1525-30.
16. Ahmed, F., T. Coyne, A. Dobson and C. McClintock, Iron status among Australian adults: findings of a population based study in Queensland, Australia. *Asia Pac J Clin Nutr*, 2008. 17(1): 40-7.



Original/*Obesidad*

Lipid profile response to weight loss program in overweight and obese patient is related with gender and age

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Abstract

Introduction: the risk of developing cardiovascular disease (CVD) increases with age, however CVD is markedly higher in men than in no-menopausal women. There are few interventions where compare the different effects to lose weight on lipid profile between men and women.

Objective: the aim of this study was to compare the response on the lipid profile by gender after a weight loss program, and determine whether there are differences by age group.

Methods: one hundred eighty (96 women and 84 men) overweight and obese participants (BMI 25–34.9 kg/m²) aged 18–50 years were randomised into treatment groups. The intervention period was 22 weeks (in all cases 3 times/wk of training for 22 weeks and 2 weeks for pre and post evaluation). All subjects followed a hypocaloric diet (25–30% less energy intake). Energy intake, body composition) and blood lipid profile were recorded at baseline and after of treatment.

Results: the response of HDL varied between men and women ($p = 0.001$). While in women it decreased (HDL: -2.94%, $p = 0.02$), HDL was elevated in men (HDL: 5% $p = 0.02$). After intervention men achieved decrease significantly LDL values a 6.65% more than women ($p = 0.01$). For TG concentrations there were significant differences between men and women in baseline however, only men had a significant change in post-training measured ($p = 0.001$). TC showed significant differences between men and women in baseline ($p = 0.013$). After intervention, men and women showed a significant decreased to TC ($p = 0.01$).

INFLUENCIA DEL GÉNERO Y LA EDAD EN LA RESPUESTA DEL PERFIL LIPÍDICO TRAS UN PROGRAMA DE PÉRDIDA DE PESO EN PERSONAS CON SOBREPESO Y OBESIDAD

Resumen

Introducción: el riesgo de desarrollar una enfermedad cardiovascular (ECV) se incrementa con la edad; sin embargo, el riesgo de ECV en edad fértil es mayor en hombres que en mujeres. Son pocas las intervenciones en las que se comparan las diferencias entre hombres y mujeres que un programa de pérdida de peso tiene sobre el perfil lipídico.

Objetivo: comprobar el cambio en el perfil lipídico entre hombres y mujeres tras un programa de pérdida de peso, comparando las diferencias por género y categoría de edad.

Métodos: ciento ochenta participantes (96 mujeres y 84 hombres) con sobrepeso y obesidad (IMC 25–34.9 kg/m²) con edades comprendidas entre los 18–50 años fueron repartidos de forma aleatoria en los diferentes grupos de intervención. El período de intervención fue de 22 semanas y 2 semanas para la evaluación pre y post. Todos los sujetos siguieron una dieta equilibrada hipocalórica (25–30% de restricción calórica) y un programa de ejercicio 3 veces/semana. Antes y después de la intervención todos los grupos fueron evaluados de los cambios en el perfil lipídico, la composición corporal y la ingesta diaria.

Resultados: hubo diferencias significativas en el cambio de HDL entre hombres y mujeres ($p = 0,001$). Mientras que en las mujeres disminuyó (HDL: -2,94%, $p = 0,02$), en los hombres hubo un aumento de la concentración de HDL (HDL: 5% $p = 0,02$). Después de la intervención los hombres lograron disminuir significativamente el LDL un 6,65% más que las mujeres ($p = 0,01$). Para concentraciones de TG hubo diferencias significativas entre hombres y mujeres al inicio de la intervención; sin embargo, solo los hombres tuvieron una mejoría significativa tras la intervención ($p = 0,001$). El TC mostró diferencias significativas entre hombres y mujeres preintervención ($p = 0,013$). Tras la intervención, los hombres y las mujeres mostraron una significativa disminución de TC ($p = 0,01$).

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Recibido: 8-III-2015.
Aceptado: 4-IV-2015.

Conclusion: men achieve a positive greater change on lipid profile than women. In addition, the favorable lipid profile response decreases with increasing age.

(*Nutr Hosp.* 2015;31:2455-2464)

DOI:10.3305/nh.2015.31.6.8926

Key words: *Lipoprotein. Gender. Overweight. Obese. Weight loss treatment. Clinical trial.*

Conclusión: los hombres obtuvieron un cambio más favorable en las variables del perfil lipídico con respecto a la mujeres. Además, la respuesta al perfil lipídico favorable disminuye con el aumento de la edad.

(*Nutr Hosp.* 2015;31:2455-2464)

DOI:10.3305/nh.2015.31.6.8926

Palabras clave: *Perfil lipídico. Género. Edad. Obesidad. Sobre peso. Pérdida de peso. Ensayo clínico.*

Abbreviations

ACSM: American College of Sport Medicine.
BMI: Body mass index.
CF: Tascular fitness.
DEE: Daily energy expenditure.
DXA: Dual-energy x-ray absorptiometry.
E: Endurance training group.
HDL: High density lipoprotein.
HPA: Habitual physical activity.
HR: Heart rate.
HRR: Heart rate reserve.
HULP: University Hospital La Paz.
ICCr: Intraclass correlation coefficient.
LDL: Low density lipoprotein.
MetS: Metabolic Syndrome.
PA: Diet and physical activity recommendations group.
PRONAF: Programas de Nutrición y Actividad Física para el tratamiento del sobrepeso y la obesidad.
RM: Repetition maximum.
RPE: Rate of perceived exertion.
S: Strength training group.
SE: Combine training group.
TC: Total cholesterol.
TG: Triglycerides.
VO₂: Oxygen uptake.

Introduction

There is a marked difference in cardiovascular disease (CVD) risk between sexes. Over the last decade, compelling evidence supports the idea that the different impact of CVD in men and women may be, at least in part, related to the cardiovascular and metabolic effects of sex steroid hormones¹. Epidemiologically, the incidence of CVD is higher in men than in premenopausal women². CVD incidence and mortality among men have shown to be 3 fold and 5 fold greater than in women, respectively³. However after the menopause, the risk of CVD increases in women⁴. Blood lipid profile is considered and independent cardiovascular risk factor⁵. Many cohort studies attempt to explain these gender differences, and the influence that age may have on lipid profile change^{1,3,6}. Premenopausal women show lower concentrations of total cholesterol (TC), low-density lipoprotein cholesterol

(LDL), and plasma triglycerides (TG), and higher high-density lipoprotein cholesterol (HDL) values than men, partially due to effects of estrogen⁷. In both sexes, the risk of CVD increases markedly with age. In most populations, TC increases as age increases. In men, this increase usually levels off around the age of 45 to 50 years, whereas in women, the increase continues sharply with postmenopause³.

Clinical trials have already shown the relevant role of healthy habits as balance diet, no smoke and regular physical activity to protect and decrease CVD risk⁸⁻¹⁰. However, most of these lifestyle or weight loss interventions do not analyze or compare the different response of lipid profile in men and women and age groups. PRONAF Study¹¹ was designed as a weight loss intervention for men and women allowing comparison of the lipid profile changes obtained. It also allows to study the effect of age on the response of the lipid profile after intervention.

Therefore, the aim of this study was to measure the response of the lipid profile between men and women after weight loss program with calorie restriction diet and exercise. A secondary aim was to determine whether there are differences by age group in the change on lipid profile.

Material and methods

Study design

The PRONAF study is a large study *Nutrition and Physical Activity for Obesity* (the PRONAF study according to its Spanish initials), whose aim was to investigate the effects of different types of physical activity and nutrition programs for the treatment of overweight and obesity. Data collection took place from 2008 to 2011 in the Region of Madrid, Spain. This study was an intervention trial of 24 week duration. The study was performed twice, one year apart, first in the overweight group (January 2009 - July 2010) and then in the obese group (January 2010 - July 2011). The measurements took place in the first week (baseline values) for all subjects before starting training, and after 22 weeks of training in week 24 (post-training values). Detailed descriptions of the PRONAF sampling and recruitment approaches, standardisation and

harmonisation processes, inclusion criteria, data collection, intervention program, statistic analyses and quality control activities were published previously¹¹.

Study sample

The study sample population consisted of 173 overweight and obese participants (94 women and 79 men) (overweight participants: body mass index [BMI] 25–29.9 kg/m², obese participants: BMI 30–34.9 kg/m²), all middle-aged (range 18–50 years). Baseline characteristics of the participants are summarized in Table I. All subjects were healthy, normoglycaemic, non-smokers, but led sedentary lifestyles. All female subjects had regular menstrual cycles. The exclusion criteria covered all physical and psychological diseases that may have precluded the performance of the requested strength or endurance training, and the consumption of any medication known to influence physical performance or the interpretation of the results. Subjects with a background of systematic strength or endurance training (moderate to high intensity training more than once a week) in the year before the study started were also excluded. In agreement with the guidelines of the Declaration of Helsinki regarding research on human subjects, all participants signed an institutionally approved document of informed consent. All subjects were carefully informed about the possible risks and benefits of the study, which was approved by the Human Research Review Committee of the La Paz University Hospital (HULP). HULP code PI-643.

Subjects who fulfilled the inclusion criteria and passed a baseline physical examination were stratified by age and sex and randomly assigned in four intervention groups. The intervention groups are extensively described in Zapico et al.¹¹. For the presented work, the sample was classified by sex and age in responders or no-responders groups. Responders were defined as those who achieved a decrease in body weight higher

than 5% and no-responders those who achieved less than 5%¹². Also, participants were assigned into 3 age groups: 18–29 years group, 30–39 years group and 40–50 years group.

Intervention program

Exercise training program. The different exercise groups followed the corresponding, supervised training program, which consisted in all cases of training 3 times/wk for 22 weeks¹¹. All training sessions were carefully supervised by certified personal trainers. An adherence to training of 90% was demanded.

Hypocaloric diet program. Diet prescription was performed for all patients by expert dieticians in the Nutrition Department of HULP. All groups underwent an individualized and hypocaloric diet (between 1200 and 3000 kcal). Diet was lowered a 25–30% from daily energy expenditure (DEE) measured using SenseWear Pro Armband™ data.

Data collection

The analyses and measurements were made at baseline and at the end of the study period:

Blood analysis. All blood samples were taken after 12 h fast between 7:00 and 9:00 a.m. at baseline and post-training intervention (week 1 and week 24). All post-training samples were obtained 72 hours after the last training day to avoid acute effects of training on blood lipids. All blood samples were drawn from the antecubital vein and handled according to standardized laboratory practice at HULP. Serum biochemicals (total cholesterol (TC), low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, and triglycerides (TG) were determined using enzymatic methods with Olympus reagents by automated spectrophotometry performed on Olympus AU 5400 (Olympus Diagnostica, Hamburg, Germany).

Table I
Baseline data of the participants (n=173)

	Overweight n=84		Obesity n=96	
	Women n=47	Men n=34	Women n=47	Men n=45
Age (years)	37.29 ± 8.25	37.42 ± 8.02	39.02 ± 7.74	38.79 ± 7.99
Body Weight (kg)	73.5 ± 5.87	88.21 ± 8.13	88.33 ± 10.1	102.04 ± 8.94
Height (m)	1.62 ± 0.06	1.75 ± 0.07	1.64 ± 0.07	1.77 ± 0.06
BMI (kg/m ²)	28.01 ± 1.32	28.57 ± 1.12	32.41 ± 1.85	32.4 ± 1.90
Body fat (%)	43.28 ± 3.62	33.8 ± 4.63	47.11 ± 3.49	38.17 ± 4.02
Body fat free mass (kg)	40.25 ± 4.3	55.99 ± 5.47	44.3 ± 4.71	58.63 ± 8.96
Bone mineral density (g/cm ²)	1.18 ± 0.1	1.26 ± 0.09	1.21 ± 0.11	1.3 ± 0.1

Results are shown as Mean ± SD.

Note. BMI, Body Mass Index. Body fat, Body fat free mass and Bone mineral density calculated by Dual-energy x-ray absorptiometry (DXA).

Menstrual cycle was controlled by diary to define the follicular and luteal phases when blood samples were taken¹³.

Body composition. Body composition was assessed by dual-energy x-ray absorptiometry DXA (GE Lunar Prodigy; GE Healthcare, Madison, WI, GE Encore 2002, version 6.10.029 software) and was used to measure total body fat (%) and body fat free (kg) mass.

Anthropometric measures included height (stadiometer SECA; range 80-200cm), body mass (BC-420MA, Bio Lógica, Tecnología Médica SL) and body mass index (BMI) calculated as [body weight (kg)/(height (m))²].

Statistical analysis

SPSS version 15.0 for Windows was used for statistical analyses (SPSS Inc., Chicago, Illinois, USA). Standard statistical methods were used for the calculation of the means and standard deviation. To analyze the effects on lipid profile used a threshold of a 5% weight loss was taken into account to consider the sample as responders or non-responders¹².

The effects of gender (men vs. women) and age (18-29 vs. 30-39 vs. 40-50 groups) on blood lipid profile were tested using four-way repeated-measures analysis of variance (ANOVA).

Multivariate analysis of variance (MANOVA) was used to compare within gender and age the delta percentage on lipid profile. Bonferroni's post-hoc test was employed to locate specific differences. Relationships among the android fat, gynoid fat, and changes in the dependent variables were determined by using Pearson correlation coefficients. The delta percentage was calculated through the standard formula: % change =

[(post-test score – pre-test score)/pre-test score]×100. The significance level was set at $\alpha=0.05$.

Results

Table II shows changes in plasma lipid and lipoprotein concentrations in four groups (men and women responders and men and women no-responders) before and after the intervention period. For HDL levels there were significant differences between men and women of responders and no-responders in baseline and post-training. Women responders decreased significantly HDL concentrations, whereas men responders obtained a significant increase for HDL values. In baseline, LDL values showed differences between men and women of the responders group ($p=0.001$) but not in no-responders group. After intervention, men responders and no-responders improved LDL concentrations, showed a significant decrease ($p=0.001$; $p=0.009$). For TG concentrations there were significant differences between men and women responders in baseline and trend to significant in post-training ($p=0.08?$). Only the men responders improved significantly the TG values after intervention. TC showed significant differences between men and women responders in baseline. After intervention, men and women responders and men no-responders showed a significant decreased to TC. The 62.5% in men and the 61.7% achieved or remained to non-atherogenic values. The effects size to lipid profile variables was: HDL: 0.017, LDL: 0.062, TG: 0.001, CT: 0.028.

Table III shows baseline and post-training blood lipid profile values for gender and age groups (18-29; 30-39; 40-50). HDL decreased significantly from the baseline to post-training period in women responders

Table II
Changes on blood lipid profile in man and women

		Responders					No responders				
		Baseline		Post-training		p-value	Baseline		Post-training		p-value
		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
HDL (mg/dL)	Men	46.23 ± 9.50		48.17 ± 10.07		0.02	43.93 ± 6.23		44.86 ± 7.37		0.60
	Women	55.65 ± 11.20 *		53.88 ± 10.57 *		0.02	52.70 ± 9.83 *		52.10 ± 11.22 *		0.69
LDL (mg/dL)	Men	142.75 ± 30.79		125.11 ± 29.25		0.01	134.07 ± 20.66		120.86 ± 13.52		0.01
	Women	124.21 ± 29.29 *		120.36 ± 27.75		0.08	126.53 ± 26.13		126.21 ± 22.90		0.94
TG (mg/dL)	Men	132.31 ± 66.80		110.40 ± 48.04		0.01	126.71 ± 55.41		119.14 ± 56.72		0.52
	Women	100.18 ± 37.00 *		96.43 ± 44.34		0.46	112.00 ± 64.39		99.65 ± 45.63		0.21
CT (mg/dL)	Men	215.80 ± 36.75		193.38 ± 34.58		0.01	200.79 ± 24.66		187.86 ± 15.84		0.01
	Women	200.50 ± 36.06 *		192.08 ± 34.14		0.04	198.60 ± 37.37		195.30 ± 32.49		0.53

Results are shown as Mean ± SD. (Men responders n=65; women responders n=74; men no responders n=14; women no responders n=20) HDL, higher high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; TG, plasma triglycerides; TC, total cholesterol.

*Differences within gender.

p value to change intragroup.

and no-responders of the 40-50 age group. For the 30-39 group there were significant differences in baseline and post-training HDL values between men responders and women responders. In baseline, the men responders of 40-50 group obtained significant differences with the same women age group in HDL levels. For post-training LDL values the women responders of 19-29 group showed significant differences with 30-39 group and 40-50 group. In baseline, the men responders of 18-29 group obtained significant differences with 40-50 group for LDL concentration. Also, the participants responders of 40-50 group showed significant differences between men and women. After intervention, men no-responders 18-29 group and men responders 30-39 group and 40-50 group achieved significant improvements for LDL levels. TG values showed significant differences in baseline measure between women no-responders of the 18-29 group and the 30-39 group. In post-training moment, men responder of the 18-29 obtained significant differences to TG concentrations with the 30-39 group. There were significant differences between men and women responders of the 30-39 group in baseline. After intervention, women no-responders of the 18-29 group decreased significantly TG values. Also, men responders of the 40-50 group improved significantly TG concentrations. For TC concentrations, women responders of the 18-29 group showed significant differences with the 30-39 and 40-50 groups in post-training. Men responders of the 18-29 group obtained significant differences to TC with the 40-50 group in baseline and post-training values. In baseline, there were significant differences between men and women responders of the 40-50 group. After intervention, men responders of the 30-39 and 40-50 groups improved significantly the TC concentrations.

Figure 1 shows % change on blood lipid profile by sex.

Figure 2 shows % change on blood lipid profile by sex and age.

Discussion

The main finding of the present study was that men appeared to have a better response of the lipid profile than women to a weight loss intervention program such as the PRONAF Study. On the other hand, with age, the favorable response on lipid profile is markedly diminished.

Guidelines established by the National Cholesterol Education Program (NCEP) promote exercise and weight loss for the treatment of abnormal lipoprotein levels¹⁴. To improve cardiometabolic health in men and women, the literature suggests that healthy diet, weight loss, exercise and physical activity are key to prevent and treat the development of these diseases¹⁵. However, despite men and women present different response to the treatments, there are not individualized recommendations.

The results of the present work showed different significant changes in HDL between men and women. In baseline, HDL concentration was significantly greater in women than men. However, after intervention this difference was lower because men obtained a significant improvement and women decreased significantly. Different studies reported in their results that HDL can increase¹⁶, decrease^{17,18}, or remain stable¹⁹ with weight loss. In women, the reduction in fat intake leads to decrease HDL concentration^{9,20,21}. Our results are in agreement with these studies. After intervention, both men and women achieved an average of 10% weight loss (data not shown). This reduction represents the main reason for the improvement on the lipid profile levels^{22,23}.

For LDL, TG and TC concentrations the PRONAF Study participants achieved general improvements after intervention. Lipid profile values decreased up to values considered as no-atherogenic. Similar interventions also agree with our outcomes^{9,10,24-28}. However, it is not that clear to discuss what happens when sex differences are studied, because there are not clinical trials comparing treatment efficacy and impact between men and women. Nevertheless, we found interventions which applied hormone therapy to improve cardiovascular risk factors in men and women^{1,29}. In these interventions considered to apply different doses for men and women, due to androgens and estrogens influence in the change in cardiovascular risk factors, often in a sex-specific manner^{1,29}.

In this regard, there is controversy to consider the different cardiovascular risk factors by sex. Regiz-Zagrosek et al.⁷ reported that it should be considered in a gender-specific manner what factors can affect more in men than in women and vice versa. They emphasize the need to study gender-specific pathophysiology analysis in response to exercise⁷.

When the response on lipid profile is compared by sex after weight loss intervention in our study, men achieved a better change than women. In the literature, we found reviews and epidemiological studies that try to explain the gender-specific differences to lipid profile abnormalities treatment. There are several factors that can affect men and women differently. Fat distribution is different in men than in women. Peripheral adiposity with gluteal fat accumulation characterizes premenopausal women⁷. However, the male pattern is android obesity⁷. This body distribution is very important because the shift from peripheral to visceral obesity has a number of negative consequences. First, visceral fat is an important source of free fatty acids and inflammatory mediators which are directly delivered to the liver via the portal vein. This contributes to develop lipid abnormalities⁷. Visceral adipocytes differ from peripheral adipocytes in their lipolytic activity^{30,31}. Moreover, fat tissue interferes with hormone metabolism, even more as growth and aging takes place. White fat is the major source of estrogens in elderly women and

Table III
Changes on blood lipid profile in man and women by age groups

	Men responders					Women responders					Men no responders					Women no responders				
	Post-training		Post-training		p-value	Post-training		Post-training		p-value	Post-training		Post-training		p-value	Post-training		Post-training		p-value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
HDL (mg/dL)	18-29	43.75 ± 4.77	47.25 ± 5.06		0.82	54.38 ± 9.55		51.85 ± 10.13		0.17	41.50 ± 6.45		42.25 ± 10.87		0.13	55.75 ± 4.35		54.25 ± 10.11		0.65
	30-39	44.38 ± 9.02	46.43 ± 10.05		0.16	55.64 ± 10.48 *		55.82 ± 11.17 *		0.89	45.50 ± 6.89		46.88 ± 6.24		0.55	51.57 ± 15.75		56.43 ± 15.41		0.55
	40-50	47.86 ± 10.38	49.39 ± 10.90		0.17	56.08 ± 12.27 *		53.46 ± 10.46		0.01	42.50 ± 0.71		42.00 ± 1.41		0.91	52.22 ± 5.49		47.78 ± 6.51		0.04
LDL (mg/dL)	18-29	115.13 ± 25.98	105.63 ± 25.16		0.02	107.50 ± 30.39		99.75 ± 25.45		0.15	134.00 ± 34.09		111.50 ± 4.65		0.02	140.00 ± 25.59		127.25 ± 34.71		0.17
	30-39	143.38 ± 31.35	123.57 ± 37.34		0.01	129.09 ± 31.13		123.82 ± 28.38 a		0.18	135.13 ± 16.57		128.75 ± 12.67		0.33	117.17 ± 23.30		130.00 ± 14.53		0.09
	40-50	148.69 ± 28.69 a	130.49 ± 22.67		0.01	126.59 ± 26.74 *		124.74 ± 25.81 a		0.53	130.00 ± 9.90		108.00 ± 2.83		0.10	126.78 ± 28.20		123.22 ± 23.98		0.56
TG (mg/dL)	18-29	93.88 ± 28.50	68.88 ± 65.94 a		0.10	106.31 ± 44.36		100 ± 54.37		0.60	137.50 ± 78.24		115.25 ± 65.94		0.31	174.75 ± 101.01		118.75 ± 58.47		0.01
	30-39	133.90 ± 71.92	125.14 ± 56.72 a		0.36	100.41 ± 30.77 *		103.45 ± 60.54		0.74	115.25 ± 45.41		111.75 ± 56.72		0.82	92.00 ± 40.07 a		87.29 ± 35.06		0.77
	40-50	139.92 ± 68.14	111.03 ± 54.45		0.01	98.00 ± 38.30		91.28 ± 27.52		0.34	151.00 ± 66.47		156.50 ± 54.45		0.85	99.67 ± 48.22		100.78 ± 49.22		0.94
TC (mg/dL)	18-29	180.38 ± 34.61	166.50 ± 27.89 b		0.06	179.62 ± 36.14		167.00 ± 37.72		0.06	198.50 ± 38.13		176.75 ± 10.40		0.07	224.00 ± 29.62		205.25 ± 39.14		0.11
	30-39	214.71 ± 41.24 a	192.33 ± 42.38		0.01	207.95 ± 33.35		199.00 ± 32.38 a		0.07	201.38 ± 20.47		195.00 ± 15.75		0.44	180.00 ± 41.64		194.86 ± 33.80		0.09
	40-50	224.31 ± 29.93	199.97 ± 28.19		0.01	203.26 ± 35.80 *		196.54 ± 30.76 a		0.07	203.00 ± 24.04		181.50 ± 14.85		0.20	201.78 ± 32.42		191.22 ± 31.75		0.08

Results are shown as Mean ± SD. (Men responders n=65, women responders n=74, men no responders n=14, women no responders n=20).

* Differences between men responders and women responders of the same age group and intervention time.

a Differences with group 18-29.

b Differences with 30-39.

p value to change intragroup.

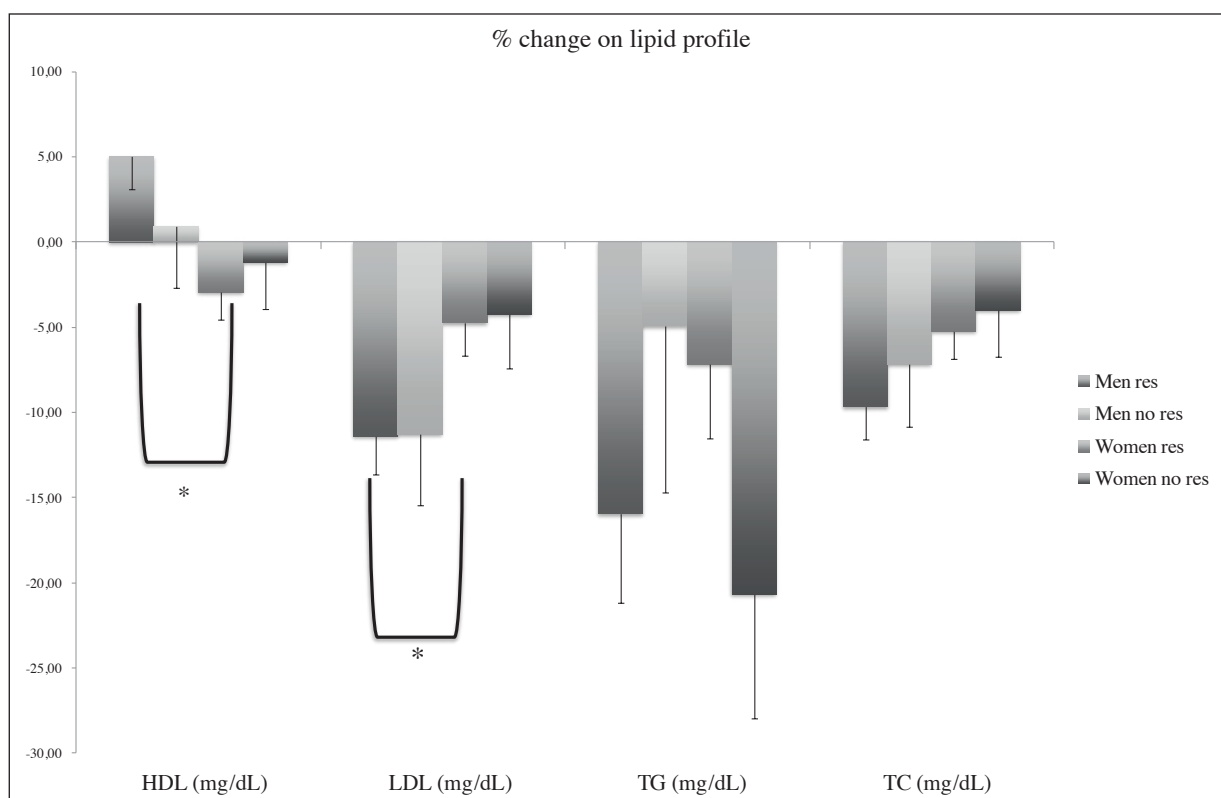


Fig. 1.—% change (mean – SD) on lipid profile by gender.

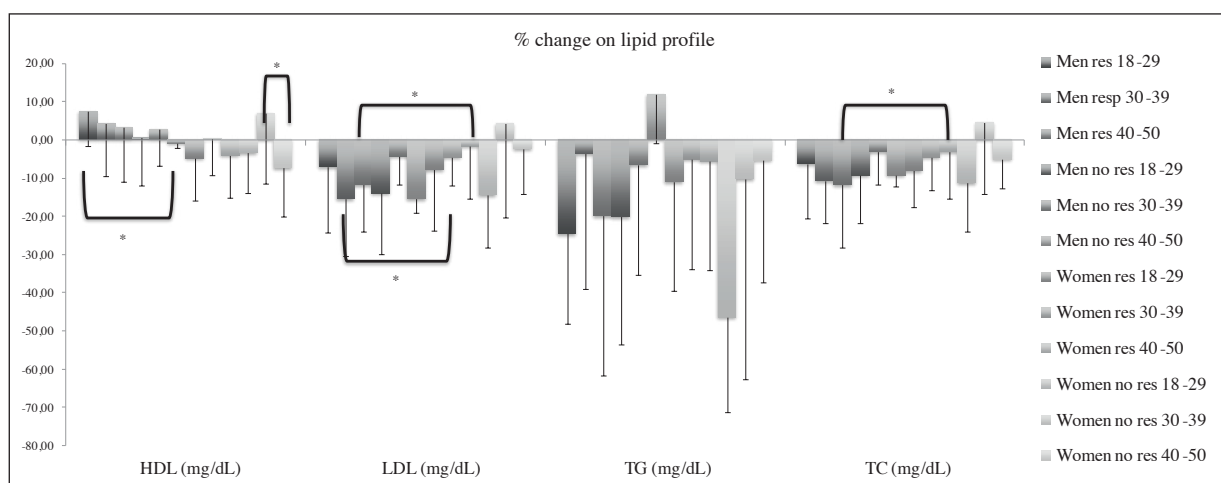


Fig. 2.—% change (mean-SD) on lipid profile by gender and age group. *: differences between gender of same age group.

men, because testosterone is converted there to estradiol in women and men. The conversion is related to adipocytes functions⁷. Due to increased age, there is an increment in the visceral fat accumulation^{7,32}. This can explain why the PRONAF Study participants obtained less improvement as age increases. When the concentration and sizes of lipoprotein particles has been studied, the results showed higher atherogenic values in the older age group⁶.

After analyzing these factors there is still discrepancy in the pathophysiologic mechanics that determine the gender differences. It is a fact that the development of atherosclerosis is influenced by gender and that the acute vasodilating effects of estrogens have been attributed as protector in the development of atherosclerosis¹.

The baseline values in our participants showed a higher cardiometabolic risk in men than in women. The



Fig. 3.—Relationship between percentage change of android and gynoid fat and percentage change of lipid profile variables.

partially sex-dependent differences between fat distribution patterns may provide an explanation of why android obesity in men is linked to more atherogenic values (Fig. 3). Thereby, the reduced tendency to accumulate fat at intraabdominal sites may be one of the primary metabolic differences underlying the reduced risk of CVD and Metabolic Syndrome. This may help to explain physiologically why the male participants who start with more atherogenic values have a better response to the weight loss treatment.

Figure 3. Relationship between percentage change of android and gynoid fat and percentage change of lipid profile variables.

Also, circulating lipids are different, are differently regulated, and have different significance in women and men^{7,32}. The estrogen effect in women is a greater activity in lipoprotein transport and removal of LDL and VLDL from the plasma than do men. This may explain the differences in baseline values between women and men in our study. The decrease in visceral fat leads to decrease LDL and TC concentrations and CVD risk. Such factors are responsible of the gender differences and may explain the better response of lipid profile in men than in women. In figure 3 can see a greater decrease in the android fat in men than in women.

Some of the findings described previously have direct clinical implications. Physicians should recognize the different effects of exercise and diet in the treatment of overweight and obesity in men and women. In PRONAF study the exercise mode showed no significant difference^{22,23}. Despite it is necessary to analyze cardiovascular risk factors, to consider the risk by sex and to choose the most appropriate treatment. In Europe, we need to develop specific aspects in our guidelines to cover cardiovascular risk management in women, as has been accomplished in USA³³.

A point of interest of the PRONAF Study is that is the first randomized controlled intervention study performed in Spanish overweight and obese adults without any other associated disease with the aim of losing weight and improving several health related parameters by means of combining caloric restriction and controlled training programs. This allows to compare and to discourse about the different response by groups of intervention, gender and/or age. And thus, to support the clinical practice for cardiovascular risk factors treatment. Unfortunately, the main limitation could be the low statistical power due to sample size to get significant differences.

Conclusion

In conclusion, the present results showed that men achieved a positive greater change on lipid profile than women. Moreover, the favorable lipid profile response decreases with increasing age. Therefore, we should consider gender characteristics in order to decide the

most appropriate treatment to enhance overweight, obesity and associated diseases. Health is a social matter and it is interesting to know which is the lowest cost and efficient treatment that ensures long-term positive changes. PRONAF Study analysis included a followed up data collection and results showed that participants maintain favorable improvements after one year finish intervention³⁴. These results are still being analyzed to throw light on the variables that can influence more weight loss interventions. It is necessary to consider the non modifiable characteristics of the sample (sex, age, genetic factors), as covered in this study. Future research is required in order to investigate the role of other non modifiable factors including genetics in PRONAF Study.

Acknowledgments

Funding: The PRONAF Study takes place with the financial support of the *Ministerio de Ciencia e Innovación, Convocatoria de Ayudas I+D 2008, Proyectos de Investigación Fundamental No Orientada, del VI Plan de Investigación Nacional 2008-2011*, (Contrac: DEP2008-06354-C04-01).

We acknowledge and thank all of the subjects who participated in the study. We thank PhD Víctor Díaz Molina for valuable discussion. Finally we appreciate the participation of the Nuclear Medicine Service of the University Hospital La Paz that carries out the DXAs.

Conflict of interest statement

The authors have no conflicts of interest.

References

1. Vitale C, Mendelsohn ME, Rosano GMC. Gender differences in the cardiovascular effect of sex hormones. *Nature Reviews Cardiology*. 2009;6(8):532-42.
2. Kannel WB, Hjortland MC, McNAMARA PM, Gordon T. Menopause and risk of cardiovascular disease: the Framingham Study. *Ann Intern med*. 1976;85(4):447.
3. Jousilahti P, Vartiainen E, Tuomilehto J, Puska P. Sex, age, cardiovascular risk factors, and coronary heart disease A prospective follow-up study of 14 786 middle-aged men and women in Finland. *Circulation*. 1999;99(9):1165-72.
4. Liu Y, Ding J, Bush TL, Longenecker JC, Nieto FJ, Golden SH, et al. Relative androgen excess and increased cardiovascular risk after menopause: a hypothesized relation. *Am J Epidemiol*. 2001;154(6):489-94.
5. Carroll S, Dudfield M. What is the relationship between exercise and metabolic abnormalities? A review of the metabolic syndrome. *Sports Med*. 2004;34(6):371-418.
6. Freedman DS, Otvos JD, Jeyarajah EJ, Shalurova I, Cupples LA, Parise H, et al. Sex and age differences in lipoprotein subclasses measured by nuclear magnetic resonance spectroscopy: the Framingham Study. *Clin chem*. 2004;50(7):1189-200.
7. Regitz-Zagrosek V, Lehmkuhl E, Mahmoodzadeh S. Gender aspects of the role of the metabolic syndrome as a risk factor for cardiovascular disease. *Gender medicine*. 2007;4:S162.

8. Kelley GA, Kelley KS. Impact of progressive resistance training on lipids and lipoproteins in adults: a meta-analysis of randomized controlled trials. *Prev Med.* 2009;48(1):9-19.
9. Sillanpää E, Häkkinen A, Punnonen K, Häkkinen K, Laaksonen D. Effects of strength and endurance training on metabolic risk factors in healthy 40-65-year-old men. *Scand J Med Sci Sports.* 2009;19(6):885-95.
10. Stensvold D, Tjønnå AE, Skaug EA, Aspenes S, Stølen T, Wisloff U, et al. Strength training versus aerobic interval training to modify risk factors of the metabolic syndrome. *J Appl Physiol.* 2010.
11. Zapico AG, Benito PJ, Gonzalez-Gross M, Peinado AB, Morencos E, Romero B, et al. Nutrition and physical activity programs for obesity treatment (PRONAF study). methodological approach of the project. *BMC Public Health.* 2012;12(1):1100.
12. Fayh APT, Lopes AL, da Silva AMV, Reischak-Oliveira A, Friedman R. Effects of 5% weight loss through diet or diet plus exercise on cardiovascular parameters of obese: a randomized clinical trial. *Eur of Nutr.* 2012;1-8.
13. Muesing RA, Forman MR, Graubard BI, Beecher GR, Lanza E, McAdam PA, et al. Cyclic changes in lipoprotein and apolipoprotein levels during the menstrual cycle in healthy premenopausal women on a controlled diet. *J Clin Endocrinol Metab.* 1996;81(10):3599-603.
14. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation.* 2002;106(25):3143-421.
15. Churilla JR. The metabolic syndrome: The Crucial Role of Exercise Prescription and Diet. *ACSM'S Health & Fitness Journal.* 2009;13(1):20-6.
16. Hughes TA, Gwynne JT, Switzer BR, Herbst C, White G. Effects of caloric restriction and weight loss on glycemic control, insulin release and resistance, and atherosclerotic risk in obese patients with type II diabetes mellitus. *Am J Med.* 1984;77(1):7-17.
17. Wing RR, Jeffery RW, Burton LR, Thorson C, Kuller LH, Folsom AR. Change in waist-hip ratio with weight loss and its association with change in cardiovascular risk factors. *Am J Clin Nutr.* 1992;55(6):1086-92.
18. Fujioka S, Matsuzawa Y, Tokunaga K, Kawamoto T, Kobatake T, Keno Y, et al. Improvement of glucose and lipid metabolism associated with selective reduction of intra-abdominal visceral fat in premenopausal women with visceral fat obesity. *Int J Obes.* 1991;15(12):853.
19. Richter WO, Schwandt P. Benefit from hypocaloric diet in obese men depends on the extent of weight-loss regarding cholesterol, and on a simultaneous change in body fat distribution regarding insulin sensitivity and glucose tolerance. *Metabolism.* 1992;41(9):1035-9.
20. Noakes M, Clifton PM. Changes in plasma lipids and other cardiovascular risk factors during 3 energy-restricted diets differing in total fat and fatty acid composition. *Am J Clin Nutr.* 2000;71(3):706-12.
21. Kasim-Karakas SE, Almario RU, Mueller WM, Peerson J. Changes in plasma lipoproteins during low-fat, high-carbohydrate diets: effects of energy intake. *Am J Clin Nutr.* 2000;71(6):1439-47.
22. Morencos E, Romero Moraleda B, Peinado Lozano AB, González Gross M, Fernández C, Gómez Candela C, et al. Effects of dietary restriction combined with different exercise programs or physical activity recommendations on blood lipids in overweight adults. *Nutr Hosp.* 2012;27(6).
23. Romero B, Morencos E, Peinado AB, Bermejo LM, Gómez Candela C, Benito PJ, et al. Can the exercise mode determine lipid profile improvements in obese patients? *Nutr Hosp.* 2013;28(3).
24. Donnelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, Smith BK. American College of Sports Medicine Position Stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exerc.* 2009;41(2):459-71.
25. Greene NP, Martin SE, Crouse SF. Acute Exercise and Training Alter Blood Lipid and Lipoprotein Profiles Differently in Overweight and Obese Men and Women. *Obesity.* 2012;20(8):1618-27.
26. Johnson NA, Sachinwalla T, Walton DW, Smith K, Armstrong A, Thompson MW, et al. Aerobic exercise training reduces hepatic and visceral lipids in obese individuals without weight loss. *Hepatology.* 2009;50(4):1105-12.
27. Sigal RJ, Kenny GP, Boule NG, Wells GA, Prud'homme D, Fortier M, et al. Effects of aerobic training, resistance training, or both on glycemic control in type 2 diabetes: a randomized trial. *Ann Intern Med.* 2007;147(6):357-69.
28. Wood PD, Stefanick ML, Williams PT, Haskell WL. The effects on plasma lipoproteins of a prudent weight-reducing diet, with or without exercise, in overweight men and women. *N Engl J Med.* 1991;325(7):461-6.
29. Vitale C, Fini M, Speziale G, Chierchia S. Gender differences in the cardiovascular effects of sex hormones. *Fund & Clin Pharm.* 2010;24(6):675-85.
30. Van Harmelen V, Reynisdottir S, Eriksson P, Thärne A, Hoffstedt J, Lännqvist F, et al. Leptin secretion from subcutaneous and visceral adipose tissue in women. *Diabetes* 1998;47(6):913-7.
31. Loria Kohen V, Fernández Fernández C, Bermejo LM, Morencos E, Romero Moraleda B, Gómez Candela C. Effect of different exercise modalities plus a hypocaloric diet on inflammation markers in overweight patients: a randomized trial. *Clin Nutr.* 2012;In press.
32. Kelley GA, Kelley KS, Roberts S, Haskell W. Combined effects of aerobic exercise and diet on lipids and lipoproteins in overweight and obese adults: a meta-analysis. *J Obes.* 2012;2012:1-16.
33. Mosca L, Banka CL, Benjamin EJ, Berra K, Bushnell C, Dolor RJ, et al. Evidence-based guidelines for cardiovascular disease prevention in women: 2007 update. *J Am Coll Card.* 2007;49(11):1230-50.
34. Kuusi T, Nieminen MS, Ehnholm C, Yki-Järvinen H, Valle M, Nikkilä E, et al. Apolipoprotein E polymorphism and coronary artery disease. Increased prevalence of apolipoprotein E-4 in angiographically verified coronary patients. *Arterioscler Thromb Vasc Biol.* 1989;9(2):237-41.



Original/*Pediatría*

Situación nutricional en el momento del ingreso en un hospital pediátrico terciario

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Resumen

Objetivo: analizar la situación nutricional de los pacientes en el momento del ingreso hospitalario a lo largo de un año natural e identificar a aquellos pacientes y/o grupos de enfermedades con mayor riesgo de malnutrición.

Material y métodos: valoración retrospectiva de la situación nutricional de 852 pacientes hospitalizados durante el año 2013 en un hospital pediátrico (462 varones y 390 mujeres). De cada paciente se registraron el sexo, edad, peso y talla, índice de masa corporal (IMC), estancia hospitalaria y diagnóstico según la Clasificación Internacional de las Enfermedades (CIE-10).

Resultados: la prevalencia de malnutrición al ingreso era del 8,2%, y la de sobrepeso/obesidad del 18%. Las enfermedades neurológicas (22,9%), junto con las respiratorias (22,9%), infecciosas (18,6%), malformaciones congénitas (11,4%) y genitourinarias (8,6%) representaban el 84,4% de los casos de malnutrición.

Conclusiones: la tasa de prevalencia de malnutrición en los pacientes pediátricos al ingreso era del 8,2%; siendo esta cifra prácticamente similar a las publicadas en los países occidentales. Los pacientes con menor edad y afectos de enfermedades neurológicas y/o respiratorias y, especialmente, con enfermedades congénitas tenían un mayor riesgo de presentar malnutrición, siendo preceptivo realizar un cribado nutricional inicial y un seguimiento durante su hospitalización.

(Nutr Hosp. 2015;31:2465-2471)

DOI:10.3305/nh.2015.31.6.8863

Palabras clave: *Admisión hospitalaria. Clasificación Internacional de Enfermedades. Estado nutricional. Índice de masa corporal. Malnutrición. Ingreso hospitalario. Niño hospitalizado.*

NUTRITIONAL STATUS AT THE TIME OF ADMISSION AMONG PATIENTS ADMITTED TO A TERTIARY-CARE PAEDIATRIC HOSPITAL

Abstract

Objective: to analyze the nutrition status of the pediatric patients at the time of hospital admission throughout a calendar year in a tertiary level hospital and to identify those patients and/or groups of pathologies with a higher risk of malnutrition.

Material and methods: retrospective evaluation of nutrition status of 852 patients hospitalized in 2013 in a pediatric hospital (462 males and 390 females). Sex, age, body mass index at the moment of admission and days of hospitalization and diagnosis codified according to the International Classification of Diseases were registered.

Results: the prevalence of malnutrition patients registered at the moment of admission was 8.2%. Excess body weight (overweight and obesity) was detected in 18% of the patients. The diseases of the nervous system (22.9%), together with the diseases of the respiratory system, the infectious diseases (18.6%), the congenital malformations (11.4%) and the diseases of the genitorurinary system (8.6%) account for 84.4% of the cases with malnutrition.

Conclusions: the overall prevalence rate for malnutrition in pediatric patients at the moment of admission in our hospital was 8.2%, being this figure similar to those published in occidental countries. It should be mandatory to accomplish an initial screening and follow up during hospitalization of younger patients and those suffering from diseases of the nervous and/or respiratory system and, especially, from congenital diseases.

(Nutr Hosp. 2015;31:2465-2471)

DOI:10.3305/nh.2015.31.6.8863

Key words: *Nutritional status. Malnutrition. Hospitalized children. Hospital admission. Body mass index. International classification of diseases.*

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Recibido: 17-II-15.

Aceptado: 15-III-15.

Introducción

El deterioro nutricional en pacientes adultos hospitalizados ha sido motivo de amplio análisis asociándose a una mayor morbilidad y, por tanto, a un incremento de los costes sanitarios¹⁻⁴. Esta eventualidad ha sido debatida en altas instancias administrativas y/o políticas, dando origen a la promulgación de guías y/o resoluciones del Consejo de Europa sobre la alimentación y cuidado nutricional en los hospitales⁵⁻⁸.

Los estudios epidemiológicos realizados en países occidentales sobre la desnutrición hospitalaria en pacientes pediátricos registran una prevalencia de malnutrición en el momento del ingreso que oscila entre un 6,1 y 13,3%⁹⁻¹⁵, siendo estos pacientes más susceptibles de presentar un deterioro nutricional durante su permanencia hospitalaria¹⁵⁻¹⁷. No obstante, esta eventualidad a menudo pasa desapercibida por carencia de políticas y/o estrategias específicas de cribado nutricional¹⁸.

Para identificar a los pacientes con riesgo de desnutrición durante su estancia hospitalaria se han desarrollado distintas herramientas de cribado nutricional que han sido validadas y adaptadas a la edad pediátrica; y que básicamente consisten en unos sistemas de puntuación que a partir de datos clínicos y antropométricos permiten reconocer a los pacientes con riesgo de desnutrición y, por tanto, necesitados de una evaluación nutricional y/o clínica más exhaustiva. Cabe mencionar el *Pediatric Nutritional Risk Score* (NRS), así como el *Screening Tool for Risk on Nutritional Status and Growth* (STRONGkids) y el *Screening Tool for the Assessment of Malnutrition in Pediatric* (STAMP), aunque no existe consenso acerca de la herramienta de cribado nutricional más apropiada para aplicar en la edad pediátrica¹⁹⁻²³.

No obstante, existen múltiples enfermedades que podrían explicar *per se* una situación de malnutrición, lo que sugiere que la situación nutricional en el momento del ingreso hospitalario podría estar condicionada por la patología que padeciera el paciente¹¹⁻²⁴ y, en consecuencia, podría ser de utilidad clínica conocer los grupos de enfermedades que podrían suponer un mayor riesgo de desnutrición hospitalaria en orden a tomar medidas preventivas al respecto.

El objetivo del presente trabajo consiste en analizar la situación nutricional de los pacientes pediátricos en el momento de la admisión hospitalaria a lo largo de un año natural en un hospital terciario e identificar a aquellos pacientes y/o grupos de enfermedades con mayor riesgo de malnutrición.

Material y métodos

La Comunidad Foral de Navarra a 1 de enero de 2013 tenía una población total de 644.477 habitantes (Instituto de Estadística de Navarra) con una población infantil (menores de 15 años) de 100.424 (15,6%). La

organización estructural y/o funcional del Sistema Navarro de Salud facilita que todos aquellos pacientes cuya situación clínica lo requiera puedan ser remitidos sin demora desde hospitales secundarios, ubicados en las poblaciones de Tudela y Estella, al Complejo Hospitalario de Navarra de Pamplona como centro de referencia u hospital terciario de nuestra comunidad.

Se ha realizado una valoración retrospectiva de la situación nutricional en el momento de la admisión de todos los pacientes que precisaron ingreso hospitalario entre el 1 de enero y el 31 de diciembre del año 2013 en el Servicio de Pediatría del Complejo Hospitalario de Navarra. Fueron excluidos los neonatos (menores de 1 mes de edad), los pacientes oncológicos, los ingresados en la Unidad de Cuidados Intensivos y los ingresos quirúrgicos.

En el momento del ingreso hospitalario de cada paciente se registraron el sexo, la edad, el peso y la talla. Así mismo, en el momento del alta hospitalaria quedaron registrados la estancia hospitalaria (números de días de hospitalización) y el diagnóstico codificado según la última edición (10ª revisión) de la Clasificación Internacional de las Enfermedades de la OMS²⁵.

Los pacientes hospitalizados fueron distribuidos por grupos de edad: lactantes (de 1 mes hasta 12 meses), preescolares (de 1 hasta 6 años), escolares (de 6 hasta 10 años) y adolescentes (de 10 hasta 15 años).

Las valoraciones de peso y talla fueron realizadas en ropa interior y descalzos. El peso se midió con una báscula Año-Sayol, con un intervalo de lectura de 0 a 120 kg y una precisión de 100 g, y la talla con un estadiómetro de pared Holtain de 60 a 210 cm, con un intervalo de precisión de 0,1 cm.

Como criterio para definir la situación nutricional de los pacientes se ha calculado el índice de masa corporal (IMC) con la fórmula: peso (en kilogramos)/talla² (en metros). Los valores de los Z-score de los IMC se calcularon con el programa Aplicación Nutricional de la Sociedad Española de Gastroenterología, Hepatología y Nutrición Pediátrica, aplicándose como referencia las tablas de crecimiento de Ferrández et al (Centro Andrea Prader, Zaragoza 2002)²⁶.

Según el valor del IMC (Z-score) se establecieron los siguientes grupos:

- Malnutrición: si el valor de IMC (Z-score) era inferior a -2,0 (percentil 3).
- Normalidad: si oscilaba entre -2,0 (percentil 3) y +1,0 (percentil 85).
- Sobrepeso: si era superior a +1,0 (percentil 85).
- Obesidad: si era superior a +2,0 (percentil 97).

Tabla I
Grupos de enfermedades (CIE-10) según los grupos de edad

<i>Clasificación Internacional de las Enfermedades (CIE-10)</i>	<i>Lactantes n (%)</i>	<i>Preescolares n (%)</i>	<i>Escolares n (%)</i>	<i>Adolescentes n (%)</i>	<i>Total n (%)</i>
1. Enfermedades infecciosas/parasitarias	50 (19,1)	67 (17,5)	6 (6,4)	10 (8,8)	133 (15,6)
3. Enfermedades de la sangre y sistema inmunológico	0	8 (2,1)	2 (2,1)	3 (2,6)	13 (1,5)
4. Enfermedades endocrinas	4 (1,5)	8 (2,1)	10 (10,6)	15 (13,2)	37 (4,3)
5. Desórdenes mentales	0	1 (0,3)	2 (2,1)	8 (7,0)	11 (1,3)
6. Enfermedades neurológicas	13 (5)	50 (13,1)	10 (10,6)	21 (18,4)	94 (11)
7. Enfermedades de los sentidos	3 (1,1)	16 (4,2)	4 (4,3)	1 (0,9)	24 (2,8)
9. Enfermedades del sistema circulatorio	2 (0,8)	1 (0,3)	0	6 (5,3)	9 (1,1)
10. Enfermedades del sistema respiratorio	109(41,6)	160(41,9)	29 (30,9)	13 (11,4)	311 (36,5)
11. Enfermedades del sistema digestivo	4 (1,5)	8 (2,1)	9 (9,6)	9 (7,9)	30 (3,5)
12. Enfermedades de la piel	6 (2,3)	13 (3,4)	9 (9,6)	7 (6,1)	35 (4,1)
13. Enfermedades del aparato locomotor	1 (0,4)	15 (3,9)	5 (5,3)	9 (7,9)	30 (3,5)
14. Enfermedades genitourinarias	54(20,6)	23 (6,0)	4 (4,3)	4 (3,5)	85 (10,0)
17. Enfermedades congénitas, malformaciones y cromosopatías	10 (3,8)	4 (1,0)	3 (3,2)	2 (1,8)	17 (2)
19. Lesiones, heridas, intoxicaciones y otros factores externos	2 (0,8)	5 (1,3)	1 (1,1)	5 (4,4)	13 (1,5)
21. Caídas, golpes y accidentes diversos	2 (0,8)	3 (0,8)	0	1 (0,9)	6 (0,7)
22. Factores que afectan al estado sanitario	1 (0,4)	0	0	0	1 (0,1)
Total	262	382	94	114	852

Chi2: 267,64 (p<0,001)

Los resultados se expresan como porcentajes (%) y medias (M) con sus desviaciones estándar (DE) y/o intervalo de confianza del 95%. El análisis estadístico (estadística descriptiva, T de Student, ANOVA y comparación de porcentajes) fue realizado mediante el programa informático Statistical Packages for the Social Sciences versión 20.0 (Chicago, Illinois, USA). La significación estadística fue asumida cuando el valor de p era inferior a 0,05.

Resultados

Durante el año 2013 fueron hospitalizados 852 pacientes: 462 varones (54,2%) y 390 mujeres (45,8%). Las variables antropométricas (peso y talla) y el cálculo del IMC se obtuvieron en 814 pacientes (95,5% de los ingresos). La distribución de los pacientes por grupos de edad fue de 262 lactantes (30,8%), 382 preesco-

lares (44,8%), 94 escolares (11%) y 114 adolescentes (13,4%). La distribución estacional fue de 282 ingresos (33,1%) en invierno, 106 (24,2%) en primavera, 184 (21,5%) en verano y, por último, de 180 (21,1%) en otoño.

La estancia media fue de 3,87 días (IC 95%: 3,61-4,09), sin que existieran diferencias estadísticamente significativas entre los grupos de edad. En el 82,4% de los casos (n=702), la estancia hospitalaria oscilaba entre 2 y 5 días, en el 12,2% (n=104) entre 6 y 10 días, en el 4,8% (n=41) entre 11 y 30 días y, por último, tan solo superaban los 30 días 5 pacientes (0,6%). Tampoco existían diferencias estadísticamente significativas en la estancia hospitalaria en relación con la situación nutricional de los pacientes en el momento del ingreso hospitalario y/o con los grupos de enfermedades de la CIE-10.

En tabla I se exponen la totalidad de ingresos hospitalarios correspondientes al año 2013 según los gru-

Tabla II
Situación nutricional de los pacientes al ingreso según grupos de edades

<i>Situación nutricional</i>	<i>Lactantes n (%)</i>	<i>Preescolares n (%)</i>	<i>Escolares n (%)</i>	<i>Adolescentes n (%)</i>
Malnutrición	23 (9%)	37 (10%)	8 (9,3%)	2 (1,9%)
Normalidad	186(72,6%)	280(75,5%)	58 (67,4%)	71 (70,3%)
Sobrepeso	34 (13,3%)	35 (9,4%)	13 (15,1%)	13 (12,9%)
Obesidad	14 (5,5%)	19 (5,1%)	7 (8,1%)	15 (14,9%)
Total	256	371	86	101

Chi2: 27,893 (P<0,006)

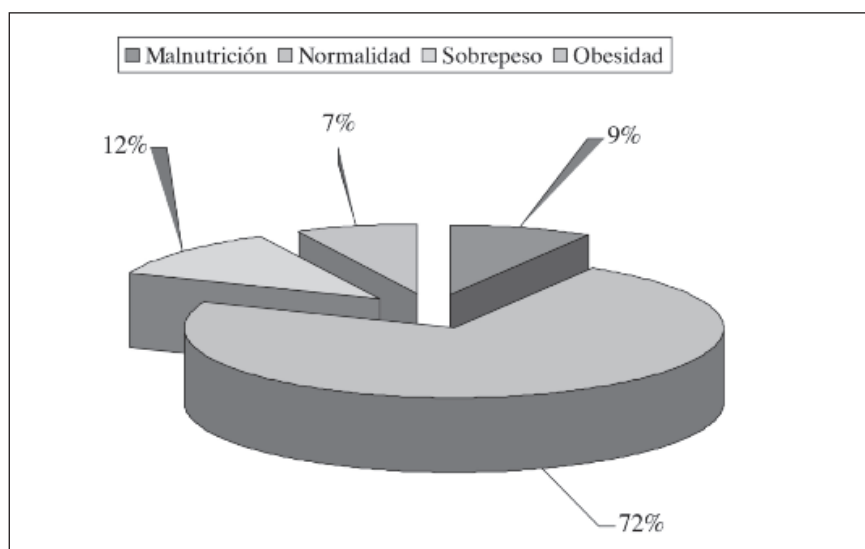


Fig. 1.—Situación nutricional de la totalidad de los pacientes al ingreso hospitalario

pos de enfermedades de la CIE-10 en cada grupo de edad. Las enfermedades del sistema respiratorio eran las de mayor prevalencia y representaban el 36,5% de las causas de ingreso hospitalario, especialmente en lactantes (41,6%) y preescolares (41,9%). Las enfermedades infecciosas el 15,6% y también especialmente en lactantes (19,1%) y preescolares (17,5%). Las enfermedades neurológicas el 11,2%, especialmente en adolescentes (18,4%). Y las enfermedades genitourinarias el 10%, especialmente en lactantes (20,6%). El resto de grupos de enfermedades representaban conjuntamente el 26,7% de las causas de ingreso hospitalario. No existían preferencias estacionales entre los grupos de enfermedades, salvo en las del sistema respiratorio cuya prevalencia era significativamente superior ($p<0,05$) en los meses de otoño (32,5%) e invierno (35,7%) frente a los de la primavera (21,2%) y verano (10,6%).

La prevalencia de malnutrición en la totalidad de los pacientes registrados en el momento del ingreso hospitalario era del 8,2% (figura 1). En la tabla II se

exponen y comparan la situaciones nutricionales de los pacientes en el momento del ingreso hospitalario en relación con los grupos de edad. En los lactantes la malnutrición era del 9% y disminuía con la edad, siendo en los adolescentes del 1,9%. En cambio, la situación de exceso de peso corporal (sobrepeso y obesidad) en los lactantes era del 18,8% y aumentaba con la edad, siendo en los adolescentes del 27,8%.

En la tabla III se expone la situación nutricional de los pacientes en el momento del ingreso hospitalario en relación con los grupos de enfermedades de la CIE-10. Las enfermedades neurológicas (22,9%) junto con las del sistema respiratorio (22,9%), las infecciosas (18,6%), las enfermedades congénitas, malformaciones y alteraciones cromosómicas (11,4%) y las genitourinarias (8,6%) representaban el 84,4% de los casos de malnutrición.

La situación de malnutrición al ingreso hospitalario era del 47% (8 de 17) en los pacientes con enfermedades congénitas, malformaciones y alteraciones cromosómicas; del 18,2% (16 de 88) en las enfermedades

Tabla III
Situación nutricional de los pacientes según grupo diagnóstico (CIE-10)

<i>Clasificación Internacional de las Enfermedades (CIE-10)</i>	<i>Malnutrición n (%)</i>	<i>Normalidad n (%)</i>	<i>Sobrepeso n (%)</i>	<i>Obesidad n (%)</i>
1. Enfermedades infecciosas y parasitarias	13 (18,6)	93 (15,7)	15 (15,8)	7 (12,7)
3. Enfermedades de la sangre y del sistema inmunológico	0	9 (1,5)	0	4 (7,3)
4. Enfermedades endocrinas	2 (2,9)	27 (4,5)	4 (4,2)	3 (5,5)
5. Desórdenes mentales	1 (1,4)	9 (1,5)	0	0
6. Enfermedades neurológicas	16 (22,9)	54 (9,1)	11 (11,6)	7 (12,7)
7. Enfermedades de los sentidos	0	11 (1,9)	5 (5,3)	1 (1,8)
9. Enfermedades del sistema circulatorio	0	7 (1,2)	0	1 (1,8)
10. Enfermedades del sistema respiratorio	16 (22,9)	6 (1,0)	37 (38,9)	15 (27,3)
11. Enfermedades del sistema digestivo	5 (7,1)	231 (38,9)	4 (4,2)	3 (5,5)
12. Enfermedades de la piel	2 (2,9)	18 (3,0)	3 (3,2)	2 (3,6)
13. Enfermedades del aparato locomotor	0	28 (4,7)	4 (4,2)	1 (1,8)
14. Enfermedades del sistema genitourinario	6 (8,6)	23 (3,9)	11 (11,6)	6 (10,9)
17. Enfermedades congénitas, malformaciones y alteraciones cromosómicas	8 (11,4)	61 (10,3)	1 (1,1)	1 (1,8)
19. Lesiones, heridas, intoxicaciones y otros factores externos	1 (1,4)	7 (1,2)	0	2 (3,6)
21. Caídas, golpes y accidentes diversos	0	7 (1,2)	0	1 (1,8)
23. Factores que afectan al estado sanitario	0	3 (0,5)	0	1 (1,8)
	70	0	95	55

Chi2: 108,866 (p<,0001)

neurológicas; del 16,7% (5 de 30) en las enfermedades digestivas; del 10,1% (13 de 128) en las enfermedades infecciosas; del 10% (1 de 10) en los desórdenes mentales; del 7,1% (6 de 84) en las enfermedades genitourinarias y del 5,4% (16 de 299) en las enfermedades respiratorias.

Discusión

En nuestro país apenas existen referencias acerca de la situación nutricional que presentan los pacientes pediátricos que requieren ingreso hospitalario, y los datos publicados son relativamente incompletos^{13,27}. Por ejemplo, en el estudio DHOSPE (Desnutrición Hospitalaria en el Paciente Pediátrico en España), aunque se trata de un ambicioso estudio multicéntrico, tan solo se registraron pacientes durante los meses estivales

(de junio a septiembre); y, tal y como también ocurría en nuestro caso, las enfermedades del sistema respiratorio que son las causas de ingreso hospitalario más frecuentes tienen una mayor prevalencia en los meses de otoño e invierno. Y, además, las enfermedades respiratorias representaban un porcentaje significativo de los casos con malnutrición.

La finalidad de este trabajo fue la de determinar la situación nutricional de los pacientes en el momento de su admisión hospitalaria en un hospital terciario pediátrico durante un año natural (de enero a diciembre) y su relación con su diagnóstico médico; aplicando para ello simplemente medidas antropométricas como método de cribado para la identificación de aquellos pacientes con malnutrición y, por tanto, con mayor riesgo de deterioro nutricional durante su estancia hospitalaria. Además, para salvar posibles arbitrariedades en la agrupación de los pacientes según sus diversas

patologías, se clasificaron por grupos de enfermedades codificadas según la edición más reciente de la Clasificación Internacional de Enfermedades de la OMS. La exclusión de los neonatos, así como de los pacientes oncológicos, quirúrgicos y los que requerían cuidados intensivos fue debido a que se trata de pacientes sometidos a un soporte nutricional reglado y derivado de su diagnóstico y/o tratamiento; y, en este caso, lo que interesaba era analizar la situación nutricional en aquellos pacientes que a priori no fueran sometidos a control nutricional en su hospitalización.

La Carta Europea de los Derechos del Niño Hospitalizado promulgada por el Parlamento Europeo y cuyo contenido fue asumido y divulgado por la UNICEF y la OMS comienza reconociendo el “derecho del niño a no ser hospitalizado salvo en el caso de no poder recibir los cuidados necesarios, y en las mismas condiciones, en su casa o en un consultorio”. Al amparo de esta resolución la política de ingresos hospitalarios pediátricos que se lleva a cabo en nuestro entorno es muy restrictiva, procurando que tan solo sean admitidos aquellos pacientes cuyas dolencias requieran cuidados inexcusablemente hospitalarios. Esta aclaración es obligada para comprender el hecho de que el 82,4% de los pacientes ingresados a lo largo del año 2013 tuvieran una estancia hospitalaria que no superaba los 5 días, y que tan solo un 5,4% superaran los 10 días de hospitalización, siendo excepcionales las estancias muy prolongadas. Además, estas medidas restrictivas –siempre procurando utilizarlas con sentido común– también explicarían la falta de relación estadística entre la situación nutricional en el momento de la admisión hospitalaria y los días de estancia en el hospital, independientemente de la edad y grupo de enfermedad.

La tasa de prevalencia global de malnutrición en los pacientes pediátricos en el momento de su admisión en nuestro hospital era del 8,2%; siendo esta una cifra prácticamente similar a las publicadas en los países occidentales⁸⁻¹⁵ y, desde luego, muy inferior a la de países de condiciones socioeconómicas menos favorecidas^{17,28,29}. No obstante, conviene destacar dos variables que parecen desempeñar un papel determinante de riesgo de malnutrición al ingreso hospitalario: la edad y la causa del ingreso. Los resultados obtenidos en este trabajo señalan, por un lado, que el 85,7% de los casos de malnutrición registrados eran de lactantes y/o preescolares. Y, por otro lado, que las enfermedades neurológicas y/o respiratorias justificaban prácticamente la mitad de los casos registrados de malnutrición; y, desde luego, las enfermedades congénitas y/o malformaciones, aunque afortunadamente de baja prevalencia, suponían un alto riesgo de malnutrición a quien las padeciera. Además, conviene recordar que uno de cada seis ingresos por enfermedades digestivas también presentaba malnutrición al ingreso.

En conclusión, en los pacientes con menor edad y afectos de enfermedades neurológicas y/o respiratorias y, especialmente, con enfermedades congénitas sería

preceptivo realizar un cribado inicial y un seguimiento durante su hospitalización –posiblemente aplicando herramientas de cribado nutricional ya validadas¹⁹⁻²³ dado del riesgo de presentar malnutrición al ingreso y potencialmente deteriorarse nutricionalmente durante su estancia hospitalaria; no obstante, estas medidas deberían hacerse extensibles a todos los pacientes. Es decir, se trataría de instaurar de manera rutinaria en nuestros hospitales estrategias sencillas para localizar a aquellos pacientes con riesgo nutricional en el momento del ingreso hospitalario, bien por la edad o por la enfermedad que presentan, y establecer de inmediato las medidas necesarias de soporte nutricional para su prevención y, en su caso resolución, de una situación nutricional adversa.

Referencias

1. Rocandio AM, Arroyo M, Ansotegui L. Assessment of nutritional status on hospital admission: nutritional scores. *Eur J Clin Nutr* 2003; 57: 824-831.
2. Beck AM, Balknäs UN, Camilo ME, Fürst P, Gentile MG, Hasunen K, Jones L, Jonkers-Schuitema C, Keller U, Melchior JC, Mikkelsen BE, Pavcic M, Schauder P, Sivonen L, Zinck O, Øien H, Ovesen L. The European view of hospital undernutrition. *Nutr Clin Pract*. 2003; 18:247-9.
3. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003; 22:235-9.
4. Pérez de la Cruz A, Lobo Tamer G, Orduna Espinosa R, Mella-do Pastor C, Aguayo de Hoyos E, Ruiz López MD. Malnutrition in hospitalized patients: prevalence and economic impact. *Med Clin (Barc)* 2004; 123:201-6.
5. Beck AM, Balknäs UN, Fürst P, Hasunen K, Jones L, Keller U, Melchior JC, Mikkelsen BE, Schauder P, Sivonen L, Zinck O, Øien H, Ovesen L. Food and nutritional care in hospitals: how to prevent undernutrition-report and guidelines from the Council of Europe. *Clin Nutr*. 2001; 20:455-60.
6. Council of Europe. Committee of Ministers. Resolution ResAP (2003/3) on food and nutritional care in hospitals. Disponible en <https://wcd.coe.int/ViewDoc.jsp?id=85747>.
7. European Nutrition for Health Alliance. STOP Disease-related Malnutrition: Prague. *Declaration June 2009*. Disponible en: http://www.european-nutrition.org/index.php/news/news_post/stop_disease_related_malnutrition_prague_declaration_june_2009.
8. Hendrikse W, Reilly J, Weaver L. Malnutrition in a children's hospital. *Clin Nutr* 1997; 16:13-18.
9. Hankard R, Block J, Martin P, et al. Nutritional status and risk in hospitalized children. *Arch Pediatr* 2001; 8:1203-1208.
10. Marteletti O, Caldari D, Guimber D, et al. Malnutrition screening in hospitalized children: influence of the hospital unit on its management. *Arch Pediatr* 2005; 12:1226-1231.
11. Pawellek I, Dokoupil K, Koletzko B. Prevalence of malnutrition in paediatric hospital patients. *Clin Nutr* 2008; 27:72-76.
12. Joosten KF, Zwart H, Hop WC, Hulst JM. National malnutrition screening days in hospitalised children in The Netherlands. *Arch Dis Child*. 2010; 95:141-5.
13. Moreno-Villares JM, Varea-Calderón V, Bousoño-García C, Lama-Moré R, Susana Redecillas-Ferreiro S, Peña-Quintana L. Nutrition status on pediatric admissions in Spanish hospitals; DHOSPE study. *Nutr Hosp*. 2013; 28:709-718.
14. Baxter JA, Al-Madhaki FI, Zlotkin SH. Prevalence of malnutrition at the time of admission among patients admitted to a Canadian tertiary-care paediatric hospital. *Paediatr Child Health*. 2014; 19:413-7.

15. Groleau V, Thibault M, Doyon M, Brochu EE, Roy CC, Babakissa C. Malnutrition in hospitalized children: prevalence, impact, and management. *Can J Diet Pract Res*. 2014; 75:29-34.
16. Rocha GA, Rocha EJ, Martins CV. The effects of hospitalization on the nutritional status of children. *J Pediatr (Rio J)* 2006; 82:70-74.
17. Ozturk Y, Buyukgebiz B, Arslan N, Ellidokuz H. Effects of hospital stay on nutritional anthropometric data in Turkish children. *J Trop Pediatr* 2003; 49:189-190.
18. Huysentruyt K, Alliet P, Muyschont L, Devreker T, Bontems P, Vandenplas Y. Hospital-related undernutrition in children: still an often unrecognized and undertreated problem. *Acta Paediatr*. 2013; 102:e460-6.
19. Sermet-Gaudelus I, Poisson-Salomon AS, Colomb V, Brusset MC, Mosser F, Berrier F et al. Simple pediatric nutritional risk score to identify children at risk of malnutrition. *Am J Clin Nutr* 2000; 72: 64-70.
20. Hulst JM, Zwart H, Hop WC, Joosten KF. Dutch national survey to test the STRONGkids nutritional risk screening tool in hospitalized children. *Clin Nutr* 2010; 29: 106-111.
21. McCarthy H, McNulty H, Dixon M, Eaton-Evans MJ. Screening for nutrition risk in children: the validation of a new tool. *J Hum Nutr Diet* 2008; 21: 395-396.
22. Lama-More RA, Moráis-López A, Herrero-Álvarez M, Caraballo-Chicano S, Galera-Martínez R, López-Ruzafa E, Rodríguez-Martínez G, De la Mano-Hernández A, Rivero de la Rosa MC and GETNI group. Validation of a nutritional screening tool for hospitalized pediatric patients. *Nutr Hosp*. 2012; 27:1429-1436.
23. Huysentruyt K, Alliet P, Muyschont L, Rossignol R, Devreker T, Bontems P, Dejonckheere J, Vandenplas Y, De Schepper J. The STRONG(kids) nutritional screening tool in hospitalized children: a validation study. *Nutrition*. 2013; 29:1356-61.
24. Joosten KF, Hulst JM. Prevalence of malnutrition in pediatric hospital patients. *Current Opinion in Pediatrics* 2008, 20:590-596.
25. Clasificación Internacional de las Enfermedades, icd-10 (disponible en: http://eciemaps.mspsi.es/ecieMaps/browser/index_10_2008.html)
26. Sociedad Española de Gastroenterología, Hepatología y Nutrición Pediátrica. Aplicación Nutricional (disponible en: <http://www.gastroinf.es/nutritional/>),
27. Moreno-Villares, JM, Oliveros-Leal, L, Pedrón-Giner C. Hospital-related malnutrition in children. *Acta Pediatr Esp* 2005; 63:63-69.
28. Sarni RO, Carvalho MF, Monte CM, Albuquerque ZP, Souza FL. Anthropometric evaluation, risk factors for malnutrition, and nutritional therapy for children in teaching hospitals in Brazil. *J Pediatr (Rio J)*. 2009;85:223-8.
29. Dogan Y, Erkan T, Yalvac S, et al. Nutritional status of patients hospitalized in pediatric clinic. *Turk J Gastroenterol* 2005; 16:212-216.



Original/*Pediatría*

The distribution of the indicator height for age of Mexican children and adolescents with Down syndrome according to different reference standards

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Abstract

Objective: to compare the indicator height for age in Mexican children with Down Syndrome (DS) with two different reference patterns of growth (American and Spanish) that might be suitable for the Mexican population.

Methods: a cross-sectional study was performed including 235 Mexican children and adolescents of both sexes with DS aged 45 days to 16 years enrolled in two specialized schools in the metropolitan area of Guadalajara. The dependent variables were weight/age; height/age; weight/height and BMI. The data expressed was percentiles and the chi-square test was used to compare the distribution of the height/age index with American and Spanish reference patterns. In addition, a chi-square test was performed for the goodness of fit of the height/age index, with breakpoints lower and greater than the 50th percentile.

Results: the percentage of participants who were below the 50th percentile in the height/age index was significantly higher with the Spanish vs. the American reference pattern. The chi-square test for goodness of fit showed that the frequency of cases located below the 50th percentile in the height/age index was significantly higher with the American pattern in the age groups of 0 to 36 months ($p = 0.022$) and 37 to 72 months ($p < 0.001$), but it was not significant ($p = 0.225$) in the older than 72 months age group.

Conclusion: the American reference pattern is a better fit for the growth of Mexican children with DS compared with the Spanish reference pattern, and the distribution profile obtained with the standard growth and WHO reference was not suitable for the assessment of children with Down syndrome.

(Nutr Hosp. 2015;31:2472-2478)

DOI:10.3305/nh.2015.31.6.8815

Key word: *Down syndrome. Height/age index. Reference pattern.*

LA DISTRIBUCIÓN DEL INDICADOR TALLA PARA LA EDAD DE NIÑOS Y ADOLESCENTES MEXICANOS CON SÍNDROME DE DOWN DE ACUERDO A DIFERENTES PATRONES DE REFERENCIA

Resumen

Objetivo: comparar el índice talla/edad en niños con síndrome de Down (SD) con dos patrones de referencia (americano y español) que podrían ser adecuados en niños mexicanos.

Métodos: en un estudio transversal se incluyeron 295 niños y adolescentes de ambos sexos con SD desde 45 días hasta 16 años de edad, inscritos en dos escuelas del área metropolitana de Guadalajara. Variables dependientes: peso/edad; talla/edad; peso/talla e IMC. Los datos fueron expresados en percentiles y se utilizó la prueba de chi-cuadrado para comparar la distribución del índice de talla/edad entre los patrones de referencia de EUA y de España. Se realizó una prueba de bondad de ajuste del índice talla/edad con puntos de corte menor y mayor al percentil 50.

Resultados: el porcentaje de participantes por debajo del percentil 50 en el índice de talla/edad fue significativamente mayor con la referencia española vs. americana. La prueba de bondad de ajuste mostró que la frecuencia de casos debajo del percentil 50 en el índice talla/edad fue significativamente mayor con la referencia estadounidense en el grupo de edad de 0-36 meses ($p = 0.022$) y 37-72 meses ($p < 0.001$), pero no fue significativa en el grupo de edad mayor de 72 meses.

Conclusión: la referencia estadounidense se ajustó más al crecimiento de los niños mexicanos con síndrome de Down que la referencia española. El perfil de distribución obtenido con el estándar de crecimiento y referencia de la OMS no fue adecuado para la evaluación de niños con síndrome de Down.

(Nutr Hosp. 2015;31:2472-2478)

DOI:10.3305/nh.2015.31.6.8815

Palabra clave: *Síndrome de Down. Índice talla/edad. Patrón de referencia.*

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Recibido: 7-II-15.

1.ª Revisión: 8-III-15.

Aceptado: 15-III-15.

Introduction

Down syndrome (DS) is the most common chromosomal aneuploidy detected and the first known genetic cause of mental disability^{1,2}. It has an incidence of 1/1000 to 1/1100 live births worldwide³ and Mexico has reported an incidence of 1/650 live births². DS is associated with congenital malformations (especially heart), a characteristic phenotype and organ dysfunction. One problem in assessing children with DS is that their growth is markedly different compared with that of normal children, it is slower, and children with DS present with short height⁴ and smaller head circumferences (HC)⁵. Because the growth of these children is affected in the uterus and after birth, the growth rate is mainly lower between six months and three years of age^{6,7}. However, this growth rate varies by countries where reference tables have been developed⁷. Mexico lacks a reference pattern for children with DS; therefore, considering that height is usually a good indicator of nutrition and health in childhood, the purpose of this study was to evaluate the indicator of height for age in Mexican children with DS using two different reference patterns for growth (American and Spanish) that might be suitable for the Mexican population.

Methods

This cross-sectional study included 235 children and adolescents of both sexes with DS aged 45 days to 16 years, who were enrolled in two specialized schools in the metropolitan area of Guadalajara: a) Integral Family Development Jalisco (public sector) and b) Down School of Guadalajara, AC (private sector) from June 2009 to February 2010. The inclusion criteria were: children with and without congenital heart disease, hypothyroidism and/or congenital malformations related to DS, children who tolerated anthropometric measurement and for whom written approval was provided by a parent or guardian.

Anthropometric variables: height/age; weight/age; weight/height and BMI (percentiles). Reference standards from the USA⁶ and Spain⁸, The WHO Child Growth Standards⁹ and the growth reference data for children aged 5-19 years were used¹⁰. Distributions of the expected frequency of the height indicator for age with the three reference standards were developed. *Other variables:* socioeconomic and demographic characteristics such as the number and type of family members; age, education and occupation of parents; and employment status, monthly household income and spending power for food estimated per month and per capita as a percentage of the minimum wage per day were also obtained.

Anthropometric measurements

To measure anthropometric indicators, children and adolescents wore minimal clothes and were barefoot

and without support. Weight: Health or Meter® high-chairs (Purvis, MS, USA) were used for children under three years or for children who could not stand. Children aged three and under seven were weighed on a scale Seca® 700 (Tecnigen, Hamburg, Germany). Children over seven years were weighed on a scale Tanita TBF-410 (Arlington heights, IL, USA).

Height. The length of children under three years of age was obtained using a Seca® 416 infantometer (Tecnigen, Hamburg, Germany). A stadiometer Seca 214 (Tecnigen, Hamburg, Germany) was used to obtain the height of children over three years old. Measurements were made by two different observers and the average of the two measurements was calculated. Before the anthropometric measurements were collected, the Habicht¹¹ standardization process was undertaken by the two participating observers.

Statistical Analysis

The frequencies and percentages of nonparametric variables and measures of central tendency parametric variables were determined. The data are expressed in percentiles, and the chi-square test was used to compare the distribution of the height/age index using the US⁵ and Spanish reference patterns of growth⁸. The sample was divided into three age groups: 0-36 months, 37-72 months and over 72 months. In addition, a chi-square test was performed for the goodness of fit of the height/age indices with breakpoints lower and higher than the 50th percentile. The data were captured in Excel and analyzed using SPSS version 10.

Ethical Considerations

Adequate information was given to parents about the importance of this non-interventional study and signed informed consent from parents and/or persons legally responsible for the participants and the consent of the directors of the institutions were obtained.

Results

A total of 235 subjects with a predominance of males (57%) were included. By age group, preschoolers were the most frequent (43.5%), then infants (23.4%), schoolchildren (23.4%) and adolescents (9.7%). Most were of low-middle socioeconomic status and were from the metropolitan area of Guadalajara, table I. The schooling of the fathers and mothers was similar with 17% of each holding bachelor's degrees. In 60% of cases, the mothers were housewives.

Regarding the perinatal and medical history, 19.2% of participants were premature; 108 cases (46%) reported some type of heart disease; 29.6% were diagnosed with non-determined heart disease and 44.4%

Table I
Descriptive data of the participant socio-demographic and economic characteristics

Variable	n	Mean	SD	Minimum	Maximum
Number of family members	225	5.2	1.7	2	12
Number of living children	225	3.0	1.7	1	14
Place of the child	226	2.8	1.7	1	13
Mother's age (years)	222	36.1	8.5	16	55
Age when pregnant (years)	222	31.4	7.8	15	49
Father's age (years)	210	37.7	9.1	18	66
Maternal education (years)	220	9.9	4	0	24
Father's education (years)	203	9.9	4	0	22
Monthly family income (\$)¹	202	7531	7671	0	51000

¹Mexican pesos. Rate peso/dollar 12.6/1

Tabla II
A comparison between the American reference pattern vs. the Spanish reference pattern using the indicator height for age (percentile) by age group.

Age (months)	American				Spanish				p
	<50		>50		<50		>50		
	n/N	%	n/N	%	n/N	%	n/N	%	
0-36	57/92	62	35/92	38	73/92	79	19/92	21	<0.001
37-72	15/75	20	60/75	80	61/75	81	17/75	19	<0.001
>72	29/68	43	39/68	57	47/65	72	18/65	28	<0.001

had a heart murmur. Upon evaluation, 56% of the heart disease diagnoses were correct. Other important pathologies were hypothyroidism (9%) and digestive congenital malformations (6.2%).

It was noted that according to the American anthropometric reference⁶, 54% of children were below the 50th percentile of the weight/age index, while when using the Spanish anthropometric reference⁸, 77.4% were below this percentile. When using the WHO weight/height index, 48.5% were below the 50th percentile and 12.3% were below the 3rd percentile. Regarding BMI, 50.1% were below the 50th percentile, 14% were below the 3rd percentile and 20.4% were above the 85th percentile.

It was observed that the percentage of participants who were below the 50th percentile in the height/age index was significantly higher using the Spanish reference pattern vs. the American reference pattern in the studied age groups, table II. The chi-square test for goodness of fit (observed/expected) showed that the frequency of cases located below the 50th percentile in the height/age

index was significantly higher using the American pattern among the age group of 0-36 months ($p=0.022$), it was significantly lower in the age group of 37-72 months ($p<0.001$), but it was not significant ($p=0.225$) in the age group older than 72 months, table III.

It was observed that with the Spanish reference pattern the frequency of cases below the 50th percentile is significantly higher in all three age groups ($p < 0.001$). Comparing the height/age index to the standard growth of 2006 and the WHO reference standard of 2007, table IV shows that in the three age groups 0-36 months, 37-72 months and older than 72 months most of the participants were below the 3rd percentile.

These findings are seen more clearly in figure 1, in which the percentile distribution of the expected frequency and distributions of the height/age index among the study population that are achieved using the American⁶, Spanish⁸ and WHO reference data from 2006⁹ and 2007 are presented¹⁰. With the American reference pattern, the distribution of height/age is acceptably uniform; however, with the Spanish pattern

Table III
A comparison between the observed vs. the expected values using reference standards (American and Spanish) for Down syndrome for the indicator height for age (percentile) by age group

Age (months)	N	American				Spanish					
		Observed		Expected		Observed*		Expected			
		<50	>50	<50	>50	<i>p</i> ^a	<50	>50	<50	>50	<i>p</i> ^a
0-36	92	57	35	46	46	0.022	0.022	73	73	46	<0.001
37-72	75	15	60	37.5	37.5	<0.001	<0.001	61	61	37.5	<0.001
>72	68	29	39	34	34	0.225	0.225	47	47	32.5	<0.001

*The Spanish references evaluate only until 15 years of age, so that in the group > 72 years changes the n = 65.

^aCalculated with the X2 test for goodness of fit.

Table IV
The distribution of participants (n=235) by percentiles according to the standard growth 2006 and 2007 WHO reference pattern for the indicator height for age.

Age (months)	N	< p3 (%)	≥ p3 and < p15 (%)	≥ p 15 and < p50 (%)	> p50 (%)
0-36	92	58 (63.1)	21 (22.8)	12 (13)	1 (1.1)
37-72	75	52 (69.3)	18 (24)	4 (5.3)	1 (1.4)
>72	68	40 (58.8)	17 (25)	10 (14.7)	1 (1.5)

most children tested are located on the left side of the graph, drawing an abnormal distribution. Additionally, the distribution profile obtained using the WHO Child Growth Standards and the growth reference data^{9, 10} confirms that these standards are not suitable for the anthropometric assessment of children with Down syndrome.

Discussion

This was a population of reasonably well-nourished lower and middle class children of the metropolitan area of Guadalajara (40.7% of the minimum wage in food expenditures per capita is equivalent to 1.9 US dollars per family member) and whose parents were people with average educational attainment for this setting (8.6 years). As has been shown in other studies^{6, 12, 13}, the growth of children with Down syndrome differs from the growth of healthy children. In Mexico, the WHO Child Growth Standards and the growth reference data^{9, 10} have been adopted for assessing the growth and nutritional status of healthy children from birth to 19 years of age^{14, 15}; however, to date, a reference standard for the growth and nutritional status of children with Down syndrome has not been identified.

The first comparison of children with DS with the US and Spanish reference patterns showed that the percentage of participants located below the 50th percentile in the height/age index was significantly higher using the pattern of Spanish reference in all of the age groups (0-36, 36-72 and > 72 months). However, when applying the test of goodness of fit, the US reference pattern also had a significant majority of children

below the 50th percentile in the age groups of 0-36 months but not in the groups of 37-72 and older than 72 months of age. After that, age/height tended to normalize with no significant differences, unlike what we observed using the Spanish reference pattern in which most children remained below the 50th percentile in all age groups.

It could be speculated that the reason why the deficits in the age/height index tend to normalize in the age group older than 72 months in our population with the use of the US reference standard and not earlier could be that children with DS would have the best development in the US that would positively influence early life, such as differences in the severity of heart disease and/or whether surgical treatment was performed, and because school age children studied tend to normalize their growth.

Figure 1 clearly shows that the distribution of growth in Mexican children with DS was more similar to the US reference pattern⁶, mainly from the 30th percentile, while the distribution was skewed to the left using the Spanish reference pattern⁸. When our population was compared with the WHO Child Growth Standards and the growth reference data^{9, 10}, the vast majority of children in the three age groups were below the 50th percentile. Over half were below the 3rd percentile, which would confirm that the WHO reference data are not adequate for assessing children with DS in different stages of growth.

Furthermore, it is noteworthy that only 20.8% of our population had a higher BMI above one standard deviation (13.6% overweight and 7.2% obese). In a study by the Netherlands Organisation for Applied Scientific Research Leiden, Van Gasteren-Oosterom et al.¹⁶ sta-

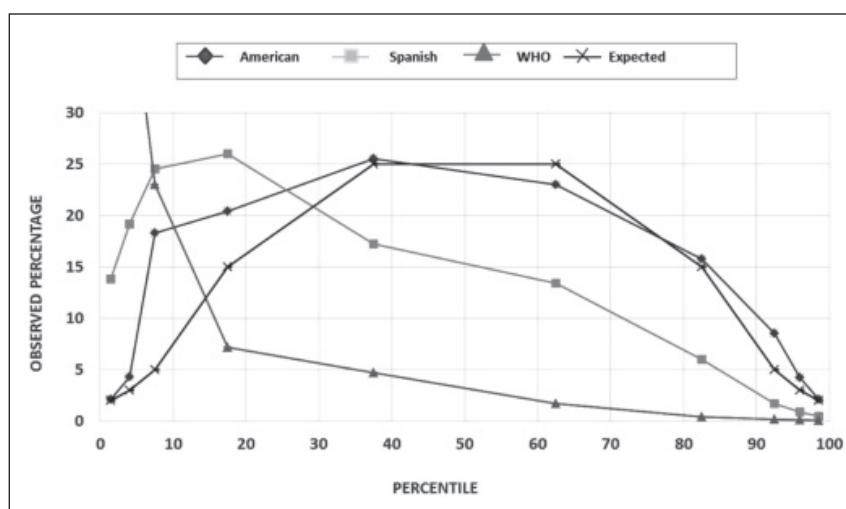


Fig. 1.—The percentile distribution of the observed frequency of the indicator height for age in Mexican children with Down syndrome according to the American, Spanish and WHO growth reference patterns.

tes that children with DS have twice the risk of obesity compared with other children. The study found that 57% of children with DS had a BMI diagnosed as overweight and 9.3% were obese, compared with children without DS among only 27% were overweight and 3.9% were obese. According to these researchers, possible physiological causes for this phenomenon include differences in metabolism and appetite control; unhealthy behavioral differences concerning motor skills that decrease physical activity and non-healthy lifestyles related to food. Matute et al¹⁷ have shown that in Spain children and adolescents with Down syndrome (DS) are less active and with higher prevalence of overweight and obesity than those without DS but the information regarding physical activity (PA) in adolescents with DS is few and inconclusive. In addition, a study from Soler & Xandri¹⁸ showed that obesity in adult with Down syndrome is a prevalent phenomenon.

One question that arose was why the Mexican children looked more like the American reference pattern than the Spanish reference pattern. One possibility is that the Spanish reference pattern excluded children with heart disease who have systemic repercussions, hypothyroidism and celiac disease, unlike the American reference pattern in which children with moderate and/or severe heart disease were included (although there were no references of hypothyroidism).

In our sample, 46% of children had some type of heart disease, and 56% of the heart disease cases were corrected. We should remember that in our study, at the time of evaluation, most children were healthy and/or their heart disease had been corrected; only 5.4% of heart disease had hemodynamic consequences. In addition, in our study, 9% of children had hypothyroidism; it has been noted that approximately 20% of children with DS have this disease¹⁹. It should also be noted that Cronk et al.⁶ found that children with moderate and/or severe heart disease were 2 and 1.5

cm smaller size than children without heart disease or mild disease, respectively.

Worldwide, there are several reference patterns specific for the evaluation of children with DS: USA, Spain, Holland, Turkey, Egypt, the United Kingdom and Ireland, Portugal, Sicily, Arabia, Sweden^{6, 7, 8, 13, 20-25}; and it has been observed that the growth profile of children with DS differs among countries, even among older age groups.

Tüytis et al.¹³ have noted that Swedish, English and Portuguese children with DS are taller than American and Sicilian children with DS, although these differences may be more or less noticeable according to age groups. Van Gameren-Oosterom et al.²¹ found that the height of Dutch children with DS was greater than that of Americans. Therefore, anthropometric differences observed in children with DS impede the use of a single reference pattern to be adopted by all countries. Pinheiro et al.⁴ compared 116 Chilean children with DS using with the American⁶ and Spanish⁸ reference patterns. They noted that there was poor agreement in the distribution obtained using the different standards and that the Spanish reference pattern was more similar to the Gaussian distribution curve in the weight/age and height/age indices. They concluded that the Spanish reference pattern better discriminates deficits and excesses.

In another study conducted in Brazil²⁶ among 90 children and 40 adolescents with DS, it was observed that with the weight/age index had a higher proportion of children below the 50th percentile using the Spanish reference and a higher proportion of children above the 95th percentile using the American reference pattern. The adolescent group had a higher proportion above the 95th percentile compared with the Spanish charts. Regarding the height/age index, there were a higher proportion of children below the 5th percentile compared with the Spanish reference pattern and no differences in the adolescent group were identified when comparing the two reference patterns.

Differences in the height of children with DS are observed among European countries. The selected sample likely contributes to these differences. For example, in the Netherlands²¹, the children included came from their own reference pattern. First, they were categorized according to their health status, and only healthy children or those with mild heart disease were included; children with mosaicism and translocations, prematurity, severe heart disease, other disorders and malformations affecting growth were excluded. Bertapelli et al.²⁷ conducted a systematic review of the different reference patterns for population with DS to verify eligibility and identified differences and similarities between studies. It is evident from the results that studies need to develop new specific references for children with DS that are reproducible at national and international levels. The main limitations of our study were that the number of participants was small and that the data cannot be extrapolated to the whole country.

Conclusions

The WHO Child Growth Standards and the growth reference data (2006, 2007) are not suitable for the anthropometric assessment of children with Down syndrome. The American reference pattern better fits the growth of Mexican children with DS than the Spanish reference pattern. It is necessary to develop new studies with a representative sample of children with DS in Mexico in order, to develop a Mexican reference pattern for children with DS that allows for an accurate assessment of their nutritional status and growth across age groups from birth to the pubertal stage.

Competing interests

The authors have declared that no competing interests exist.

References

- Viñas-Portilla CI, Vega-Conejo V, Zaldívar-Vaillant T, Rodríguez-Gaus H, Lantigua-Cruz A. Síndrome de Down. A propósito de 2 familias portadoras de translocación 14; 21. *Rev Cubana Pediatr* 1999; 71: 43-48.
- Garduño-Zarazúa LM, Giammatteo-Alois L, Kofman-Epstein S, Cervantes Peredo AB. Prevalencia de mosaicismo para la trisomía 21 y análisis de las variantes citogenéticas en pacientes con diagnóstico de síndrome de Down. Revisión de 24 años (1986-2010) del Servicio de Genética del Hospital General de México Dr. Eduardo Liceaga. *Bol Med Hosp Infant Mex* 2013; 70: 31-37.
- World Health Organization (WHO) Genes and human disease. Down Syndrome. Consulted on September 4, 2014. Available on: <http://www.who.int/genomics/public/geneticdiseases/en/index1.html>.
- Pinheiro AC, Urteaga C, Cañete G, Atalah E. Evaluación del estado nutricional en niños con síndrome de Down según diferentes referencias antropométricas. *Rev Chil Pediatr* 2003; 74: 585-589.
- Gallardo B. Síndrome de Down: un reto para el pediatra de hoy. *Paediatrica* 2000; 3: 22-27.
- Cronk C, Crocker A, Pueschel S, Shea A, Reed RB. Growth charts for children with Down syndrome: 1 month to 18 years of age. *Pediatrics* 1988; 81: 102-110.
- Myrelid A, Gustafsson J, Ollars B, Anneren G. Growth charts for Down's syndrome from birth to 18 years of age. *Arch Dis Child* 2002; 87: 97-103.
- Pastor-Durán X, Quintó-Domech LI, Corretguer-Calzada M, Hernández-Martínez M, Serés-Santmaría A. Tablas de crecimiento actualizadas de los niños españoles con Síndrome de Down. *Rev Med Int Sx Down* 2004; 8: 34-46.
- World Health Organization (WHO) Multicentre Growth Reference Study Group. WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatr* 2006; 450: 76-85.
- de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ*. 2007; 85: 660-7.
- World Health Organization. Measuring Change in Nutritional Status. Guidelines for Assessing the Nutritional Impact of Supplementary Feeding Programmes for Vulnerable Groups. WHO: Geneva. 1983.
- Kimura J, Tachibana K, Imaizumi K, Kuroki Y. Longitudinal growth and height velocity of Japanese children with Down's syndrome. *Acta Paediatr* 2003; 92: 1039-1042.
- Tüysüz B, Gökner NT, Öztürk B. Growth charts of Turkish children with Down syndrome. *Am J Med Genet Part A* 2012; 158A: 2656-2664.
- Gutiérrez JP, Rivera-Dommarco J, Shamah-Levy T, Villalpando-Hernández S, Franco A, Cuevas-Nasu L, Romero-Martínez M, Hernández-Ávila M. Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública (MX), 2012.
- Servicios básicos de salud. Promoción y educación para la salud en materia alimentaria. Criterios para brindar orientación. Norma Oficial Mexicana NOM-043-SSA2-2012, *Diario Oficial de la Federación*, 28 de mayo de 2012.
- Van Gameren-Oosterom HB, van Dommelen P, Schönbeck Y, Oudesluys-Murphy AM, van Wouwe JP, Buitendijk SE. Prevalence of overweight in Dutch children with Down syndrome. *Pediatrics* 2012; 130: e1520-6.
- Matute-Llorente A, González-Agüero A, Gómez-Cabello A, Vicente-Rodríguez G, Casajús JA. Physical activity and cardiorespiratory fitness in adolescents with Down syndrome. *Nutr Hosp*. 2013; 28:1151-1155.
- Soler-Marin S, Xandri-Graupoera JM. Nutritional status of intellectual disabled persons with Down syndrome. *Nutr Hosp* 2011; 26:1059-66.
- Regueras L, Prieto P, Muñoz-Calvo MT, Pozo J, Arguinzoniz L, Argente J. Endocrinological abnormalities in 1,105 children and adolescents with Down syndrome. *Med Clin (Barc)* 2011; 136: 376-81.
- Piro E, Pennino C, Cammarata M, Corsello G, Greci A, Lo Guidice C, Morabito M, Piccione M, Guiffre L. Growth charts of Down's syndrome in Sicily: Evaluation of 382 children 0-14 years of age. *Am J Med Genet* 1990; 7: 66-70.
- Van Gameren-Oosterom HBM, Van Dommelen P, Oudesluys-Murphy AM, Buitendijk SE, Stef Van Buuren S, Van Wouwe JP. Healthy Growth in Children with Down syndrome. *PLoS ONE* 2012; 7: e31079. doi:10.1371/journal.pone.0031079.
- Afifi HH, Aglan MS, Zaki ME, Thomas MM, Tosson AMS. Growth charts of Down syndrome in Egypt: A study of 434 children 0-36 months of age. *Am J Med Genet Part A* 2012; 158A: 2647-2655.
- Meguid NA, El-Kotoury AI, Abdel-Salam GM, El-Ruby MO, Afifi HH. Growth charts of Egyptian children with Down syndrome (0-36 months). *East Mediterr Health J* 2004; 10: 106-115.

24. Fernandes A, Mourato AP, Xavier MJ, Andrade D, Fernandes C, Palha M. Characterisation of the somatic evaluation of Portuguese children with Trisomy 21 preliminary results. *Downs Syndr Res Pract* 2001; 6: 134–138.
25. Al Husain M. Growth charts for children with Down's syndrome in Saudi Arabia: Birth to 5 years. *Int J Clin Pract* 2003; 57:170–174.
26. Lopes TS, Ferreira DM, Pereira RA, Da Veiga GC. Assessment of anthropometric indexes of children and adolescents with Down syndrome. *J Pediatr (Rio J)*. 2008; 84: 350-356.
27. Bertapelli F, Martin JESS, Goncalves EM, Barbeta VJO, Guerra-Junior G. 2013. Growth curves in Down syndrome: Implications for clinical practice. *Am J Med Genet Part A* 2014; 164A: 844-7.



Original/*Pediatría*

Diferencias demográficas y socioeconómicas asociadas al consumo de bebidas azucaradas en niños y adolescentes colombianos

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Resumen

Introducción: las bebidas azucaradas (BA) se están convirtiendo en un componente común en las dietas de niños y adolescentes y su consumo se relaciona con factores de riesgo de enfermedad cardiovascular. El objetivo de este estudio fue describir el consumo de BA entre niños y adolescentes colombianos y examinar las diferencias demográficas y socioeconómicas de acuerdo al sexo.

Métodos: estudio descriptivo y transversal secundario de la información obtenida en la Encuesta Nacional de la Situación Nutricional 2010 (ENSIN 2010), en 10.373 niños y adolescentes, entre 5 y 17 años. El consumo de BA (bebidas carbonatadas y/o concentrados azucarados), los factores demográficos (sexo, edad, etnia, urbanidad, región y área geográfica) y el nivel sociodemográfico (puntaje de Sisbén) se recogieron por encuesta estructurada. Se establecieron asociaciones mediante la construcción de modelos de regresión logística binaria simple y multivariable.

Resultados: a nivel nacional, el 23% de las niñas y el 22,4% de los niños acusaron un consumo de al menos una vez a la semana de BA y se observan diferencias significativas por factores demográficos. En las niñas, los factores asociados a la ingesta de BA (≥ 1 vez/sem) eran las pertenecientes al grupo entre 14 y 17 años de edad [OR = 1,65 (IC95% 1,32-2,06)], las residentes de la región central [OR = 2,42 (IC95% 1,81-3,25)] y las procedentes de las áreas urbanas [OR 1,77 (IC95% 1,42-2,20)]. En los niños, la regresión logística multivariante muestra que los adolescentes entre 14 y 17 años de edad [OR= 1,96 (IC 95% 1,58-2,24)], procedentes de los territorios nacionales [OR = 2,42 (IC95% 1,77-3,32)] y los residentes del área urbana [OR 1,79(IC95% 1,45-2,20)] se asociaron con una mayor probabilidad de consumo de BA. La clase social no se asoció con la ingesta de BA.

DEMOGRAPHIC AND SOCIOECONOMIC DIFFERENCES IN CONSUMPTION OF SUGAR-SWEETENED BEVERAGES AMONG COLOMBIAN CHILDREN AND ADOLESCENTS

Abstract

Introduction: sugar-sweetened beverages (SSB) are becoming a common component in the diets among children and adolescents, and its consumption is associated with an increased risk factors for cardiovascular disease. The aim of the present study was to describe the consumption of sugar-sweetened beverages among Colombian children and adolescents and to examine whether differences by demographic and socioeconomic according to gender.

Methods: we used data from the 2010 National Nutrition Survey of Colombia (ENSIN 2010) for 10373 children and adolescents between 5 and 17 years old. SSB intake was based on intake from regular soda and/or concentrated drinks. Demographic factors (sex, age, ethnicity, urbanicity, area and geographic region) and socioeconomic level (social class) were collected by structured questionnaire. Associations were established through a multivariate logistic regression. All analyzes were calculated by complex samples.

Results: nationwide, 23% of girls and 22.4% of boys drank SSB at least once a week. Differences by demographic factors were observed for SSB consumption. In girls, factors associated with a greater odds for SSB intake (≥ 1 time/week) were aged 14 to 17 years old [OR = 1.65 (95% CI = 1.32, 2.06)], living in the central region [OR = 2.42 (95% CI = 1.81, 3.25)] and urban area [OR = 1.77 (95% CI = 1.42, 2.20)]. In boys, the multivariate logistic regression shows that adolescents aged 14 to 17 years old [OR = 1.96 (95% CI = 1.58, 2.24)], living in the national territories (South) [OR = 2.42 (95% CI = 1.77, 3.32)] and urban area [OR = 1.79 (95% CI = 1.45, 2.20)] were associated with a higher probability of SSB consumption. Social class was not associated with SSB intake.

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Recibido: 17-III-15.

Aceptado: 22-IV-15.

Conclusiones: el consumo de BA cambia según los factores sociodemográficos estudiados. El Estado podría usar los resultados de este estudio para fomentar la disminución del consumo regular de BA e incentivar el consumo de bebidas saludables (como el agua) entre los niños y adolescentes de Colombia.

(*Nutr Hosp.* 2015;31:2479-2486)

DOI:10.3305/nh.2015.31.6.8986

Palabras clave: *Bebidas carbonatadas. Factores sociodemográficos. Niños. Adolescentes. Factores asociados.*

Introducción

En varios estudios se ha observado que el consumo de bebidas con alto contenido energético representa un factor de riesgo, asociado a manifestaciones tempranas para enfermedades cardiovasculares¹, obesidad² y diabetes mellitus tipo 2³. En los trabajos de Malik et al.^{4,5} se demostró que el consumo regular de bebidas azucaradas (BA) se asocia con más de 180 000 muertes al año en el mundo, y se lo considera una de las principales fuentes de azúcar añadido a la dieta, que aporta, aproximadamente, el 33 % del azúcar consumida en la alimentación habitual.

A pesar de ello, el debate acerca de la contribución de las BA en el desarrollo de manifestaciones tempranas asociadas a las enfermedades no transmisibles en edades tempranas, aún sigue en discusión^{6,7}. Conceptualmente, se consideran BA las bebidas saborizadas, los concentrados de frutas y las bebidas carbonatadas. Esas bebidas tienen un alto contenido energético, un alto índice glucémico y un bajo índice de saciedad, lo que puede producir mayor consumo de alimentos después de su ingesta⁸. En una revisión sistemática de estudios prospectivos, con observación a largo plazo, Pérez-Morales et al.⁹ observaron que la mayoría de trabajos indicaban una asociación entre la ingesta de BA antes de los 6 años de edad y un aumento de adiposidad en períodos posteriores de la vida. Los estudios con mayor tiempo de observación reportaron una asociación positiva entre la ingesta diaria de BA y un aumento en el peso corporal. Esa misma relación fue observada entre el consumo de BA y la elevación de marcadores de adiposidad en población adolescente¹⁰.

En población joven se han identificado varios factores que determinan la elección de los alimentos, que varían en función de la fase de la vida, del individuo o de los grupos de individuos¹¹. La riqueza del hogar, la seguridad alimentaria, la influencia cultural, el contexto social y el nivel de educación, se han identificado a menudo como factores asociados¹². Bajo esa perspectiva, evaluar los factores que tienen influencia sobre la elección de alimentos y que proporcionan todo un conjunto de maneras de intervenir y de mejorar las elecciones de alimentos en edades tempranas es necesario.

Conclusions: SSB intake varies by certain demographic factors. Government can use findings from this study to tailor efforts to decrease SSB intake and to encourage consumption of more healthful beverages (e.g, water) among Colombian children and adolescents.

(*Nutr Hosp.* 2015;31:2479-2486)

DOI:10.3305/nh.2015.31.6.8986

Keywords: *Carbonated Beverages. Socioeconomic. Children. Adolescents. Related factors.*

Colombia, un país de mediano ingreso, se ubica entre los mayores consumidores mundiales de BA, específicamente en el consumo de bebidas carbonatadas; ocupa el décimo lugar mundialmente, con un consumo *per cápita*, en 2013, de 66,5 litros (266 botellas individuales de 250 cc). La literatura del consumo de BA en edades tempranas está emergiendo con trabajos realizados en países de América Latina, como México¹³, Costa Rica¹⁴, Argentina¹⁵ y Brasil¹⁶. No obstante, son pocos los estudios desarrollados, especialmente en las primeras edades de la vida, que permitan evaluar los factores que tienen influencia sobre la elección de alimentos con alto contenido energético¹⁷. El objetivo de este estudio fue describir el consumo de BA entre niños y adolescentes colombianos y examinar las diferencias demográficas y socioeconómicas de acuerdo al sexo.

Métodos

Población

El presente es un estudio epidemiológico, observacional de corte transversal, que utilizó datos secundarios para analizar la prevalencia del consumo regular de BA autorreportada en una muestra representativa de niños y adolescentes de Colombia. La más reciente Encuesta Nacional de la Situación Nutricional (Ensin)¹⁸, que se llevó a cabo en el año 2010, fue la principal fuente de datos para este estudio. Desde el 2005 esa encuesta es financiada por el Instituto Colombiano de Bienestar Familiar (ICBF), y, tradicionalmente, se enfoca en estudiar la prevalencia de problemas nutricionales y algunas condiciones de salud. Adicionalmente, es un importante insumo para evaluar políticas públicas de población. La Ensin 2010 tiene cobertura nacional, es distribuida en 258 municipios de los 32 departamentos del país, y en Bogotá D.C. El muestreo es de tipo probabilístico, estratificado y multietápico de la población civil no institucional, y fue aprobado por el comité de ética de la Encuesta Nacional de la Situación Nutricional y por el Instituto Nacional de Salud.

Variables. Se definió como variable dependiente la frecuencia de consumo de BA, mediante las preguntas por seguir: 1-«¿Usualmente, en un mes, usted consume gaseosas o refrescos concentrados?»; y 2-«¿Con qué frecuencia consume gaseosas o refrescos concentrados?». Posteriormente, se identificó la cantidad de frecuencia de consumo en cuatro categorías por seguir: «diariamente», «semanalmente», «mensualmente» y «no consume». Los factores sociodemográficos: i) edad (5-9 años, 10-13 años, 14-17 años), ii) sexo (niño, niña), iii) etnia (indígena, negro/afrodescendiente y otros grupos étnicos: raizal del archipiélago, gitanos y residentes de Palenque), iv) nivel socioeconómico-Sisben (I al VI), v) región geográfica (Atlántica, Oriental, Central, Pacífica, Bogotá, Territorios Nacionales) y vi) área geográfica (rural, urbana), fueron examinados como variables independientes de predisposición al consumo de BA.

Plan de análisis

En primer lugar se realizó un análisis exploratorio para determinar la distribución de frecuencias (medidas de tendencia central y de dispersión para variables cuantitativas), frecuencias relativas (para variables cualitativas). Para estimar la relación entre la frecuencia de consumo de BA con los factores sociodemográficos estudiados (edad, sexo, etnia, nivel socioeconómico-SISBEN, región y área geográfica), se utilizaron modelos de regresión logística binaria. El primer modelo binario sin ajustar figura 1, y un segundo modelo ajustado por edad, etnia, área geográfica, región geográfica y puntaje de SISBEN figura 2. La frecuencia de consumo de BA en las categorías (diariamente, semanalmente, mensualmente y no consume), se usó para los análisis descriptivos; y para los modelos de regresión binario se utilizó la respuesta recodificada de manera dicotómica (sí o no). Para el presente análisis se excluyeron las niñas que estaban en estado de embarazo. Todos los análisis fueron ajustados por los pesos muestrales, y se tuvieron en cuenta el diseño de la muestra y los factores de expansión poblacional. Los análisis fueron realizados en SPSS, versión 20, y se consideró como significativo un valor $P < 0.05$.

Resultados

La muestra estuvo constituida por 10373 niños (5279 varones y 5094 hembras) entre 5 y 17 años de edad (edad media: 11,73 años; IC95 % 11,64-11,83 años). Entre las niñas, tener entre 14 y 17 años, pertenecer al SISBEN nivel III, residir en zona urbana y reconocerse en la etnia negra mostraban el mayor patrón de consumo diario de BA, con valores de 26,8 %, 26,3 %, 25,7 % y 23,4 %, respectivamente. Los demás

valores de consumo por variable sociodemográfica se presentan en la tabla I.

En los niños, tener entre 14 y 17 años, clasificarse en el SISBEN nivel II, residir en zona urbana y pertenecer a otras etnias colombianas se mostró el mayor patrón de consumo diario de BA (28,2 %, 26,4 %, 25,5 % y 23,0 %), respectivamente, tabla II.

En las Figuras 1 y 2, se presentan los resultados del análisis de regresión logística, según el sexo. Tras ajustar por grupo etario, puntuación del SISBEN, región, área geográfica y etnia, encontramos en ambos grupos que tener entre 10-13 años y 14-17 años, proceder de las regiones Atlántica, Oriental, Central, Bogotá y Llanos Orientales, y residir en las zonas urbanas, se asociaba como factores predisponentes al consumo de BA. En niñas, los factores asociados a la ingesta de BA (≥ 1 vez/sem) eran las pertenecientes al grupo entre 14 y 17 años de edad [OR 1,65 (IC95% 1,32-2,06)], residentes de la región central [OR 2,42 (IC95% 1,81-3,25)] y procedentes del área urbana [OR 1,77 (IC95% 1,42-2,20)]. En niños, la regresión logística multivariante muestra que los adolescentes entre los 14 y 17 años de edad [OR 1,96 (IC 95% 1,58-2,24)], procedentes de los territorios nacionales [OR 2,42 (IC95% 1,77-3,32)] y residentes del área urbana [OR 1,79 (IC95% 1,45-2,20)] se asociaron con una mayor probabilidad de consumo de BA. La clase social –*indicador socioeconómico*– y el grupo étnico –*indicador demográfico*–, no se asociaron con la ingesta regular de BA.

Discusión

El principal hallazgo de este trabajo es que 1 de cada 5, y 3 de cada 5 niños y adolescentes colombianos, acusan un patrón de consumo diario y semanal de BA, respectivamente. Este resultado es cercano al encontrado en Norteamérica por Rader et al. (62 %) ¹⁹ y menor al reportado por Ribeiro et al. (86,6 %) ²⁰ en Belo Horizonte, Brasil (2006), en población con características similares a la descrita en este trabajo.

Varios autores han identificado que la mayor exposición al mercadeo de BA está significativamente asociada con un mayor consumo de esos productos ²¹⁻²³. En población colombiana ²¹, se ha relacionado que la elevada prevalencia en el consumo regular de BA puede estar relacionada con la publicidad que se emite en la franja infantil de la televisión, la cual presenta un mayor porcentaje de alimentos y bebidas no alcohólicas, clasificados como «altos» en azúcar, sodio y grasa. Sobre ese hallazgo, Andreyeva et al. ²⁴ demostraron que existe una clara orientación del mercadeo de BA hacia los jóvenes, especialmente hacia los jóvenes negros e hispanos. En el trabajo de Reedy et al. ²³ se pudo determinar que las BA son la mayor fuente de azúcares añadidos en la dieta estadounidense y la principal fuente de calorías en la dieta de los jóvenes.

Tabla I
Distribución de consumo de BA por variables sociodemográficas en niñas

	<i>Diariamente</i>		<i>Semanalmente</i>		<i>Mensualmente</i>		<i>No consume</i>	
	n	% ^a	n	% ^a	n	% ^a	n	% ^a
<i>Total</i>	1181	23,0	2631	52,7	441	9,0	841	15,3
<i>Grupo Etéreo</i>								
Entre 5 y 9 años	284	18,3	795	50,7	178	12,5	297	18,5
Entre 10 y 13 años	348	22,6	754	52,1	128	8,3	264	17,0
Entre 14 y 17 años	549	26,8	1082	54,6	135	6,9	280	11,8
<i>Nivel del SISBEN</i>								
Nivel I	641	21,8	1470	50,7	282	9,6	549	17,9
Nivel II	157	23,2	350	52,7	50	9,7	93	14,4
Nivel III	113	26,3	237	55,8	31	6,2‡	55	11,7
Nivel IV o más	270	24,0	574	55,3	78	8,4	144	12,3
<i>Región Geográfica</i>								
Atlántica	295	24,6	642	55,6	97	8,8	126	11,0
Oriental	164	21,5	399	54,1	69	9,2	117	15,1
Central	278	27,4	553	44,6	102	9,6	279	18,4
Pacífica	109	14,2	378	53,9	54	8,1	156	23,9
Bogotá	59	24,4	144	59,7	21	8,8‡	17	7,1‡
Territorios Nacionales	276	22,7	515	52,8	98	9,5	146	15,0
<i>Área Geográfica</i>								
Urbano	886	25,7	1790	54,2	244	8,0	446	12,0
Rural	295	15,6	841	48,5	197	11,5	395	24,4
<i>Etnia^b</i>								
Indígena	129	14,4	303	47,0	71	10,5‡	111	28,2
Negro	123	23,4	300	54,8	35	7,9	79	13,9
Otros grupos étnicos	907	22,4	2000	52,6	331	9,1	649	14,9

‡ Coeficiente de Variación Superior a 20%

^a No es correcto calcular los porcentajes a partir de los n presentados en esta tabla, estos cálculos se toman a partir del peso ponderal proveniente de los valores dados a cada sujeto.

^b La cantidad total de niñas analizadas de acuerdo con la etnia son 5038, los 56 restantes pertenecen a los de grupo Raizal del archipiélago, Gitanos y residentes de Palenque.

Eso sugiere la necesidad de intervenciones comunitarias para reducir la ingesta excesiva BA, en especial en la población de adolescentes entre 14 y 17 años, procedentes de las zonas urbanas y autorreconocidos como etnia negra. En los trabajos de Gutiérrez-Ruvalcaba et al.²⁴ se ha demostrado que las BA promueven la obesidad y el sobrepeso, porque el consumo de energía adicional de los líquidos desplaza la energía que proviene de los alimentos sólidos de la dieta. Como los niños no compensan las calorías líquidas adicionales con la ingesta de sólidos, es razonable sugerir que el consumo excesivo de BA aumentaría el riesgo de obesidad²⁰. Es decir, que estas bebidas están posicionándose en el consumo diario y

es probable que se esté generando un desplazamiento importante de alimentos recomendados para una alimentación saludable. Por ejemplo, en jóvenes americanos, Shah et al.²⁵ mostraron que el consumo semanal de BA se asocia a sobrepeso, y que cada ración adicional (360 mL) incrementaba en un 60 % el riesgo de obesidad. Eso coincide con reportes de estudios observacionales en niños y jóvenes estadounidenses²⁶ y finlandeses²⁷. En adición, Ludwig et al.²⁸, muestran que con cada 200mL/día de BA consumida en la dieta, el riesgo de obesidad abdominal se aumenta en 1,6 veces, y el IMC en 0,24 Kg•m⁻¹. Complementario a lo anterior, Malik et al.²⁹ en un meta-análisis, que incluyó cuatro estudios de cohortes, mostraron

Tabla II
Distribución de consumo de BA por variables sociodemográficas en niños

	<i>Diariamente</i>		<i>Semanalmente</i>		<i>Mensualmente</i>		<i>No consume</i>	
	n	% ^a	n	% ^a	n	% ^a	n	% ^a
<i>Total</i>	1238	22,4	2764	53,9	462	9,2	815	14,5
<i>Grupo Etáreo</i>								
Entre 5 y 9 años	312	16,5	834	51,9	203	13,0	344	18,6
Entre 10 y 13 años	351	21,3	827	53,1	160	10,0	246	15,6
Entre 14 y 17 años	575	28,2	1103	56,2	99	5,3	225	10,3
<i>Nivel del SISBEN</i>								
Nivel I	692	21,1	1540	51,7	290	10,1	509	17,0
Nivel II	164	26,4	329	50,5	49	8,6	95	14,6
Nivel III	111	21,8	267	57,5	35	7,7‡	66	13,0
Nivel IV o más	271	23,0	628	58,0	88	8,3	145	10,7
<i>Región Geográfica</i>								
Atlántica	276	21,7	661	57,1	102	9,4	134	11,8
Oriental	185	23,7	407	53,1	88	10,9	99	12,3
Central	277	24,8	558	49,5	82	7,2	274	18,5
Pacífica	112	12,8	389	53,3	78	11,0	157	22,9
Bogotá	81	27,4	171	58,2	24	8,2‡	18	6,2‡
Territorios Nacionales	307	24,1	578	54,4	88	7,0	133	14,5
<i>Área Geográfica</i>								
Urbano	896	25,5	1777	55,9	233	7,7	412	11,0
Rural	342	15,6	987	49,4	229	12,6	403	22,5
<i>Etnia^b</i>								
Indígena	140	16,9	322	49,0	72	10,5	100	23,6
Negro	126	19,8	316	54,5	46	8,0	100	17,7
Otros grupos étnicos	948	23,0	2096	54,0	343	9,3	614	13,7

‡ Coeficiente de Variación Superior a 20%.

^a No es correcto calcular los porcentajes a partir de los n presentados en esta tabla, estos cálculos se toman a partir del peso ponderal proveniente de los valores dados a cada sujeto.

^b La cantidad total de niños analizadas de acuerdo con la etnia son 5223, los 56 restantes pertenecen a los de grupo Raizal del archipiélago, Gitanos y residentes de Palenque.

una asociación positiva de consumo regular de BA y la elevación de lípidos y marcadores de obesidad en niños y adolescentes. Estos autores reportan, que la ingesta diaria de 8 onzas de BA, incrementan las probabilidades de que un niño se vuelva obeso en un 60 %.

Otros factores sociodemográficos, como presentar altos puntajes del SISBEN (niveles III y IV, o más), muestran los mayores porcentajes de ingesta diaria de BA, resultado este que difiere con lo reportado por Pabayo et al.³⁰, pues estos autores reportan que pertenecer a grupos socioeconómicos bajos se asocia a patrones dietéticos poco saludables, donde se resalta el consumo excesivo de BA. También

encontramos que la población indígena mostró las tasas más bajas de consumo regular de BA (16,9 % en niños; y 14,4 % en niñas). Ese resultado coincide con el trabajo de Rosique et al.³¹ quienes afirman que los hábitos dietéticos de los indígenas se basan, generalmente, en productos provenientes de la pesca, o la agricultura; y rara vez incluyen los alimentos procesados en su canasta familiar. En Colombia se produjo un importante trasvase de población de los pueblos a las ciudades, lo que originó cambios en el consumo de alimentos. Previamente, hemos demostrado que la población indígena colombiana, presenta importantes carencias de micronutrientes relacionados con la doble carga nutricional y la

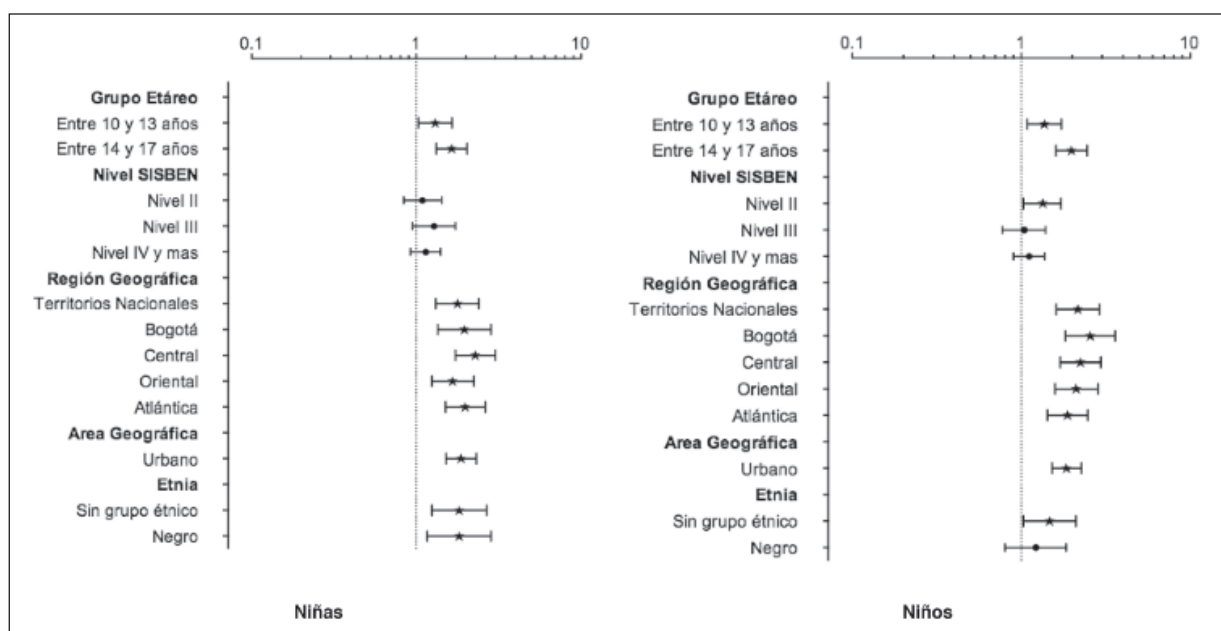


Fig. 1.—Asociación entre el consumo diario de bebidas azucaradas con factores demográficos y socioeconómicos en niñas y niños. Análisis sin estratificar.

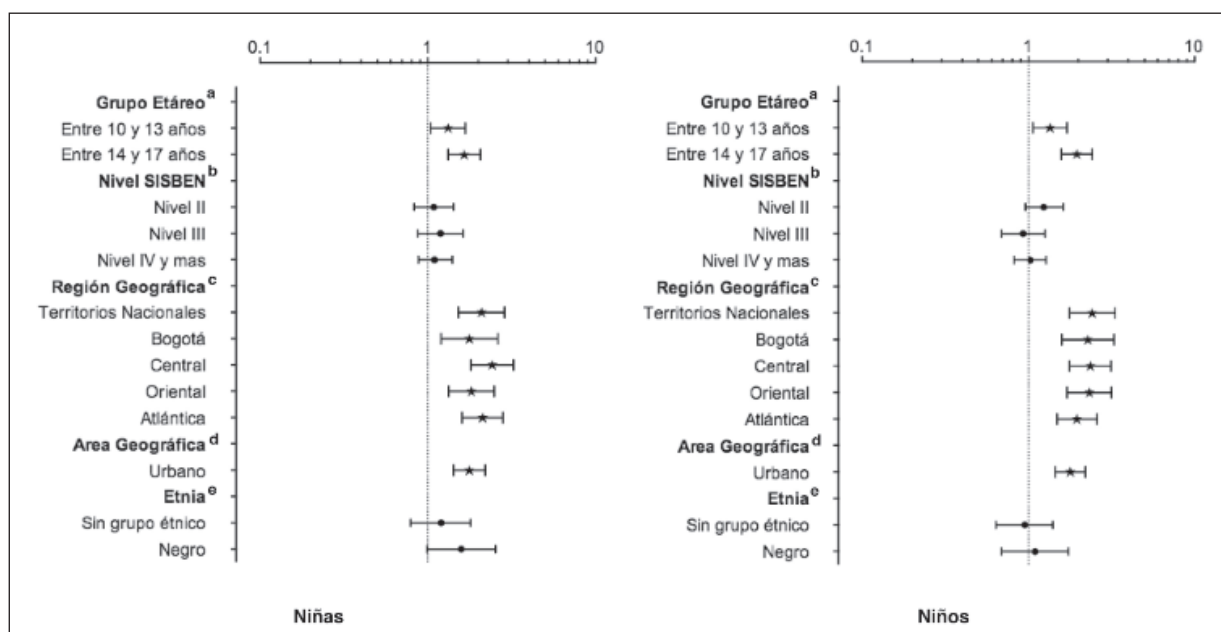


Fig. 2.—Asociación entre el consumo diario de bebidas azucaradas con factores demográficos y socioeconómicos en niñas y niños. Análisis multivariado.

^aGrupo de referencia para grupo etéreo: Entre 5 y 9 años. ^bGrupo de referencia para nivel del SISBEN: SISBEN Nivel I. ^cGrupo de referencia para Región Geográfica: Región Pacífica. ^dGrupo de referencia para Área Geográfica: Área Rural. ^eGrupo de referencia para Etnia: Indígenas. ★ «Valores significativos $p < 0,05$.

transición epidemiológica que caracteriza los países latinos²⁹⁻³¹.

Un interesante hallazgo demográfico, fue la diferencia entre el consumo diario de BA con el lugar de procedencia (urbana: 25,7 % vs. rural: 15,6 %). Sin embargo, otro aspecto que en la actualidad tiene mayor

importancia es la progresiva urbanización del medio rural. La sociedad rural ha evolucionado y no tiene mucho sentido hablar en la actualidad de una cultura rural en contraposición a la urbana. Esos resultados confirman los encontrados en otros estudios, donde el consumo regular de BA se relaciona con el lugar de

procedencia³¹⁻³⁴. En varios trabajos se ha demostrado que el tamaño del área geográfica es una variable relevante a la hora de explicar el comportamiento del consumidor debido a las diferencias de precio^{31,34}. En Colombia se ha verificado que los factores psicosociales juegan un papel preponderante en la seguridad alimentaria y hay estudios que demuestran la relación existente entre los hábitos alimentarios, el nivel socioeconómico y la cultura de las familias, con el estado nutricional^{21,29-31,34}. La distinción clásica entre Escuela Urbana y Rural se ha diluido debido al avance tecnológico, el proceso globalizador y la mejora de los medios de comunicación, y se ha visto favorecida por la promulgación de normas legislativas que facilitan la compensación de desigualdades como las observadas en este trabajo (rural vs. urbano, niño vs. niñas, negro vs. indígenas).

Una de las principales limitaciones del estudio es la manera como fue reportado el consumo habitual de BA en los niños y adolescentes encuestados en la Ensin 2010. Teniendo en cuenta el carácter descriptivo transversal de este estudio, las conclusiones respecto al modelo de asociación no permiten establecer una relación de causalidad, sino únicamente una relación de asociación. Esto puede haber llevado a sobrestimar la prevalencia general de consumo de BA en este estudio. Sin embargo, eso no les resta validez a los hallazgos encontrados ya que ellos reflejan la realidad social del país y se basan en análisis estratificados por zonas geográficas y por procedencia. Observamos que la ingesta regular de las BA se relaciona con el contexto demográfico y socioeconómico, y que ambos son factores que deben tomarse en cuenta para dar explicaciones y soluciones ante la actual presencia de la obesidad y el sobrepeso de niños y adolescentes de Colombia; es importante profundizar sobre otros aspectos relacionados con el consumo de los alimentos, como el poder adquisitivo familiar, el nivel educativo o la influencia de los padres, los cuales determinan la disponibilidad, el acceso, el consumo y el aprovechamiento biológico de los alimentos.

En general, los resultados del presente estudio son de importancia en materia nutricional y en salud pública ya que muestran importantes prevalencias de ingesta regular de BA; y varios trabajos han demostrado los efectos negativos en la salud de niños y adolescentes²⁰⁻³⁰. Los periodos infantil y adolescente suelen ser los momentos en que los individuos asumen por primera vez la responsabilidad de su alimentación. Por tanto, se trata de periodos de educación crítica para el desarrollo de hábitos alimentarios, que tienen mucha importancia en la salud futura. En el último reporte de la Organización Mundial de la Salud³⁵ se recomiendan estrategias que permitan reducir el acceso de los jóvenes a BA, para disminuir su consumo y alentar a los adolescentes a que opten por el agua, la leche baja en grasa o sin grasa, o jugos con frutas 100 % naturales. Para Colombia y, en general, para los países de Latinoamérica de medianos ingresos presentan gran

inequidad social, doble carga que impone la malnutrición y problemas de acceso de alimentos, es de vital importancia que dispongan de opciones de bebidas saludables en lugar de bebidas poco nutritivas. Datos de la Ensin 2005, muestran que mientras el 14,5 % de los menores de 17 años presentaba condición de desnutrición crónica, el 16,8 % sufría de sobrepeso. Esta doble carga nutricional afecta a todos los grupos de edad entre los niños y adolescentes y está presente en zonas urbanas y rurales.

En conclusión, los resultados de este estudio muestran una importante prevalencia de consumo diario de BA, por lo que se recomiendan intervenciones integrales en las que estén involucrados los componentes nutricional y educativo. El Estado Colombiano, podría usar los resultados de este estudio para fomentar la disminución del consumo regular de BA e incentivar el consumo de bebidas saludables (como el agua) entre los niños y adolescentes de Colombia.

Conflicto de intereses

Los autores declaran no tener ningún conflicto de intereses.

Agradecimientos

Los autores agradecen al Instituto Colombiano de Bienestar Familiar –ICBF– y a Profamilia por el permiso otorgado para realizar el análisis del presente trabajo.

Referencias

1. Rippe JM. The metabolic and endocrine response and health implications of consuming sugar-sweetened beverages: findings from recent randomized controlled trials. *Adv Nutr*. 2013;4(6):677-8.
2. Hu, FB. Resolved: there is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. *Obesity Reviews*. 2013;14:606-19.
3. Hu FB, Malik VS. Sugar-sweetened beverages and risk of obesity and type 2 diabetes: epidemiologic evidence. *Physiol Behav*. 2010; 100(1):47-5.
4. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr* 2006;84:274-88.
5. Malik VS, Popkin BM, Bray GA, Després JP, Hu FB. Sugar-Sweetened Beverages, Obesity, Type 2 Diabetes Mellitus, and Cardiovascular Disease Risk. *Circulation*, 2010;121:1356-64.
6. Bray GA, Popkin BM. Dietary sugar and body weight: have we reached a crisis in the epidemic of obesity and diabetes?: health be damned! Pour on the sugar. *Diabetes Care*. 2014;37(4):950-6.
7. Beets MW, Weaver RG, Tilley F, Turner-McGrievy G, Huberty J, Ward DS, Freedman DA. Salty or Sweet? Nutritional Quality, Consumption, and Cost of Snacks Served in Afterschool Programs. *J Sch Health*. 2015;85(2):118-24.
8. Silva P, Duran S. Bebidas azucaradas, más que un simple refresco. *Rev. Chil. Nutr*. 2014;41(1):90-97.
9. Perez-Morales E, Bacardí-Gascón M, Jiménez-Cruz A. Sugar sweetened beverage intake before 6 years of age and weight or

- BMI status among older children; systematic review of prospective studies. *Nutr Hosp* 2013;28(1):47-51.
10. Gómez-Miranda, LM, Bacardí-Gascón M, Jiménez-Cruz A. Estudios aleatorizados sobre el consumo de bebidas azucaradas sobre la adiposidad en mayores de 13 años. Revisión sistemática. *Nutr Hosp* 2013;28(6):1792-6.
11. Ziaei S, Contreras M, Zelaya Blandón E, Persson LA, Hjern A, Ekström EC. Women's autonomy and social support and their associations with infant and young child feeding and nutritional status: community-based survey in rural Nicaragua. *Public Health Nutr*. 2014;1-12.
12. Wijtzes AI, Jansen W, Jansen PW, Jaddoe VW, Hofman A, Raat H. Maternal educational level and preschool children's consumption of high-calorie snacks and sugar-containing beverages: mediation by the family food environment. *Prev Med*. 2013; 57(5):607-12.
13. Stern D, Piernas C, Barquera S, Rivera JA, Popkin BM. Caloric beverages were major sources of energy among children and adults in Mexico, 1999-2012. *J Nutr*. 2014;144(6):949-56.
14. Rhee JJ, Mattei J, Campos H. Association between commercial and traditional sugar-sweetened beverages and measures of adiposity in Costa Rica. *Public Health Nutr*. 2012;15(8):1347-54.
15. Hirschler V, Buzzano K, Erviti A, Ismael N, Silva S, Dalamon R. Overweight and lifestyle behaviors of low socioeconomic elementary school children in Buenos Aires. *BMC Pediatr*. 2009;9:17.
16. Pereira RA, Souza AM, Duffey KJ, Sichieri R, Popkin BM. Beverage consumption in Brazil: results from the first National Dietary Survey. *Public Health Nutr*. 2014;27:1-9.
17. Mejía-Díaz DM, Carmona-Garcés IC, Giraldo-López PA, González-Zapata L. Nutritional content of food, and nonalcoholic beverages advertisements broadcasted in children's slot of colombian national television. *Nutr Hosp*. 2014;29(4):858-64.
18. Instituto Colombiano de Bienestar Familiar. Encuesta Nacional de la Situación Nutricional en Colombia. *Instituto Colombiano de Bienestar Familiar: Bogotá D.C.*; 2010.
19. Rader R, Mullen K, Sterkel R, Strunk R, Garbutt J. Opportunities to reduce children's excessive consumption of calories from beverages. *Clin Pediatr (Phila)*. 2014; 53(11):1047-54.
20. Ribeiro R, Lotufo P, Lamounier J, Oliveira R, Soares J, Botter D. Fatores adicionais de risco cardiovascular associados ao excesso de peso em crianças e adolescentes. O estudo de Belo Horizonte. *Arq Bras Cardiol*. 2006;86(6):4-18.
21. Mejía-Díaz D, Carmona-Garcés I, Giraldo-López P, González-Zapata L. Contenido nutricional de alimentos y bebidas publicitados en la franja infantil de la televisión colombiana. *Nutr. Hosp*. 2014;29(4):858-64.
22. Andreyeva T, Kelly IR, Harris JL. Exposure to food advertising on television: associations with children's fast food and soft drink consumption and obesity. *Econ Hum Biol*. 2011;9(3):221-33.
23. Reedy J, Krebs-Smith SM. Dietary sources of energy, solid fats, and added sugars among children and adolescents in the United States. *J Am Diet Assoc*. 2010;110(10):1477-84.
24. Gutiérrez-Ruvalcaba CL, Vásquez-Garibay E, Romero-Velarde E, Troyo-Sanromán R, Cabrera-Pivaral C, Ramírez-Magaña O. Consumo de refrescos y riesgo de obesidad en adolescentes de Guadalajara, México. *Bol Med Hosp Infant Mex* 2009;66:522-8.
25. Shah T, Purohit G, Nair SP, Patel B, Rawal Y, Shah RM. Assessment of obesity, overweight and its association with the fast food consumption in medical students. *J Clin Diagn Res*. 2014;8:CC05-7.
26. Wang YC, Ludwig DS, Sonneville K, Gortmaker SL. Impact of change in sweetened caloric beverage consumption on energy intake among children and adolescents. *Arch Pediatr Adolesc Med*. 2009;163:336-343.
27. Nissinen K, Mikkilä V, Männistö S, Lahti-Koski M, Räsänen L, Viikari J, Raitakari OT. Sweetened and sugar-sweetened soft drink intake in childhood in relation to adult BMI and overweight. The Cardiovascular Risk in Young Finns Study. *Public Health Nutr*. 2009;12:2018-26.
28. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet*. 2001;357(9255):505-8.
29. Martínez-Torres J, Meneses-Echavéz JF, Ramírez-Vélez R. Prevalence and demographic factors associated with vitamin A deficiency in Colombian children aged 12-59 months. *Endocrinol Nutr*. 2014;61(9):460-6.
30. Martínez-Torres J, Ramírez-Vélez R. Zinc deficiency and associated factors in colombian children; results from the 2010 national nutrition survey; a cross sectional study. *Nutr Hosp*. 2014;29(4):832-7.
31. Ramírez-Vélez R, Martínez-Torres J, Meneses-Echavez JF. Prevalence and demographic factors associated with ferritin deficiency in Colombian children, 2010. *Rev Peru Med Exp Salud Publica*. 2014;31(2):237-42.
32. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. *Am J Clin Nutr*. 2006;84:274-88.
33. Pabayo R, Spence J, Cutumisu N, Casey L, Storey K. Socio-demographic, behavioural and environmental correlates of sweetened beverage consumption among pre-school children. *Public Health Nutr*. 2012;15(8):1338-46.
34. Rosique J, Restrepo M, Manjarrés L, Gálvez A, Santa J. Estado nutricional y hábitos alimentarios en indígenas embera de Colombia. *Rev Chil Nutr*. 2010;37(3):270-80.
35. Guideline: Sugars intake for adults and children. Geneva: World Health Organization; 2015.



Original/*Pediatría*

Prenatal factors associated with birth weight and length and current nutritional status of hospitalized children aged 4-24 months

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Abstract

The objective of the present study was to investigate the associations of prenatal factors with birth weight and length, as well as current nutritional status, of children hospitalized in southern Brazil. We conducted a cross-sectional study of 300 child-mother pairs. Children were between 4 and 24 months old. They were at the inpatient unit or pediatric emergency department of the Hospital de Clínicas de Porto Alegre. Anthropometric data were collected, and a questionnaire on gestational data was answered by the children's mothers. Maternal variables of interest were: prepregnancy body mass index (BMI), gestational weight gain, smoking and/or use of alcohol, use of illicit drugs, gestational diabetes and/or high blood pressure. Children's variables of interest were: sex, gestational age, birth weight (BW) and birth length (BL), and current anthropometric data [body mass index for age (BMI/A), height for age (H/A), and weight for age (W/A)]. The gestational weight gain and smoking were associated with BW. We also found that H/A was associated with BW and BL, W/A was associated with BW, and BMI/A was associated with BL. The gestational weight gain was associated with BL, diabetes was associated with BW and BL, and high blood pressure was associated with low height in the first two years of life. We concluded that prenatal factors may have an influence on both BW and BL, causing the birth of small and large for gestational age children, and thus affecting their growth rate during the first years of life.

(Nutr Hosp. 2015;31:2487-2495)

DOI:10.3305/nh.2015.31.6.8846

Key words: *Fetal development. Birth weight. Nutritional status. Infant nutrition.*

FACTORES PRENATALES ASOCIADOS CON PESO Y LONGITUD AL NACER Y ACTUAL ESTADO NUTRICIONAL DE LOS NIÑOS ENTRE 4 Y 24 MESES HOSPITALIZADOS

Resumen

El objetivo de este estudio fue identificar las asociaciones de factores prenatales con el peso y la longitud al nacer y el estado nutricional actual de los niños hospitalizados en el sur de Brasil. Para ello se realizó un estudio transversal de 300 pares de madres y niños de entre 4 y 24 meses de edad, que estaban en la unidad de hospitalización o de emergencia pediátrica del Hospital de Clínicas de Porto Alegre. Se recogieron los datos antropométricos y se respondió a un cuestionario sobre los datos del embarazo. Variables maternas en estudio: IMC antes del embarazo, aumento de peso gestacional, fumar y/o beber alcohol, uso de drogas ilegales, la diabetes y/o hipertensión gestacional; y de los niños: el sexo, la edad gestacional, el peso (PN) y la longitud al nacer (LN), así como los datos antropométricos actuales (índice de masa corporal para la edad (IMC/E), altura para la edad (A/E) y peso para la edad (P/E)). Para las asociaciones entre variables se utilizó la prueba de chi-cuadrado y exacta de Fisher; para las que demostraron $p < 0.20$ se realizó regresión logística. En el análisis, el aumento de peso gestacional y el tabaquismo se asociaron con PN. También señaló que si A/E se asoció con PN y LN, P/E se asoció con el PN y el IMC/E con el LN. En el análisis multivariado, el aumento de peso gestacional se asoció con LN, diabetes con PN y CN, y la hipertensión con el retraso del crecimiento en los dos primeros años de vida. Llegamos a la conclusión de que los factores prenatales pueden afectar tanto al peso como a la LN, provocando el nacimiento de niños pequeños o grandes para la edad gestacional, lo que afecta el crecimiento de estos en los dos primeros años de vida.

(Nutr Hosp. 2015;31:2487-2495)

DOI:10.3305/nh.2015.31.6.8846

Palabras clave: *Desarrollo fetal. Peso al nacer. Estado nutricional. Nutrición del lactante.*

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Recibido: 12-II-15.
1.ª Revisión: 8-III-15.
Aceptado: 10-III-15.

Abbreviations

BMI: Body Mass Index.
BMI/A: Body Mass Index for Age.
H/A: Height for Age.
W/A: Weight for Age.
BW: Birth Weight.
BL: Birth Length.
IOM: Institute of Medicine.
WHO: World Health Organization.
OR: Odds ratio.
CI: Confidence Intervals.

Introduction

The eating habits of the Brazilian population have been changing in recent decades because of the increased consumption of junk food and reduced consumption of legumes, vegetables, and fruits¹. In addition, junk food has been offered to children at an increasingly younger age². These changes result in a nutritional transition process. That is, lower prevalence of nutritional deficits and higher prevalence of overweight and obesity³ in increasingly younger age groups, with earlier onset of complications related to overweight, such as type 2 diabetes (DM2), high blood pressure and dyslipidemia⁴.

Several studies have shown a strong association between low birth weight and development of chronic diseases in adulthood⁵⁻⁶. The predominant explanation for this association is Barker's hypothesis, also known as the thrifty phenotype hypothesis. Barker suggests that the fetus is able to adapt to adverse intrauterine environment, optimizing the use of reduced energy supplies to ensure survival. However, this adaptive process may lead to the metabolic benefit of certain organs at the expense of others. This causes persistent changes in tissue growth and function, thus contributing to an increased risk of chronic diseases in adulthood⁵.

Maternal prepregnancy nutritional status or insufficient weight gain during pregnancy, as well as other risk factors, such as smoking, use of alcohol and drugs, height, parity, age, size of the placenta, and presence of maternal diseases (high blood pressure, diabetes), may interfere with intrauterine growth, leading to the birth of small-for-gestational-age children⁷ and a greater chance of developing chronic diseases in adulthood⁵.

However, most studies on factors affecting intrauterine growth have focused more on birth weight than on birth length. Nevertheless, current evidence shows that birth length is a strong predictor of future height and may be related to early death in adulthood⁸. Thus, the objective of the present study was to investigate the association of prenatal factors with birth weight and length, as well as current nutritional status, of children hospitalized at a teaching hospital in Porto Alegre, Rio Grande do Sul, Brazil.

Methods

The present study is part of a larger cross-sectional study entitled "Maternal knowledge about feeding in the first years of life and its relationship to the introduction of complementary foods to children aged 4-24 months hospitalized at a tertiary hospital in Porto Alegre," conducted in Porto Alegre, Rio Grande do Sul, Brazil.

Our sample included female and male children whose mothers were with them at the hospital. Children's age ranged from 4 to 24 months and they were treated at the inpatient unit or emergency department of the Hospital de Clínicas de Porto Alegre between March 2012 and July 2013. Patients whose mothers were not present, who were using enteral and parenteral nutrition therapy, those with a chronic complication that could interfere with feeding and growth, such as neurological and genetic diseases, allergies, and/or food intolerances, were excluded from the study. In addition, we also excluded mothers younger than 18 years old who were not accompanied by their legal guardians, illiterate mothers, and those who were recommended not to breastfeed, such as HIV-positive mothers and those being treated for cancer.

The sample size was calculated based on another study conducted at a teaching hospital in São Paulo⁹. Using a 95% confidence interval, a margin of error of 5%, a statistical power of 80%, and considering that a weight gain during pregnancy < 7 kg is associated with prevalence of low birth weight newborns when compared with adequate weight gain during pregnancy (15.8 vs. 2.5%), we calculated a minimum of 300 mother-child pairs.

Resident nutritionists and undergraduate students of nutrition were trained to collect the anthropometric data and to administer the questionnaire related to the variables of interest. The variables related to prenatal care were: prepregnancy BMI, weight gain during pregnancy, smoking and/or drinking habits, use of illicit drugs, presence of diabetes or gestational diabetes, and chronic high blood pressure or preeclampsia. The variables related to the children were: sex, gestational age, birth weight and length, body mass index for age (BMI/A), height for age (H/A), and weight for age (W/A). Birth data were preferably collected from the children's health booklets.

The classification criteria suggested by Alexander et al. (1996)¹⁰ were used for birth weight, and the criteria by Olsen et al. (2010)¹¹ was used for birth length considering children born at term. Preterm infants were evaluated and classified according to Fenton & Kim (2013)¹². Considering both birth weight and length, those children who were below the 10th percentile were classified as small for gestational age (SGA), those between the 10th and 90th percentiles were classified as appropriate for gestational age (AGA), and those above the 90th percentile were considered large for gestational age (LGA).

Children's current nutritional status was assessed based on weight and length collected from their medical records. The curves for H/A, BMI/A, and W/A of the 2007 World Health Organization (WHO). Z-score was used considering the following cutoff points for BMI/A: < -2.00 standard deviation (SD) = underweight, ≥ -2.00 and $< +2.00$ SD = normal weight, and $\geq +2.00$ SD = overweight. The cutoff points for H/A were: < -2.00 SD = short height and ≥ -2.00 SD = appropriate height for age. The cutoff points for W/A were: < -2.00 SD = underweight for age, ≥ -2.00 and $< +2.00$ SD = appropriate weight for age, and $\geq +2.00$ SD = overweight for age. The cutoff points for W/A were: < -2.00 SD = underweight for age, between -2.00 and $+2.00$ SD = appropriate weight for age, and $> +2.00$ SD = overweight for age. Corrected age was used for the classification of preterm children.

Gestational weight gain, as well as the diagnosis of diabetes and hypertension were self-reported by mothers. In smoking, alcohol consumption and use of illicit drugs were considered only to the mother's statement as consumption during pregnancy, independent of dose and frequency. Maternal educational level was classified as up to 8 years of schooling, between 9 and 11 years of schooling, and over 12 years of schooling. Those mothers who had up to 8 years of schooling were considered to have a low educational level.

The weight reported by the mothers before pregnancy and the height measured on the day of data collection were used to calculate their prepregnancy BMI. The nutritional recommendations of the Institute of Medicine (2013)¹³ for pregnant women were used to classify the prepregnancy BMI.

Gestational weight gain was evaluated according to the recommendation of the IOM (2013)¹³ based on the prepregnancy nutritional status. For underweight pregnant women, a weight gain between 12.5 and 18.0 kg was considered adequate; for those with normal weight, a gain between 11.5 and 16.0 kg was considered appropriate; for overweight pregnant women, between 7.0 and 11.5 kg was an appropriate gain; and finally the obese women were expected to gain from 5.0 to 9.0 kg. Those values below the minimum recommended value were considered to be insufficient weight gain and the values above the recommended maximum value were considered to be excessive weight gain.

The statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 18.0. Univariate analysis was used to express the frequency of prenatal factors. The association of birth weight, birth length, and current nutritional status with prenatal variables was tested using Pearson's chi-square test or Fisher's exact test. Those variables showing a p -value < 0.20 in the univariate analysis were included in the multivariate analysis using logistic regression. The estimates were expressed as odds ratios (OR) and confidence intervals (CI). The level of significance was set at 0.05.

The present study was conducted according to the Guidelines and Regulatory Standards of Research Involving Humans Subjects (Resolution 196/96) and it was approved by the Research and Graduate Studies Group (GPPG) and Ethics Research Committee (CEP) of the Hospital de Clínicas de Porto Alegre (HCPA), protocol number 12-0080 (CEP-HCPA). Confidentiality of all participants' personal data was ensured.

Results

Three-hundred and four mother-child pairs were included in the study. Four pairs were excluded because

Table I
Characteristics of the sample and nutritional status of children between 4 and 24 months hospitalized at hospital in southern Brazil

Variables	n	%
Sex		
Male	178	59.3
Female	122	40.7
Gestational Age		
< 37 weeks	48	16.0
≥ 37 weeks	252	84.0
Birth weight		
SGA	47	15.9
AGA	217	73.3
LGA	32	10.8
Birth length		
SGA	85	28.9
AGA	198	67.3
LGA	11	3.7
BMI for age		
Underweight	13	4.4
Normal weight	236	78.7
Overweight	51	17.0
Height for age		
Short height	56	18.7
Appropriate height	244	81.3
Weight for age		
Underweight	22	7.3
Appropriate weight	257	85.7
Overweight	21	7.0

SGA = small for gestational age; AGA = appropriate for gestational age; LGA = Large for gestational age; BMI = body mass index.

of incomplete data. Therefore, the final sample consisted of 300 mother-child pairs.

Table II <i>Prenatal data and characteristics of mothers of children between 4 and 24 months hospitalized at hospital in southern Brazil</i>		
<i>Variables</i>	<i>n</i>	<i>%</i>
Maternal age		
≤ 19 years	48	16.0
20-34 years	221	73.7
≥ 35 years	31	10.3
Maternal educational level		
≤ 8 years	124	41.5
9-11 years	151	50.5
≥ 12 years	24	8.0
Parity		
Primiparity	111	37.0
Multiparity	189	63.0
Prepregnancy BMI		
Underweight (<18.5 kg/m ²)	15	7.0
Normal weight (18.5-24.9 kg/m ²)	127	59.6
Overweight (25-29.9 kg/m ²)	50	23.5
Obesity (>30 kg/m ²)	21	9.9
Gestational weight gain		
Insufficient	68	31.9
Appropriate	52	24.4
Excessive	93	43.7
Smokers		
Yes	72	24.0
No	228	76.0
Drug use		
Yes	4	1.3
No	296	98.7
Alcohol use		
Yes	29	9.7
No	271	90.3
High blood pressure		
Yes	52	17.3
No	248	82.7
Diabetes		
Yes	13	4.4
No	285	95.6

BMI = body mass index.

Table I describes the children's characteristics. The sample consisted of mean age was 9.62 months (± 5.07). The mother's characteristics are described in table II. Maternal age ranged from 16 to 45 years (mean 26.29 ± 08.06 years). Regarding diseases during pregnancy, 52 (17.3%) mothers had high blood pressure, and five of them (9.4%) were hypertensive before pregnancy; in addition, 13 (4.4%) mothers had diabetes, and two of them (15.4%) had type 1 diabetes before pregnancy.

In relation to the prenatal factors associated with anthropometric measures at birth (Table III), we found a statistically significant association between birth weight SGA with insufficient gestational weight gain and smoking, and excessive gestational weight gain with birth weight LGA. The univariate analysis showed that prepregnancy BMI and gestational weight gain were possibly associated with birth length and gestational diabetes, as well as birth weight and length. After performing the logistic regression, we found an association of gestational diabetes with birth weight ($p = 0.04$, OR = 0.27, 95% CI = 0.07-0.95) and an association of gestational weight gain ($p = 0.04$, and OR = 2.15, 95% CI = 1.004-4.62) and diabetes ($p = 0.01$, OR = 12.06, 95% CI = 0.006-0.55) with birth length. Thus, children of mothers who had insufficient weight gain during pregnancy have greater chance (OR = 2.15) of being SGA at birth when considering birth length. In addition, children born to mothers with gestational diabetes are more likely to be LGA at birth when considering both birth weight and length. When the anthropometric measures at birth are associated with the current nutritional status, we found that short H/A was associated both with birth weight and length SGA, whereas low W/A was associated with the birth of SGA infants, considering only the birth weight. Furthermore, it was observed that infants born SGA according birth length were overweight (BMI / I) within the first two years of life.

No statistically significant associations were found between children's prenatal factors and current nutritional status according to the univariate analysis (Table IV). However, after logistic regression, gestational high blood pressure was associated with H/A, demonstrating that children born to mothers with high blood pressure during pregnancy are four times more likely (OR = 5.46, 95% CI: 1.21-24.71) to have short height in the first two years of life, regardless of prepregnancy BMI and weight gain during pregnancy.

Discussion

Birth weight is a strong predictor of perinatal mortality and morbidity¹⁸ and development of chronic diseases in adulthood⁵. The global prevalence of low birth weight infants is 14%¹⁴ and in southern Brazil is 13% of SGA newborns¹⁵. The prevalence of SGA infants in our study was approximately 16%, higher than the ra-

Table III
Prenatal factors and current nutritional status associated with birth weight and length of children between 4 and 24 months hospitalized at hospital in southern Brazil

Variables	Birth Weight						<i>p</i> ^a	Birth length						<i>p</i> ^a
	SGA		AGA		LGA			SGA		AGA		LGA		
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Maternal age							0.31							0.88
≤ 19 years	12	25.5	29	13.4	6	18.8		15	17.6	31	15.7	1	9.1	
20-34 years	31	66.0	165	76.0	23	68.8		61	71.8	147	74.2	8	72.7	
≥ 35 years	4	8.5	23	10.6	4	12.5		9	10.6	20	10. ¹	2	18.2	
Parity							0.63							0.30
Primiparity	16	34.0	84	38.7	10	31.3		27	31.8	80	40.4	3	27.3	
Multiparity	31	66.0	133	61.3	22	68.8		58	68.2	118	59.6	8	72.7	
Prepregnancy BMI							0.44							0.11 ^c
Underweight	4	11.1	11	7.1	0	0		8	12.7	7	5.0	0	0	
Appropriate	22	61.1	90	58.1	14	70.0		34	54.0	89	63.1	2	40.0	
Overweight	9	25.0	37	23.9	3	15.0		17	27.0	31	22.0	1	20.0	
Obesity	1	2.8	17	11.0	3	15.0		4	6.3	14	9.9	2	40.0	
Gestational weight gain							0.001 ^b							0.07 ^c
Insufficient	18	50.0	46	29.7	3	15.0		27	42.9	37	26.2	2	40.0	
Appropriate	6	16.7	45	29.0	1	5.0		11	17.5	41	29.1	0	0	
Excessive	12	33.3	64	41.3	16	80.0		25	39.7	63	44.7	3	60.0	
Smokers							0.001 ^b							0.37
Yes	22	46.8	42	19.4	7	21.9		25	29.4	44	22.2	2	18.2	
No	25	53.2	175	80.6	25	78.1		60	70.6	154	77.8	9	81.8	
Drug use							0.74							1.00
Yes	1	2.1	2	0.9	1	3.1		1	1.2	3	1.5	0	0	
No	46	97.9	215	99.1	31	96.9		84	98.8	195	98.5	11	100	
Alcohol use							0.23							0.93
Yes	7	14.9	21	9.7	1	3.1		9	10.6	19	9.6	1	9.1	
No	40	85.1	196	90.3	31	96.9		76	89.4	177	90.4	10	90.9	
High blood pressure							0.55							0.46
Yes	6	12.8	39	18.0	7	21.9		12	14.1	34	17.2	5	45.5	
No	41	87.2	178	82.0	25	78.1		73	85.9	164	82.8	6	54.5	
Diabetes							0.07 ^c							0.07 ^c
Yes	1	2.1	8	3.7	4	12.5		2	2.4	8	4.1	2	18.2	
No	46	97.9	207	96.3	28	87.5		82	97.6	189	95.9	9	81.8	
BMI for age							0.70							0.04 ^b
Underweight	2	4.3	11	5.1	0	0		6	7.1	6	3.0	1	9.1	
Normal weight	38	80.9	170	78.3	25	78.1		59	69.4	163	82.3	10	90.9	
Overweight	7	14.9	36	16.6	7	21.9		20	23.5	29	14.6	0	0	
Height for age							0.02 ^b							0.02 ^b
Short height	15	31.9	36	16.6	4	12.5		24	28.2	30	15.2	1	9.1	
Appropriate height	32	68.1	181	83.4	28	87.5		61	71.8	168	84.8	10	90.9	
Weight for age							0.02 ^b							0.07 ^c
Underweight	9	19.1	12	5.6	1	3.1		12	14.2	10	5.0	0	0	
Appropriate weight	37	78.7	188	86.6	29	90.6		66	77.6	176	88.9	10	90.9	
Overweight	1	2.1	17	7.8	2	6.3		7	8.2	12	6.1	1	9.1	

^aChi-square test or Fisher's exact test. ^bStatistically significant association (*p*<0.05). ^cAssociation analyzed using logistic regression. BMI = body mass index; SGA = small for gestational age; AGA = appropriate for gestational age; LGA = large for gestational age.

Table IV
Prenatal factors associated with the current nutritional status of children hospitalized at hospital in southern Brazil

Variables	BMI for age						Height for age						Weight for age											
	Underweight			Normal weight			Overweight			Low			Appropriate			Underweight			Appropriate weight			Overweight		
	n	%		n	%		n	%		n	%		n	%		n	%		n	%		n	%	
Maternal age																								
	2	15.4	41	17.4	5	9.8				10	17.9	38	15.6			7	31.8	38	14.8	3	14.3			0.16 ^b
	11	84.6	171	72.5	39	76.5				38	67.9	183	75.0			13	59.1	194	75.5	14	66.7			
	0	0	24	10.2	7	13.7				8	14.3	23	9.4			2	9.1	25	9.7	4	19.0			
Parity																								
Primiparity	3	23.1	92	39.0	16	31.4				17	30.4	94	38.5			9	40.9	91	35.4	11	52.4			0.27
Multiparity	10	76.9	144	61.0	35	68.6				39	69.6	150	61.5			13	59.1	166	64.6	10	47.6			
Pregpregnancy BMI																								
	2	20.0	9	5.5	4	10.5				5	12.2	10	5.8			4	21.1	9	5.1	2	11.8			0.15 ^b
	3	30.0	103	62.4	21	55.3				19	46.3	108	62.8			8	42.1	109	61.5	10	58.8			
	5	50.0	37	22.4	8	21.1				14	34.1	36	20.9			6	31.6	40	22.6	4	23.5			
	0	0	16	9.7	5	13.2				3	7.3	18	10.5			1	5.3	19	10.7	1	5.9			
Gestational weight gain																								
	2	20.0	53	32.1	13	34.2				15	36.6	53	30.8			10	52.6	50	28.2	8	47.1			0.08 ^b
	2	20.0	44	26.7	6	15.8				9	22.0	43	25.0			2	10.5	48	27.1	2	11.8			
	6	60.0	68	41.2	19	50.0				17	41.5	76	44.2			7	36.8	79	44.6	7	41.2			
Smokers																								
Yes	1	7.7	56	23.7	15	29.4				17	30.4	55	22.5			6	27.3	58	22.6	8	61.9			0.27
No	12	92.3	180	76.3	36	70.6				39	69.6	189	77.5			16	72.7	199	77.4	13	38.1			
Drug use																								
	0	0	3	1.3	1	2.0				0	0	4	1.6			0	0	3	1.2	1	4.8			0.27
No	13	100	233	98.7	50	98.0				56	100	240	98.4			22	100	254	98.8	20	95.0			
Alcohol use																								
	0	0	23	9.7	6	11.8				3	5.4	26	10.7			0	0	25	90.3	4	19.0			0.09 ^b
Yes	13	100	213	90.3	45	88.2				53	94.6	218	89.3			22	100	232	9.7	17	81.0			
High blood pressure																								
	2	84.6	42	17.8	8	15.7				5	8.9	47	19.3			2	9.1	46	17.9	4	19.0			0.57
No	11	15.4	194	82.2	43	84.3				51	91.1	197	80.7			20	90.9	211	82.1	17	81.0			
Diabetes																								
	0	0	13	5.5	0	0				3	5.4	10	4.1			0	0	13	5.1	0	0			0.55
Yes	12	100	222	94.5	51	100				53	94.6	232	95.9			22	100	242	94.9	21	100			
No																								

^aChi-square test or Fisher's exact test. ^bAssociation analyzed using logistic regression. BMI = body mass index.

tes found in other studies, possibly because our sample included only hospitalized children.

In present study, the prevalence of women who smoked during pregnancy was 24%, showing a statistically significant association with SGA infants according to birth weight. In agreement with these findings, regional study found similar prevalence¹⁵. It is known that the risk factors for low birth weight, maternal smoking is one of the most important modifiable factors¹⁶, since tobacco use during pregnancy is an independent determinant of infant mortality and is associated with reduced birth weight^{15,17} and birth length¹⁵. The mechanisms involved with the effects of maternal smoking during pregnancy on intrauterine fetal growth are not yet fully understood. However, there is evidence that smoking during pregnancy may be associated with higher blood pressure, cardiovascular diseases, altered lipid profile, and weight gain from childhood to adulthood. Nicotine is a teratogen that can induce vasoconstriction in the uterus and placenta, thus reducing blood flow and supply of oxygen and nutrients to the fetus, affecting growth and development¹⁶.

Insufficient gestational weight gain was also associated with SGA babies, considering both weight and length at birth (OR=2.15, CI=1.00-4.62). A recent study showed that low prepregnancy BMI, an independent and combined effect with weight gain during pregnancy, was associated with SGA infants;¹⁸ in addition, the authors found that there was a 2.23 higher chance of infant mortality, regardless of gestational age, low birth weight, maternal age, maternal educational level, and maternal race¹⁹. These findings corroborate the theory of Barker (1995), which suggests that a limited intrauterine environment, both due to maternal malnutrition and insufficient weight gain during pregnancy, induces the fetus to adapt to malnutrition by means of metabolic changes, redistribution of blood flow, and changes in the production of fetal and placental hormones that control growth, resulting in slow growth, associating so low birth weight to development of chronic diseases in adulthood⁵. Current evidence also suggests that birth length is associated with an increase of 1.63cm in height at age 11, regardless of birth weight, thus demonstrating that birth length is a strong predictor of future height⁸.

Although our study has also found no association between prepregnancy maternal obesity and birth weight and length and current nutritional status of infants, we found that excessive weight gain during pregnancy may be associated with LGA infants considering birth weight. The percentage of mothers with excessive weight gain during pregnancy was 43.7%, and 33.4% of mothers were overweight or obese before pregnancy. Corroborating our findings, Brazilian study found high prevalence of women with excessive weight gain during pregnancy and overweight and obesity in early pregnancy²⁰. Excessive weight gain during pregnancy in mothers with normal prepregnancy BMI was also associated with increased birth weight and incidence of fetal

macrosomia²¹, in addition to overweight and increased adiposity at age five, controlling for socioeconomic factors, family lifestyle, birth weight for gestational age, and breastfeeding²². These figures are a reason for concern because obesity in women of childbearing age and during pregnancy has been increasing over the last 20 years²³. Furthermore, obesity during pregnancy may result in adverse effects for both mother, such as increased mortality, preeclampsia and gestational diabetes, and the baby, such as being LGA at birth and higher risk of developing chronic diseases throughout life²⁴.

Gestational diabetes was associated with the birth of LGA infants classified according to birth weight and length. The association of gestational diabetes with excessive birth weight is already well established in the literature. In agreement with these findings, a study conducted in Rio Grande do Sul involving 7,760 children also found this association²⁵. However, our findings suggest that gestational diabetes is associated with longer birth length, although we could not find studies in the literature evaluating this association. In addition, recent evidence suggests that prenatal exposure to diabetes accelerates the increase in BMI in late childhood (between 10 and 13 years), regardless of socioeconomic factors and prepregnancy BMI²⁶.

In terms of current nutritional status, we found the following associations: birth weight (SGA) and low weight for age (W/A), birth weight and length (SGA) and short height for age (H/A), and birth length (SGA) and overweight in the first two years of life. A study conducted in Pelotas (RS), Brazil, also found a higher percentage of children with short H/A and low W/A at the end of the first year of life among low birth weight children²⁷. Approximately 10% of SGA children remain below two standard deviations of height during childhood, adolescence, and adulthood. Although more than 80% of them catch up growth during the first six months of life and most of them reach above two standard deviations height at age 2. However, SGA preterm babies may take longer to catch up than babies born at term⁷.

Recently, short height gained international attention when, in May 2012, the World Health Organization (WHO) adopted a resolution on maternal-infant health and nutrition that included six global goals to reduce the high rate of diseases associated with malnutrition, particularly during the critical period from conception to 24 months of age. The first goal is related to short height and it aims to reduce by 40% the number of children with short height under 5 years old by 2025. This problem affects a large numbers of children worldwide and brings consequences for health in the long term, including cognition and learning deficits, loss of productivity and, when there is also excessive weight gain during childhood, increased risk of chronic diseases²⁸. It is estimated that about 20% of a 10 cm height deficit at 3 years old is already present at birth²⁹. In addition, a cohort study from Pelotas (RS), Brazil, showed a mean difference of 3 cm in the height of 2,106 boys and

1,947 girls in the first four years of life between extreme categories of maternal educational level, which represents 2.9% of the mean height of those children from mothers with higher educational level. This difference was observed since birth and it increased in the first two years of life³⁰. This evidence may explain the high prevalence of short height (18.7%) found in our study, as 15.9% and 28.9% were classified as SGA according to birth weight and length, respectively, and because it is a maternal sample where nearly half of the mothers had low educational level (41.5%).

Despite the nutritional risk of SGA children in the first years of life, special attention is needed, since low birth weight *per se* is not responsible for the increased risk of developing diseases later in adulthood; instead fast catch-up growth after birth may prompt the development of diseases³¹. New evidence suggests that SGA children whose growth rate is higher during the first years of life have a greater chance of obesity later in childhood³², which is in agreement with our findings, since those children who were born SGA considering their length were overweight in the first years of life. In particular, low birth weight babies are highly likely to be overfed, leading to rapid weight gain, which is positively related to overweight in adulthood. A study conducted in India showed that over 70% of mothers added complementary foods to the diet of infants at six weeks of age and 80% did so to the diet of infants at four months of age because they believed that their babies “were not growing enough” with exclusive breastfeeding³³. Also, traditionally, in many societies and cultures, “chubby” babies are considered to be healthy. This deeply rooted belief leads mothers to make all possible efforts to improve weight gain in early postnatal life³⁴.

Another association with current nutritional status found in our study was that high blood pressure during pregnancy is a risk factor for short height. A study conducted in the same hospital comparing preterm very low birth weight infants from mothers with preeclampsia with controls found that those children born to mothers with preeclampsia did not show the catch-up weight gain in the first 18 months of corrected age³⁵. This finding could explain this possible association, since high blood pressure during pregnancy is associated with SGA newborns;⁷ and in the present study we found a prevalence of 12.8% and 14.1% of SGA children according to birth weight and length, respectively, from mothers with high blood pressure.

However, it is worth considering some limitations of the present study: cross-sectional design; sample size, since variables such as prepregnancy BMI, BMI/A, and W/A showed possible trend of association with birth length in the univariate analysis, however we could not analyze this in the multivariate analysis because of lack of children within each category. This was also true regarding the association between W/A and alcohol consumption during pregnancy, possibly because some mothers did not report alcohol intake as its consumption is not recommended during pregnan-

cy. Furthermore, recall bias must be considered because maternal variables such as weight before pregnancy and gestational weight gain were mostly reported by mothers. Nevertheless, it is worth noting that the heterogeneity of the sample makes it possible to extrapolate our data to other individuals in the same age group. It is also noteworthy that data collection was conducted by a trained research team and we used instruments and techniques that have been validated internationally and nationally.

Thus, we conclude that prenatal factors such as insufficient gestational weight gain and smoking are risk factors for the birth of SGA children considering birth weight and/or length, and these children have low weight and height for age and are overweight (BMI/A) in the first two years of life. Conversely, excessive weight gain during pregnancy and gestational diabetes were considered risk factors for the birth of LGA children considering birth weight and/or length. In addition, high blood pressure during pregnancy was shown to be a risk factor for short height in the first two years of life.

Therefore, it is important to highlight that not only birth weight, but also birth length is influenced by the intrauterine environment and can be a predictor for the development of chronic diseases in adulthood. Thus, cohort studies investigating birth length are needed to identify this long-term influence. Furthermore, during the prenatal period, it is important to detect the risk factors for the birth of children with inappropriate weight and length for gestational age (SGA and LGA). We expect that such knowledge makes it possible to plan prenatal care that effectively includes actions to reduce the nutritional inadequacies during pregnancy and to prevent the development of chronic diseases in adulthood.

Acknowledgement

The authors would like to thank Audrey Machado dos Reis, Luiza Oldenburg and Graziela Parnoff Pereira Baladão for helping to conduct this research. The authors are also thankful for the statistical support provided by the Graduate and Research Group (GPPG) of the Hospital de Clínicas de Porto Alegre (HCPA).

Financial support

Research Incentive Fund (FIPE) of the HCPA.

Conflict of interests

The authors have no conflict of interest to declare.

References

1. Brasil. Ministério da Saúde. *Guia alimentar para a população brasileira: promovendo a alimentação saudável*. 1ª ed. Brasília 2006; p. 128 e 140.

2. Fox MK, Pac S, Devaney B, Jankowski L. Feeding Infants and Toddlers Study: What Foods are Infants and Toddlers Eating? *J Am Diet Assoc* 2004; 104(1), 22-30.
3. Wang Y, Monteiro C, Popkin BM. Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. *American Journal of Clinical Nutrition* 2002; 75(6), 971-77.
4. Gomes S, Espanca R, Gato A, Miranda C. Obesidade em idade pré-escolar – cedo demais para pesar demais! *Acta Medica Portuguesa* 2010; 23(3), 371-378.
5. Barker DJP. Fetal origins of coronary heart disease. *BMJ* 1995; 311, 171–174.
6. Hernández MI & Mericq V. Metabolic syndrome in children born small-for-gestational age. *Arq Bras Endocrinol Metab* 2011; 55(8), 583-589.
7. Saenger P, Czernichow P, Hughes I, Reiter EO. Small for Gestational Age: Short Stature and Beyond. *Endocrine Reviews* 2007; 28(2), 219–51.
8. Araújo CLP, Hallal PC, Nader GA, Menezes AMB, Victora CG. Size at birth and height in early adolescence: a prospective birth cohort study. *Cad Saúde Pública* 2008; 24(4), 871-78.
9. Minagawa AT, Biagoline REM, Fujimori E et al. Baixo peso ao nascer e condições maternas no pré-natal. *Rev Esc Enferm USP*. 2006; 40(4), 548-54.
10. Alexander GR, Himes JH, Kaufman RB, Mor J, Kogan M. A United States national reference for fetal growth. *Obstet Gynecol* 1996; 87(2), 163-8.
11. Olsen IE, Groveman SA, Lawson ML, Clark RH, Zemel BS. New Intrauterine Growth Curves Based on United States Data. *Pediatrics* 2010; 125(2), 214-24.
12. Fenton TR & Kim JH. A systematic review and meta-analysis to revise the Fenton growth chart for preterm infants. *BMC Pediatrics* 2013; 13, 59.
13. Institute of Medicine. *Guidelines on Weight Gain and Pregnancy* National Academy. 2013.
14. Boguszewski MCS, Mericq V, Bergada I et al. Latin American Consensus: Children Born Small for Gestational Age. *BMC Pediatrics* 2011; 11, 66.
15. Zhang L, González-Chica DA, Cesar JA et al. Tabagismo materno durante a gestação e medidas antropométricas do recém-nascido: um estudo de base populacional no extremo sul do Brasil. *Cad Saúde Pública* 2011; 27(9), 1768-1776.
16. Bakker H. & Jaddoe VWV. Cardiovascular and metabolic influences of fetal smoke exposure. *Eur J Epidemiol* 2011; 26, 763–770.
17. Geib LTC, Fréu CM, Brandão M, Nunes ML. Determinantes sociais e biológicos da mortalidade infantil em coorte de base populacional em Passo Fundo, Rio Grande do Sul. *Ciência & Saúde Coletiva* 2010; 15(2), 363-70.
18. Bove I, Santander FM, Klaps L, Landa AD. Asociaciones entre el crecimiento prenatal y la antropometría materna en el Uruguay. *Nutr Hosp* 2014; 30, 643-649.
19. Davis RR & Hofferth SL. The Association Between Inadequate Gestational Weight Gain and Infant Mortality Among U.S. Infants Born in 2002. *Matern Child Health J* 2012; 16, 119–24.
20. Melo ASO, Assunção PL, Gondim SSR et al. Estado nutricional materno, ganho de peso gestacional e peso ao nascer. *Rev Bras Epidemiol* 2007; 10(2), 249-57.
21. Costa BMF, Paulinelli RR, Barbosa MA. (2012) Association between maternal and fetal weight gain: cohort study. *São Paulo Med J* 2012; 130(4), 242-247.
22. Hinkle SN, Sharma AJ, Swan DW et al. Excess Gestational Weight Gain Is Associated with Child Adiposity among Mothers with Normal and Overweight Prepregnancy Weight Status. *J Nutr* 2012; 142, 1851–58.
23. Factor-Litvak P. Maternal obesity and heart disease in the offspring: Interventions may need to begin before pregnancy. *BMJ* 2013; 347, 4960.
24. O'Reilly JR & Reynolds RM. The risk of maternal obesity to the long-term health of the offspring. *Clin Endocrinol* 2013; 78, 9-16.
25. Madi JM, Rombaldi RL, Filho PFO et al. Fatores maternos e perinatais relacionados à macrosomia fetal. *Rev Bras Ginecol Obstet* 2006; 28(4), 232-7.
26. Crume TL, Ogden L, Daniels S et al. The Impact of In Utero Exposure to Diabetes on Childhood Body Mass Index Growth Trajectories: The EPOCH Study. *J Pediatr* 2011; 158, 941-6.
27. Gigante DP, Victora CG, Araújo CLP, Barros FC. Tendências no perfil nutricional das crianças nascidas em 1993 em Pelotas, Rio Grande do Sul, Brasil: análises longitudinais. *Cad Saúde Pública* 2003; 19(1), 141-7.
28. Onis M de, Dewey KG, Borghi E et al. The World Health Organization's global target for reducing childhood stunting by 2025: rationale and proposed actions. *Maternal and Child* 2013; 9(2), 6-26.
29. Dewey KG & Begum K. Long-term consequences of stunting in early life. *Maternal and Child Nutr* 2011; 7(3), 5–18.
30. Matijasevich A, Howe LD, Tilling K et al. Maternal education inequalities in height growth rates in early childhood: 2004 Pelotas birth cohort study. *Paediatric and Perinatal Epidemiol* 2012; 26, 236–249.
31. Singhal A & Lucas A. Early origins of cardiovascular disease: is there a unifying hypothesis? *Lancet* 2004; 363, 1642-1645.
32. Jones-Smith JC, Neufeld LM, Laraia B et al. Early life growth trajectories and future risk for overweight. *Nutrition and Diab* 2013; 3, 60.
33. Oommen A, Vatsa M, Paul V, Aggarwal R. Breastfeeding practices of urban and rural mothers. *Indian Pediatr* 2009; 46, 891–4.
34. Jain V & Singhal A. Catch up growth in low birth weight infants: Striking a healthy balance. *Rev Endocr Metab Disord* 2012; 13, 141–7.
35. Silveira RC, Procianny RS, Koch MS, Benjamin ACW, Schlindwein CF. Growth and neurodevelopment outcome of very low birth weight infants delivered by preeclamptic mothers. *Acta Paediatrica* 2007; 96, 1738–42.



Original/Síndrome metabólico

Predictive factors of non-alcoholic steatohepatitis: relationship with metabolic syndrome

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Abstract

Non-alcoholic fatty liver disease (NAFLD) has been proposed as the hepatic manifestation of the metabolic syndrome (Ms), with insulin resistance (IR) as the common pathophysiological mechanism.

Methods: we included 145 patients with NAFLD proven liver biopsy. NAS-score was employed to grading NAFLD. We determined anthropometric measurements, basal blood pressure (BP), biochemical measurements including high lipoprotein cholesterol (HDL-Chol), low-density lipoprotein cholesterol (LDL-Chol), triglycerides and leptin levels, homeostasis model assessment index (HOMA-IR), and abdominal ultrasound scan (US) was performed. Diagnosis of Ms was performed based on ATP III criteria.

Results: average age was 43.6 + 11.2 years old and the mean body mass index (BMI) was 39 ± 10.7 kg/m². Sex distribution was: females 66 and males 79. Forty patients (27.5%) presented a NAS score ≥ 5. Waist circumference (p = 0.007), systolic and diastolic BP (p = 0.002 and p = 0.003 respectively), (HOMA-IR) (p < 0.0001), body mass index BMI (p = 0.04), Ms (p = 0.04) and US-NAFLD were significantly associated with NAS-score ≥ 5. Independent factors associated to NAS-score ≥ 5 were Ms and BMI > 30. Leptin levels were higher in patients with advanced fibrosis (≥ F2) compared to patients with mild fibrosis (F0-F1) (75.5 + 50.2 ng/ml vs - 39.7 + 38.4 ng/ml respectively; p = 0.002).

Conclusion: presence of Ms and obesity (BMI > 30) are the principal independent factors associated to NASH (NAS score ≥ 5). Leptin levels and BMI are higher in patients with advanced fibrosis.

(Nutr Hosp. 2015;31:2496-2502)

DOI:10.3305/nh.2015.31.6.8908

Key words: Non alcoholic steatohepatitis. Metabolic syndrome. Adipokines. Body mass index.

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Recibido: 1-III-2015.

Aceptado: 2-IV-2015.

FACTORES PREDICTIVOS DE ESTEATOHEPATITIS NO ALCOHÓLICA: PAPEL DEL SÍNDROME METABÓLICO

Resumen

La esteatohepatitis no alcohólica (EHNA) se ha propuesto como la manifestación hepática del síndrome metabólico (SM), con la resistencia a la insulina (IR) como mecanismo fisiopatológico común.

Métodos: se incluyeron 145 pacientes con biopsia hepática con enfermedad por hígado graso no alcohólica. NAS-score se utilizó para graduar la EHNA. Se realizaron las siguientes determinaciones; antropometría, presión arterial basal (BP), LDL colesterol, HDL colesterol, triglicéridos, leptina, resistencia a la insulina (HOMA-IR) y ecografía abdominal. El diagnóstico de síndrome metabólico se realizó en base a los criterios del ATP III.

Resultados: la edad fue 43,6 + 11,2 años y la media de índice de masa corporal (IMC) 39 + 10,7 kg/m² (66 mujeres y 79 varones). Cuarenta pacientes (27,5%) presentaron una puntuación NAS ≥ 5. La circunferencia de la cintura (p = 0,007), la presión arterial sistólica y diastólica (p = 0,002 y p = 0,003, respectivamente, la resistencia a la insulina (HOMA-IR) (p < 0,0001), IMC (p = 0,04), el SM (p = 0,04) y los datos ecográficos se asociaron significativamente con NAS-score ≥ 5. Los factores independientes asociados a NAS-score ≥ 5 fueron el SM y el IMC > 30. Los niveles de leptina fueron mayores en pacientes con fibrosis avanzada (≥ F2) en comparación con los pacientes con fibrosis leve (F0-F1) (75,5 + 50,2 ng / ml frente a 39,7 + 38,4 ng / ml, respectivamente; p = 0.002).

Conclusión: la presencia de SM y obesidad (IMC > 30) son los principales factores independientes asociados a la EHNA (puntuación NAS ≥ 5). Los niveles de leptina y el IMC son mayores en los pacientes con fibrosis avanzada.

(Nutr Hosp. 2015;31:2496-2502)

DOI:10.3305/nh.2015.31.6.8908

Palabras clave: Esteatohepatitis no alcohólica. Síndrome metabólico. Adipokinas. Índice de masa corporal.

Introduction

Non-alcoholic fatty liver disease (NAFLD) is recognized worldwide as the most common cause of chronic liver disease. The spectrum of the disease ranges from simple steatosis, which has a more benign course to the histological severe steatohepatitis (NASH), a pathological entity associated with an increased risk for developing cirrhosis and hepatocellular carcinoma¹.

Insulin resistance (IR) is a condition in which the cells of the body become resistant to the effects of insulin². IR can have important long-term consequences, including the development of type 2 diabetes mellitus (DM), cardiovascular disease, and certain malignancies that are associated with obesity and IR³. Fracanzani *et al.*⁴ and Mofrad *et al.*⁵ suggested that IR or diabetes could play a role in elevations of plasma alanine aminotransferase (ALT) levels in adults.

There is also an apparent association among IR, abdominal obesity, and a variety of abnormalities, such as type 2 DM, hypertension, an atherogenic lipid profile that includes hypertriglyceridemia and low serum high-density lipoprotein cholesterol (LDL/HDL-Chol) concentrations². This constellation of disorders is called metabolic syndrome (Ms). Non-alcoholic fatty liver disease (NAFLD) has been proposed as the hepatic manifestation of the Ms, with IR as the common pathophysiological mechanism⁶.

Additionally, the severity of insulin resistance correlates with liver histology in subjects with NAFLD^{7,8,9}.

However, NAFLD may also be encountered in non-obese, non-diabetic individuals⁸.

The pathogenesis of NAFLD has not been fully elucidated. The most widely supported theory implicates IR as the key mechanism leading to hepatic steatosis, and perhaps also to steatohepatitis. Also, other multiple hits as hepatic iron, leptin, antioxidant deficiencies, and intestinal bacteria have all been suggested as potential oxidative stressors; treatment with probiotic agents has demonstrated to reduce transaminases levels in patients with NAFLD¹⁰.

However, at the present time, given the large number of patients at risk (patients that are obese, have Ms, and/or type 2 DM), many clinicians still only consider a diagnostic liver biopsy in those with persistently elevated liver enzymes, when other liver condition have been excluded¹¹. Yet, it is still unknown why some patients have high BMI and presence of Ms while others do not. Moreover, several genes have been identified to be associated with these phenotypes and they could explain different manifestations of the same disease¹²⁻¹⁴.

The aim of this study is to evaluate the association of IR, Ms and BMI in relation to liver histology in patients with NAFLD.

Methods

Study population

We included a total of 145 individuals who were diagnosed of NAFLD using liver biopsy. These patients

were remitted to our hospital due to elevations of transaminases levels. Exclusion criteria were daily alcohol intake > 20 g (men) or > 10 g (women), history of diabetes, fasting hyperglycemia, positive serologic finding for hepatitis B or C virus, history of malignancy, stroke, cardiovascular disease or hepatectomy, any chronic use of medications other than vitamins, abnormal findings on ultrasound as intrahepatic bile duct dilatation, intrahepatic stone, liver nodule or mass, and other etiologic factors of chronic liver disease. We determined anthropometric measurements and abdominal ultrasound scan (US). A fasting blood sample was used to measure plasma aminotransferases, serum insulin, glucose HOMA-IR, lipid profile and adipokines levels. All individuals had a US performed as a part of their study.

Measurement of variables

Anthropometric measurements: Their height, weight, and waist circumferences were measured to the nearest half-cm or half-kg. The waist circumference was measured at the mid-point between the lower border of the rib cage and the iliac crest.

Laboratory evaluation included measurement of the ALT, fasting blood glucose, fasting insulin, total, cholesterol, HDL-Chol, LDL-Chol and triglycerides. IR was determined by homeostasis model assessment index (HOMA-IR), calculated using the computer-based solution of the model provided by the Diabetes Trials Unit, Oxford Center for Diabetes, Endocrinology, and Metabolism¹⁵. Plasma glucose levels were determined by using an automated glucose oxidase method (Glucose analyser 2, Beckman Instruments, Fullerton, California). Insulin was measured by RIA (RIA Diagnostic Corporation, Los Angeles, CA) with a sensitivity of 0.5m UI/L (normal range 0.5-30 mUI/L) and the HOMA was calculated using these values¹⁶.

Serum total cholesterol and triglyceride concentrations were determined by enzymatic colorimetric assay (Technicon Instruments, Ltd., New York, N.Y., USA), while HDL-Chol was determined enzymatically in the supernatant after precipitation of other lipoproteins with dextran sulfate-magnesium. Leptin was measured by ELISA (Diagnostic Systems Laboratories, Inc., Texas, USA) with a sensitivity of 0.05 ng/ml and a normal range of 10-100 ng/ml¹⁷. Adiponectin was measured by ELISA (R&D systems, Inc., Minneapolis, USA) with a sensitivity of 0.246 ng/ml and a normal range of 8.65-21.43 ng/ml¹⁸.

Definitions of Metabolic Syndrome

The diagnosis of Ms was based on the presence of three or more of the components listed by the revised Adult Treatment Panel (ATP III) of the National Cholesterol Education Program¹⁵.

These components include: 1) elevated waist circumference (waist circumference >90 cm in males or > 85 cm in females); 2) elevated triglyceride (> 150 mg/dl); 3) reduced HDL-Chol (< 40 mg / dl for men and < 50 mg / dl for women); 4) elevated blood pressure (> 130/85 mm Hg or the use of medication for hypertension); 5) elevated fasting glucose (> 100 mg/dl or the use of medication for hyperglycemia).

Histology

Liver histology (H & E and Masson's trichrome stain) was centrally reviewed by the Pathology Committee of the NASH CRN blinded to clinical data. Biopsies were scored for the following features according to NASH CRN criteria published by Kleiner *et al.*¹⁹:

Steatosis (grade 0 (< 5% macrovesicular fat in hepatocytes), grade 1 (5–33%), grade 2 (34–66%), grade 3(>66%)), lobular inflammation (0–2),hepatocellular ballooning (0–2),and fibrosis (stage 0, stage 1a (mild perisinusoidal), stage 1b (moderate perisinusoidal), stage 1c (portal / periportal fibrosis only), stage 2 (zone 3 and periportal), stage 3 (bridging fibrosis), stage 4 (cirrhosis)). A NAFLD activity score (NAS-score) was tabulated by summing the scores for steatosis, lobular inflammation, and ballooning degeneration (1–8 score possible). For regression analyses, all fibrosis stage 1 (1a, 1b, and 1c) biopsies 2 were combined and treated as mild stage, and stage 3 and 4 biopsies were combined and treated as advanced stage, and a categorical NAS score was defined as: 0 = 1–4 (reference), 1 = 5–8 NAS score of 0-2 occurred in cases largely considered not diagnostic of NASH; scores of 3-4 were divided among those considered not diagnostic borderline. Scores of 5-8 occurred in cases that were largely considered diagnostic of NASH^{20,21}.

Radiologic assessment

Findings of the ultrasonographic scan of upper abdomen were noted in all patients to assess the grade of fatty liver at presentation and to rule out other hepatic pathology. The severity of hepatic steatosis was graded in these patients based on previously published criteria²².Ultrasonographically detected-NAFLD (US-NAFLD) was defined when the ultrasonography revealed fatty liver. Fatty liver were diagnosed with the ultrasound based on known standard criteria, including parenchymal brightness, liver-to-kidney contrast, deep beam attenuation, and bright vessel walls²²⁻²³.

Statistic

Values were expressed as mean + SD or as a number (percentage).

The significance of the relationship between NASH and baseline characteristics or histology was determined from a Wilcoxon two-sample test for continuous variables, and either a χ^2 test for non-ordered categories, a Cochran-Armitage trend test for ordered categories, Fisher's exact test, or binary or multinomial logistic regression for categorical variables. Adjusted odds ratios or cumulative odds ratios of categorical histological feature with the presence of a component of MS were estimated from either a logistic (for binary outcomes), multinomial or ordinal logistic regression model. *P* values were determined from a likelihood ratio test. Regression models presented were adjusted for sex and age. A *p*-value <0.05 was considered significant. SPSS 15.0 (IL, USA) was used as statistical software.

Results

A total of 145 patients gave informed consents and were enrolled in the study. The mean age was 43.6 ±11.2 years old (range 18-67) an and the mean BMI 39±10.7 kg/m² (range 22-76) with 66 females and 79 males (Table I).

Table I
Clinical characteristics of 145 patients divided by NASH (NAS score ≥5)

	NAS score <4 (no NASH)	NAS score ≥5
Age (years)	44.2±10.6	43.4±12.4
Gender (n)(male/female)	55/24	50/16
WC (cm)	100±12.5	1.3.9±13
BP systolic (mmHg)	129.4±22.7	138.±22.5*
BP dyastolic (mmHg)	78.7±19.9	85.8±17.9*
HOMA-IR	3.4±2-6	4.6±2.9*
AST (IU/L)	35.4±22.9	39.6±25.6
ALT (IU(L)	52.9±41.6	67.9±41.9*
Total Chol (mg/dl)	181.8±52.1	186.4±39.3
Ldl-Chol (mg/dl)	110.6±41.7	111.9±34.7
Hdl-Chol (mg/dl)	43±13.8	45.5±26.4
BMI (Kg /m ²)	39.6±11.1	40.8±10.6
Leptin (ng/ml)	39.5±33	55.1±53.2*
Adiponectin (ng/ml)	14.9±19	13±20.8
Ms (n %)	44 (42%)	30 (75%)*

WC: waist circumference, TG: triglicerides, Total ch: total cholesterol, BP: blood pressure, AST: aspartate amino transpherase, ALT: alanine amino transpherase, BMI: body mass index, Ms: metabolic syndrome.

Serum albumin, iron parameters and prothrombin time was with the normal range in all patients.

The US examination of the abdomen revealed a fatty liver in 72 (50%) patients. None of the patients had features of portal hypertension.

Forty patients (27.5%) patients were classified as NASH (NAS score 5-8). The histopathologic features of patients are given in table II.

Univariate analysis results revealed that waist circumference ($p=0.007$), blood pressure systolic/diastolic ratio ($p=0.001$), HOMA-IR ($p<0.0001$), BMI ($p=0.04$), Ms ($p=0.05$) and US-NAFLD were significantly associated with $NAS \geq 5$ ($p<0.0005$) (Table III). Figure 1 shows relation between US-NAFLD findings and NAS score.

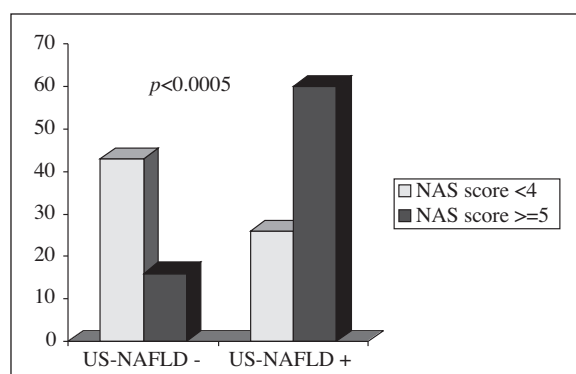


Fig. 1.–Relation between US-NAFLD findings and NAS score.

Table II
Histologic characteristics (n=145)

Histological parameter	Frequency n(%)		
	Grade 1	Grade 2	Grade 3
Steatosis	35(24.1%)	36(24.8%)	74(51%)
Balloning	128(88.2%)	17 (11.7%)	-
Lobular inflammation	48(33.1%)	58 (40%)	39 (26.8%)
Fibrosis	Stage 0 68(46.8%)	Stage 1 58(40%)	Stage 2 9(6.2%) Stage 3 10(6.8%)

Table III
Binary Lineal regression between independent factors and “definitive NASH” (score 5-8)

	OR	I.C. 95% para OR		Sig.
		Inferior	Superior	
Age	1.013	.985	1.041	0.366
Gender	1.189	.645	2.192	0.579
WC (cm)	1.065	1.017	1.115	0.007
TG (mg/dl)	1.003	.998	1.008	0.250
BP systolic	3.316	1.638	6.713	0.001
BP dyastolic	3.214	1.739	5.958	0.001
HOMA-IR	1.401	1.168	1.681	0.000
AST (UI/L)	1.004	.991	1.017	0.543
ALT (UI/L)	1.001	.994	1.009	0.699
Total Ch (mg/dl)	1.001	.995	1.008	0.661
Ldl-Ch (mg/dl)	1.003	.994	1.011	0.530
Hdl-Ch (mg/dl)	.996	.978	1.015	0.675
BMI	1.032	1.001	1.064	0.042
Leptin (ng/ml)	1.008	0.998	1.018	0.048
Adiponectin (ng/ml)	.989	.971	1.007	0.233
Ms	2.815	1.367	5.800	0.005

WC: waist circumference, TG: triglicerides, Total ch: total cholesterol, BP: blood pressure, AST: aspartate amino transperase, ALT: alanine amino transperase, BMI: body mass index, Ms: metabolic syndrome.

Table IV
Multivariate analysis of association between NASH (NAS score ≥ 5) and its independent predictors

	OR	I.C. 95% para OR	p
Ms	2.248	1.030 4.906	.042
BMI >30	2.436	1.077 5.506	.032

Multivariate analysis adjusted for gender and age including independent significant variables revealed that the only independent predictors of NAS ≥ 5 were Ms and BMI > 30 (Table IV).

Factors associated with fibrosis stage

An evaluation was carried out to identify factors associated with severe fibrosis (stages 2,3,4 vs stages 0 and 1 fibrosis). Univariate analysis revealed that HOMA-IR (3.6 ± 2.6 vs 5.1 ± 3.4 ; $p=0.03$), BMI (38.1 ± 10.4 Kg/m² vs 45.6 ± 10.1 Kg/m²; $p=0.004$), and leptine levels (39.7 ± 38.4 ng/ml vs 75.5 ± 50.2 ng/ml; $p=0.002$) were significantly associated with degree of fibrosis. Multivariate analysis adjusted for gender and age showed that the independent predictors of advanced fibrosis were leptin levels and BMI (Table V).

Discussion

In this study we have identified the factors associated to more advanced degree of NAFLD were central obesity determined by WC, BP systolic and diastolic, HOMA-IR, BMI, and Ms. However, multivariate analysis showed that independent predictors of definitive NASH were Ms and BMI >30 .

Non-alcoholic fatty liver disease represents the hepatic manifestation of the Ms. NAFLD pathological alterations, which range from simple steatosis to steatohepatitis, may lead to fibrosis and end stage liver disease²⁴. As its incidence parallels that of the Ms, NAFLD is currently becoming one of the first chronic liver diseases in Western countries and therefore has a major health impact²⁵.

In the same way, central obesity, which reflects visceral adiposity, it is often measured using the BMI and

various cut off values are proposed^{26,27,28}. Yet, BMI does not allow distinguishing central obesity, which is a metabolic disorder included in the MS, from peripheral obesity. In that sense, waist circumference appears to be more reliable and should be preferred²⁸.

Several studies have demonstrate a correlation between BMI, steatosis and NASH^{29,30}. Elevated splachnic serum free fatty acid levels and reduced hepatic insulin clearance play a role in the pathogenesis of diabetes, hyperlipedemia and hypertension in patients with central obesity.

The prevalence of US-NAFLD in this study was 51.1% which was significantly higher in patients with NAs score 5-8 (78.9%) in comparison with US-NAFLD in patients with NAs scores <5 (21.1%). These results are in agreement with results of study published by Sinn DH *et al.*³¹

The effect of BMI is similar to the results of Rocha and Fassio, and we suggested that BMI measurement is helpful for evaluation of NAFLD^{32,33}. As well as previous studies, BMI is predictor of NAFLD severity or it is significantly higher in the patients with fatty liver^{34,35}.

In our study we have observed a significant association between leptine levels and fibrosis stage. The relationship between leptin and hepatic fibrosis is controversial. Studies in vitro have clearly demonstrated a role in profibrogenic responses within the liver¹⁷. In accordance with our study, patients with NAFLD, and alcoholic liver disease have increased levels of circulating leptin³⁶. In NASH, leptin receptors become resistant to its effect leading to hyperleptinemia which alters insulin signaling and promotes accumulation of intracellular fatty acids in hepatocytes thereby increasing hepatic steatosis and steatohepatitis³⁶. Our study indicates that serum leptin levels are associated to advanced fibrosis in patients with NAFLD but it is not an independent predictor of NASH severity (evaluated by NAS score)³⁷. Similar findings have been reported previously³⁸.

Leptin is strongly associated with Ms and its components, which are indicators of metabolic disorders such as dyslipidemia, DM2, and hypertension³⁹.

In conclusion presence of Ms and obesity (BMI >30) are the principal independent factors associated to definitive NASH (NAS score ≥ 5). Leptin levels and BMI are higher in patients with avanced fibrosis. A US-NAFLD positive result is usefull to detect patients with NAFLD.

Tabla V
Multivariate analysis of association between fibrosis stage (mild: stage 0,1 vs. advanced: stage 2,3,4) and its independent predictors

	Regression coefficient	St error	t value	Significance	95% confidence interval
Leptine levels	0.4	0.02	1.05	0.009	1-1.2
BMI	0.4	0.2	1.6	0.01	1.1-2.8

Of course, for confirmation of this association, more comprehensive studies are needed.

Referencias

- Ong JP, Younossi ZM. Epidemiology and natural history of NAFLD and NASH *Clin Liver Dis* 2007;11:1-16.
- Bugianesi E, McCullough AJ, Marchesini G. Insulin resistance: a metabolic pathway to chronic liver disease. *Hepatology* 2005;42:987-1000.
- Grundey SM, Cleeman JI, Daniels SR *et al.* Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. *Circulation* 2005;112:2735-52.
- Fracanzani AL, Valenti L, Bugianesi E, Andreoletti M, Colli A, Vanni E, *et al.* Risk of severe liver disease in nonalcoholic fatty liver disease with normal aminotransferase levels: a role for insulin resistance and diabetes. *Hepatology* 2008;48:792-798.
- Mofrad P, Contos MJ, Haque M, Sargeant C, Fisher RA, Lukek VA, *et al.* Clinical and histologic spectrum of nonalcoholic fatty liver disease associated with normal ALT values. *Hepatology* 2003;37:1286-1292.
- Salamone F, Bugianesi E. Nonalcoholic fatty liver disease: the hepatic trigger of the metabolic syndrome. *J Hepatol* 2010;53:1146-50.
- Ryan MC, Wilson AM, Slavin J *et al.* Associations between liver histology and severity of the metabolic syndrome in subjects with nonalcoholic fatty liver disease. *Diabetes Care* 2005;28:1222-4.
- Marchesini G, Bugianesi E, Forlani G *et al.* Nonalcoholic fatty liver, steatohepatitis, and the metabolic syndrome. *Hepatology* 2003;37:917-23.
- R Aller, DA de Luis, D Pacheco, MC Velasco, O Izaola, MG Sagrado. Insulin resistance predicts steatosis and fibrosis in morbidly obese patients undergoing bariatric surgery. *J Investig Med* 2012; 60:1005-8.
- R Aller, DA de Luis, O Izaola, R Conde, M González Sagrado, D Primo, B de la Fuente, J González. Effect of a probiotic on liver aminotransferases in nonalcoholic fatty liver disease patients: a double blind randomized clinical trial. *Eur Rev Med Pharmacol Sci* 2011;15:1090-5.
- Chalasani N, Younossi Z, Lavine JE, Diehl AM, Brunt EM, Cusi k, *et al.* The diagnosis and management of non-alcoholic fatty liver disease: practice guideline by the American Association for the Study of Liver Diseases, American College of Gastroenterology, and the American Gastroenterological Association. *Hepatology* 2012; 55: 2005-2023.
- Romeo S, Kozlitina J, Xing C, Pertsemlidis A, Cox D *et al.* Genetic variation in PNPLA3 confers susceptibility to non-alcoholic fatty liver disease. *Nat Genet* 2008; 40: 1461-1465.
- DA de Luis, M Gonzalez Sagrado, R Aller, O Izaola, R Conde. Effects of C358A missense polymorphism of the endocannabinoid degrading enzyme fatty acid amide hydrolase on weight loss after a hypocaloric diet. *Metabolism Clinical and Experimental* 2011; 60:730-734.
- R Aller, DA de Luis, D. Pacheco, MC Velasco, R Conde, O Izaola, M González-Sagrado. Influence of G1359A polymorphism of the cannabinoid receptor gene (CNR1) on insulin resistance and adipokines in patients with non alcoholic fatty liver disease. *Nutr Hosp* 2012;27:1637-1640.
- Grundey SM, Cleeman JI, Daniels SR *et al.* Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. *Circulation* 2005;112:2735-52.
- Mathews DR, Hosker JP, Rudenski AS, *et al.* Homesostasis model assessment: insulin resistance and beta cell function from fasting plasma glucose and insulin concentrations in man. *Diabetologia* 1985;28:412-414.
- Meier U, Gressner M. Endocrine regulation of energy metabolism: review of pathobiochemical and clinical chemical aspects of leptin, Ghrelin, adiponectin, and resistin. *Clinical Chemistry* 2004;50:1511-1525.
- Suominen P. evaluation of an enzyme immunometric assay to measure serum adiponectin concentrations. *Clin Chem* 2004;50:219-221.
- Kleiner DE, Brunt EM, Van Natta M, *et al.* Design and validation of a histological scoring system for nonalcoholic fatty liver disease. *Hepatology* 2005; 41:1313-21.
- Kleiner DE, Behling CB, Brunt EM, *et al.* Comparison of adult and pediatric NAFLD confirmation of a second pattern of progressive fatty liver disease in children. *Hepatology* 2006;44:259A-60A.
- Brunt EM. Pathology of nonalcoholic steatohepatitis. *Hepatology Res.* 2005; 33:68-71. (PubMed:16214395).
- Hegen-Ansert SL (1996). Textbook of diagnostic ultrasonography. Mosby, Aliso Viejo.
- Hernaez R, Lazo M, Bonekamp S *et al.* Diagnostic accuracy and reability of ultrasonography for the detection of ultrasonography for the detection of fatty liver: A meta-analysis. *Hepatology* 2011 ;54:1082-90.
- Sinn DH¹, Gwak GY, Park HN, Kim JE, Min YW, Kim KM, Kim YJ, Choi MS, Lee JH, Koh KC, Paik SW, Yoo BC. Ultrasonographically detected non-alcoholic fatty liver disease is an independent predictor for identifying patients with insulin resistance in non-obese, non-diabetic middle-aged Asian adults. *Am J Gastroenterol* 2012 ;107:561-7.
- Agopian VG, Kaldas FM, Hong JC, Whittaker M, Holt C, Rana A, Zarrinpar A, Petrowsky H, Farmer D, Yersiz H, Xia V, Hiatt JR, Busuttil RW. Liver transplantation for nonalcoholic steatohepatitis: the new epidemic. *Ann Surg* 2012 ;256:624-33.
- Fierbinteanu-Braticevici C, Negreanu L, Tarantino G. Is fatty liver always benign and should not consequently be treated? *J Physiol Pharmacol* 2013; 64: 3-9.
- Cauchy F, Zalinski S, Dokmak S, Fuks D, Farges O, Castera L, Paradis V, Belghiti J. Surgical treatment of hepatocellular carcinoma associated with the metabolic syndrome. *Br J Surg* 2013;100:113-121.
- Bhayani NH, Hyder O, Frederick W, Schulick RD, Wolfgang CL, Hirose K, Edil B, Herman JM, Choti MA, Pawlik TM. Effect of metabolic syndrome on perioperative outcomes after liver surgery: A National Surgical Quality Improvement Program (NSQIP) analysis. *Surgery* 2012; 152: 218-226.
- Zarzavadjian Le Bian A, Costi R, Constantinides V, Smadja C. Metabolic disorders, non-alcoholic fatty liver disease and major liver resection: an underestimated perioperative risk. *J Gastrointest Surg* 2012; 16: 2247-2255.
- Neuschwander-Tetri BA, Caldwell SH (2003) Nonalcoholic steatohepatitis: summary of an American Association for the study of liver disease (AASLD) single topic conference. *Hepatology* 37:1209-1219.
- Brunt EM, Janney CG, Di Bisceglie AM, Neuschwanda-Tetri BA, Bacon BR (1999) Nonalcoholic steatohepatitis: a proposal for grading and staging the histological lesions. *Am J Gastroenterol* 94:2467-2474.
- Ultrasonographically detected non-alcoholic fatty liver disease is an independent predictor for identifying patients with insulin resistance in non-obese, non-diabetic middle-aged Asian adults.
- Sinn DH, Gwak GY, Park HN, Kim JE, Min YW, Kim KM, Kim YJ, Choi MS, Lee JH, Koh KC, Paik SW, Yoo BC. *Am J Gastroenterol* 2012 ;107:561-7.
- Prognostic impact of clinic and ambulatory blood pressure components in high-risk type 2 diabetic patients: the Rio de Janeiro Type 2 Diabetes Cohort Study. *J Hypertens* 2013 ;31:2176-86.
- Salles GF, Leite NC, Pereira BB, Nascimento EM, Cardoso CR. *J Hypertens* 2013 31(11):2176-86.
- Management of Dyslipidemia as a Cardiovascular Risk Factor in Individuals With nonalcoholic Fatty Liver Disease. Corey KE, Chalasani N. *Clin Gastroenterol Hepatol* 2013;17S1542-3565.
- Korah T.E, El-Sayed S, ElShafie M. K, Hammada G. E, Safan M. A. Significance of serum leptin and adiponectin levels in

- Egyptian patients with chronic hepatitis C virus associated hepatic steatosis and fibrosis. *World J Hepatol* 2013; 5: 74-81.
37. Kumar Singh D, Sakhuja P, Rastogi A, Singh A, Gondal R, Kumar Sarin S. Serum leptin levels correlate with body mass index but not with histologic disease severity in Indian patients with non-alcoholic steatohepatitis: A pilot study. *Indian J Med* 2013; 137 : 986-987.
38. Muñoz L. E., Cordero P., Torres L., Saucedo A. Y., Flores J. P., Segura J. J. Adipokines in a group of mexican patients with nonalcoholic steatohepatitis. *Ann Hepatol* 2009; 8: 123-128.
39. García Jiménez S, Bernal Fernández G, Martínez Salazar M F, Monroy Noyola A, Toledano Jaimes C, Meneses Acosta A, González Maya L, Aveleyra Ojeda E, Terrazas Meraz M A, Marie-Catherine B, Sánchez Alemán M A. Serum Leptin is Associated With Metabolic Syndrome in Obese Mexican Subjects. *Journal of Clinical Laboratory Analysis* 2015; 291:5-9.



Original/Síndrome metabólico

Valoración del perfil lipídico y de la densidad mineral ósea en pacientes trasplantados renales

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Resumen

Introducción: las alteraciones del metabolismo lipídico y del metabolismo mineral óseo son trastornos frecuentes entre los pacientes trasplantados renales, lo que contribuye a la aparición de enfermedades metabólicas y cardiovasculares que ponen en peligro la integridad del injerto.

Objetivo: describir y observar la evolución de las alteraciones de la densidad mineral ósea (DMO) y las alteraciones lipídicas en una población de pacientes trasplantados renales.

Material y método: en este trabajo se ha seguido a 119 pacientes de ambos sexos trasplantados renales, a los cuales se les realizaron mediciones pretrasplante y postrasplante durante cinco años de parámetros bioquímicos, mediciones antropométricas y de la densidad mineral ósea en columna lumbar, fémur y radio-cubital.

Resultados: durante los cinco años tras el trasplante se produce un importante aumento de parámetros bioquímicos, IMC, dislipemia, diabetes e hipertensión arterial. A los seis meses existe un alto porcentaje de pacientes con DMO patológica, aumentando un 4,1% al año del trasplante.

Conclusiones: tras el trasplante se produce un gran incremento de la hiperlipidemia que se asocia con un patrón característico de alteración de lípidos con elevación del colesterol total, lipoproteínas de baja densidad, lipoproteínas de alta densidad, así como el consiguiente aumento de los triglicéridos, a pesar del tratamiento con estatinas, lo que conlleva un aumento en los factores de riesgo de padecer diabetes, hipertensión arterial y enfermedades cardiovasculares; además se produce una pérdida de masa ósea, lo que conlleva un alto riesgo de sufrir fracturas graves, poniendo en peligro el injerto renal y la calidad de vida del paciente.

(Nutr Hosp. 2015;31:2503-2510)

DOI:10.3305/nh.2015.31.6.8719

Palabras clave: Trasplante renal. Alteraciones lipídicas. Hiperlipidemia. Hipertrigliceridemia. Antropometría. Densidad mineral ósea.

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Recibido: 24-I-2015.
Aceptado: 27-III-2015.

ASSESSMENT OF LIPID PROFILES AND BONE MINERAL DENSITY IN RENAL TRANSPLANT PATIENTS

Abstract

Introduction: alterations in lipid metabolism and bone mineral metabolism disturbances are common disorders among renal transplant patients, contributing to the apparition of oxidative metabolic and cardiovascular diseases that threaten the integrity of the graft.

Aims: describe and observe the evolution of alterations in bone mineral density (BMD) and lipid abnormalities in a population of kidney transplant patients.

Material and method: the samples consisted of 119 kidney transplant patients of both sexes, measurements were performed pretransplant and posttransplant for five years of biochemical parameters, anthropometric measurements and measurement of bone mineral density at the lumbar spine, femur and radioulnar.

Results: during the five years after transplantation a significant increase in biochemical parameters, BMI, dyslipidemia, diabetes and hypertension occurs. At six months there is a high percentage of patients with pathologic BMD increase by 4.1% per year of transplantation.

Conclusions: after kidney transplantation, a large increase of hyperlipidemia associated with a characteristic pattern of altered lipid with elevated total cholesterol, low density lipoprotein, high density lipoprotein, and the resulting increase in triglycerides, occurs despite statin therapy, leading to an increase in risk factors for diabetes, hypertension, diseases and cardiovasculares further loss of bone mass which carries a high risk of serious fractures occurs, threatening kidney graft and quality of life of patients.

(Nutr Hosp. 2015;31:2503-2510)

DOI:10.3305/nh.2015.31.6.8719

Key words: Renal transplantation. Lipid disorders. Hyperlipidemia. Hypertriglyceridemia. Anthropometry. Bone Mineral Density.

Introducción

Los trastornos del metabolismo mineral óseo y los trastornos del metabolismo lipídico representan un gran problema para los pacientes trasplantados renales ya que estos pueden afectar tanto a la supervivencia del injerto así como a la del propio paciente¹⁻³. Las alteraciones del metabolismo óseo producen baja densidad mineral ósea (DMO) lo que conlleva un aumento del riesgo de fractura ósea por osteoporosis, ya que durante los primeros seis meses del trasplante se produce una pérdida ósea rápida que afecta principalmente al hueso esponjoso; a nivel de la columna lumbar, dicha pérdida es de 1,5% por mes, provocando una significativa elevación del riesgo fractura⁴.

Entre un 80% y un 90% de los pacientes trasplantados renales muestran cierto grado de hiperlipidemia, esto también va en función de la edad, la dieta, el funcionamiento renal, la obesidad⁵, el uso de diuréticos, la proteinuria y el tratamiento inmunosupresor (esteroides y ciclosporina A); pero como factor principal, íntimamente relacionado con todos los anteriores expuestos, está la insulinoresistencia (IR) y el hiperinsulinismo que de ella se deriva⁶.

Si bien la mayoría de los pacientes presentan varios trastornos del metabolismo óseo en el momento del trasplante renal (TxR), tras este, hay una mejora en el equilibrio mineral debido a la homeostasis del injerto renal funcionante (la mayoría de los casos tienen una tasa de filtración glomerular de 30-60 ml / min), sin embargo, puede observarse una sustancial pérdida de masa ósea^{7,8}.

Por tanto, por un lado la posibilidad de reversibilidad de las alteraciones óseas limitadas por la restauración incompleta de la función renal, por el fracaso del injerto y/o por la administración crónica de medicamentos que interactúan negativamente con el metabolismo óseo (por ejemplo, inmunosupresores y corticoides)^{9,10,11}, y

por otro lado, debido a la elevada morbilidad cardiovascular tras el trasplante y al hecho de que la dislipemia puede acelerar el deterioro del paciente trasplantado renal^{12,13} destacan la importancia del inicio de las medidas profilácticas inmediatas tras el trasplante.

En nuestro centro, hemos realizado un estudio retrospectivo para describir y observar la evolución de las alteraciones de la densidad mineral ósea (DMO) y las alteraciones lipídicas en una población de pacientes trasplantados renales.

Materiales y Métodos

Sujetos

La muestra estuvo formada por 119 pacientes trasplantados renales de ambos sexos que acuden de forma periódica a la consulta de trasplante renal en el Hospital Universitario Virgen de las Nieves de Granada. No fueron seleccionados mediante procedimientos de muestreo aleatorio y su participación en el estudio viene determinada por la asistencia a la consulta en las fechas en que se realizó el estudio (Marzo de 1998 a Marzo de 2011) para su seguimiento y control. Las edades estaban comprendidas entre 16 y 74 años, 70 hombres y 49 mujeres en total. La enfermedad de base se recoge en la Figura 1.

Métodos

A todos los pacientes se realizaron mediciones pre-trasplante y posttrasplante (desde el 1º año hasta el 5º año) de: colesterol total, lipoproteínas de baja densidad (LDL), lipoproteínas de elevada densidad (HDL) y niveles de triglicéridos.

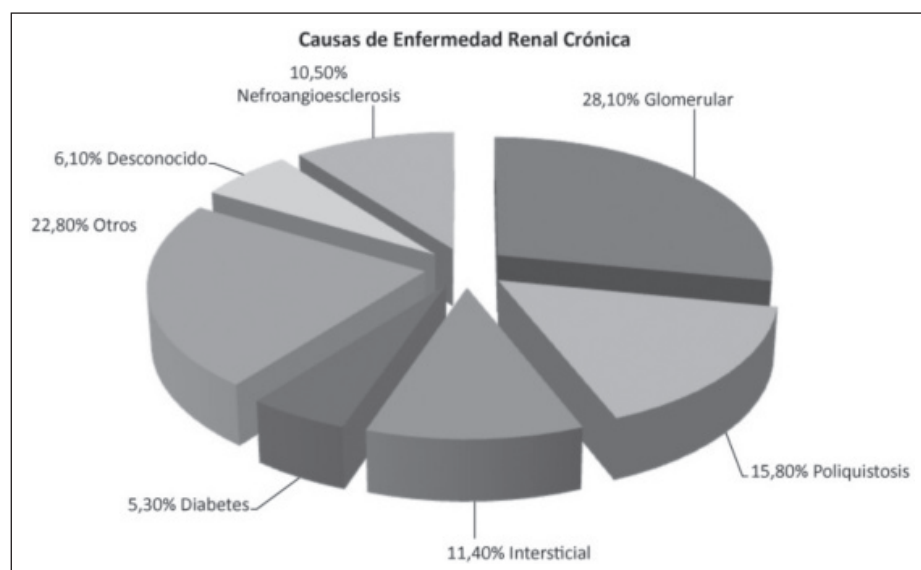


Fig. 1.

La medición de la DMO en columna lumbar, fémur y radio-cubital se realizó mediante absorciometría dual de Rx (DXA) con un equipo de densitometría ósea de Rx Hologic DQR-4500. Este equipo mide de forma exacta y rápida el contenido mineral óseo, mediante radiografías digitales cuantitativas, con lo que se puede obtener tanto la medida del contenido mineral óseo en gr. como la DMO en gr/cm². La precisión es superior al 1% con un coeficiente de variación del 1%, para una DMO= 1 gr/cm², siendo la resolución espacial de 1,5%. Las mediciones se realizaron a los seis meses y al año de trasplante. Los resultados se expresan en valores absolutos de T Score y se establecen como normales valores de DMO superiores a -1 desviación estándar (DE) con relación a la media de adultos jóvenes (T score > -1), osteopenia los valores de T-score entre -1 y -2,5, y osteoporosis los valores de DMO inferiores a -2,5 DE (T score < -2,5).

A todos los pacientes se les efectuaron mediciones antropométricas de peso y altura. El peso se midió mediante una balanza tallímetro Perperson 113481 en kilogramos y la altura en centímetros. El índice de masa corporal fue calculado mediante la fórmula peso/talla², y agrupado según la clasificación de la OMS en IMC < 20: delgados, 20 a 25: sobrepeso 1, de 26 a 30: sobrepeso 2, y >30: obesidad. Así mismo se recogieron datos acerca de diagnósticos de hipertensión y diabetes.

Análisis estadístico

El análisis se realizó mediante el paquete estadístico SPSS 15.0.1; para valorar las diferencias entre Índice

de Masa Corporal, parámetros bioquímicos y años en grupos, se utilizó el análisis de varianza (ANOVA), y descriptivos para valorar el estudio de la densidad mineral ósea.

Todos los datos se expresan en valor medio $\pm$ desviación estándar ($X \pm DS$), considerándose significación estadística con valores de $p < 0,05$.

Resultados

Como se puede observar, se produce un gran aumento del IMC desde el momento pretrasplante al primer año trasplantado para ir aumentando lenta aunque progresivamente en los años sucesivos (Fig. 2).

Las concentraciones medias de colesterol total también experimentaron un gran incremento tras el primer año de trasplante, aunque bajaron ligeramente del segundo al quinto año, éstos continuaron siendo bastantes más elevados que en el momento “pretrasplante” (Tabla I). En este aspecto, se presentaron niveles de colesterol total por encima de los valores de referencia de nuestro laboratorio (200-240 mg/dl), en la etapa pretrasplante un 18%, en la etapa postrasplante: el 1º año un 49%, el 2º año un 42,2%, al tercer año un 30,8%, al 4º año un 43% y al 5º año un 43%.

Las concentraciones medias de HDL experimentaron un aumento significativo desde la etapa previa al trasplante a los años siguientes al trasplante, alcanzando valores próximos entre sí (Tabla I). En este aspecto, se presentaron niveles de colesterol total por debajo de los valores de referencia del laboratorio (40-60 mg/dl), en la etapa pretrasplante un 35%, en la etapa postrasplante

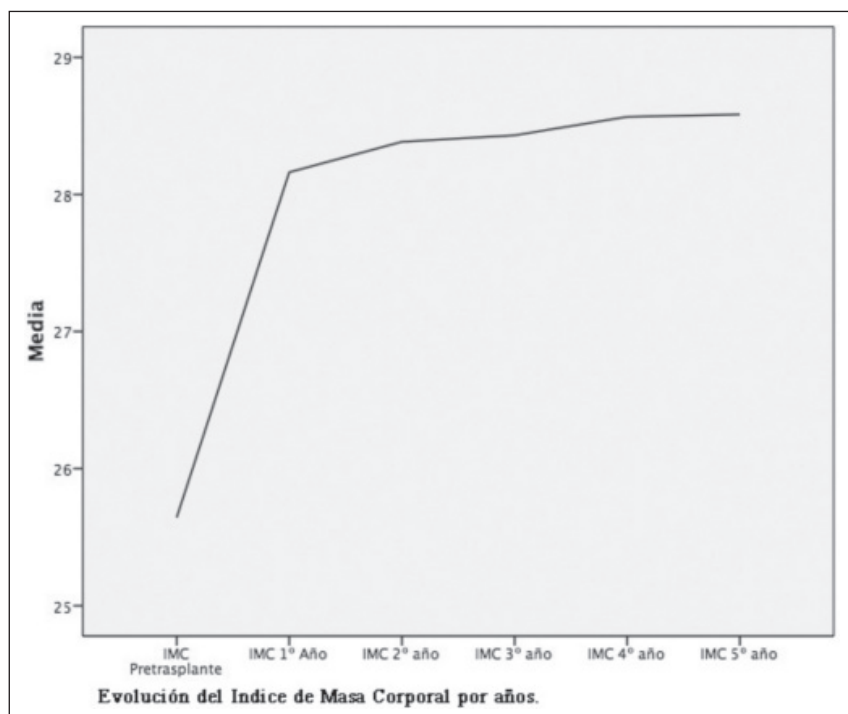


Fig. 2.

Tabla I
Parámetros bioquímicos medios por años

<i>Bioquímica</i>	<i>Año</i>	<i>Media</i>	<i>Desviación Std.</i>	<i>Mínimo</i>	<i>Máximo</i>
Colesterol total	Pretrasplante	155,74	46,52	85	334
	1°	202,55	35,76	117	289
	2°	193,67	35,31	113	304
	3°	189,93	37,59	104	342
	4°	189,59	36,72	112	271
	5°	192,55	40,06	103	305
HDL	Pretrasplante	47,43	17,07	23	97
	1°	59,72	16,27	25	99
	2°	61,53	20,91	30	159
	3°	59,12	17,74	21	113
	4°	59,62	17,9	26	107
	5°	59	25,78	31	104
LDL	Pretrasplante	89,16	36,43	29	204
	1°	118,61	43,2	10	353
	2°	115,32	39,78	25	359
	3°	112,18	40,07	39	338
	4°	108,57	32,16	52	188
	5°	113,24	32,41	55	192
Triglicéridos	Pretrasplante	143,42	75,41	52	479
	1°	144,05	81,28	49	543
	2°	144,41	77,92	46	473
	3°	149,37	78,10	52	528
	4°	154,90	88,9	40	511
	5°	157,72	63,37	49	342

HDL: lipoproteínas de elevada densidad.

LDL: lipoproteínas de baja densidad.

plante: el 1° año un 10%, el 2° año un 11%, el 3° un 12%, el 4° un 12% y el 5° un 14,3%.

Las concentraciones medias de LDL también sufrieron un gran aumento en el primer año posttrasplante, tomando valores próximos entre sí en los siguientes años tras el trasplante, excepto en el 4° año donde se produjo un descenso de los mismos (Tabla I). Se presentaron niveles por encima de los valores de referencia de nuestro laboratorio (70-150 mg/dl), en la etapa pretrasplante un 5,4%, %, en la etapa posttrasplante: el 1° año un 19%, el 2° año un 13,8 %, el 3° un 12,4%, el 4° un 11,7% y el 5° un 13,4%.

En cuanto a las concentraciones medias de triglicéridos, experimentaron un aumento desde primer año tras el trasplante aumentando progresivamente hasta el 5° año (Tabla I). Se presentaron concentraciones por encima de los valores de referencia de nuestro laboratorio (50-200 mg/dl), en la etapa pretrasplante un 13,5%, en la etapa posttrasplante: el 1° año un 16,55,

el 2° año un 18,7%, el 3° un 19,9%, el 4° un 20,1% y el 5° un 24,1%.

Considerando que hemos definido dislipemia como valores de colesterol total >200 mg/dl (5.17 mmol/l) y triglicéridos >200 mg/dl (2.26 mmol/l), observamos que se produce un aumento en el porcentaje de la dislipemia en los años sucesivos tras el trasplante renal, mostrando valores medios muy por encima de los valores medios iniciales pretrasplante (Fig. 3).

En cuanto al número de pacientes diagnosticados de diabetes, vemos que también se produce un gran aumento en el número de casos tras el trasplante que va aumentando en los años posteriores (Fig. 4). Este hecho también se observa en los pacientes diagnosticados de hipertensión arterial (HTA), con un importante incremento en el número de los mismos tras el trasplante (Fig. 5).

En cuanto a la evolución de la DMO, como podemos observar en la Tabla II, a los seis meses de trasplante

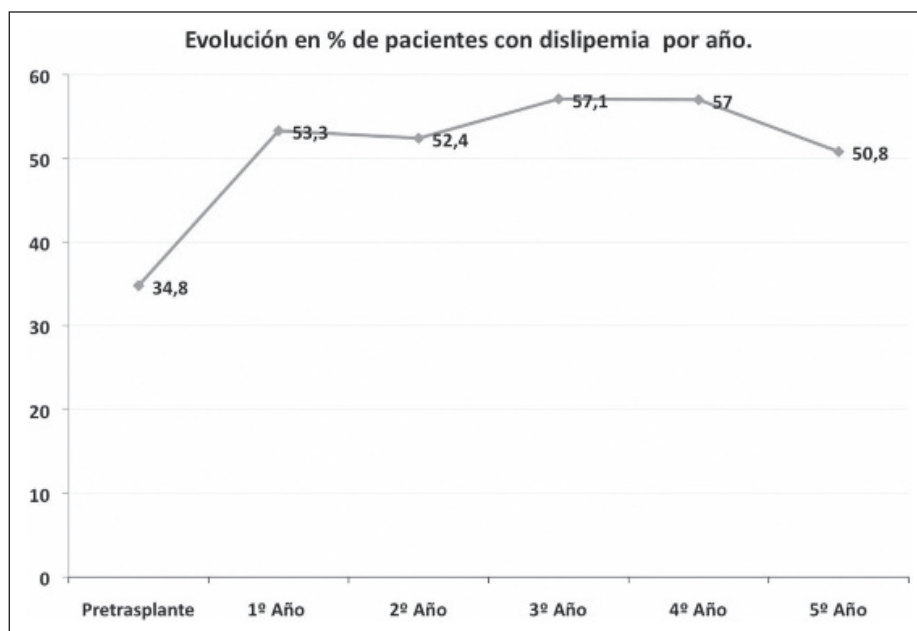


Fig. 3.

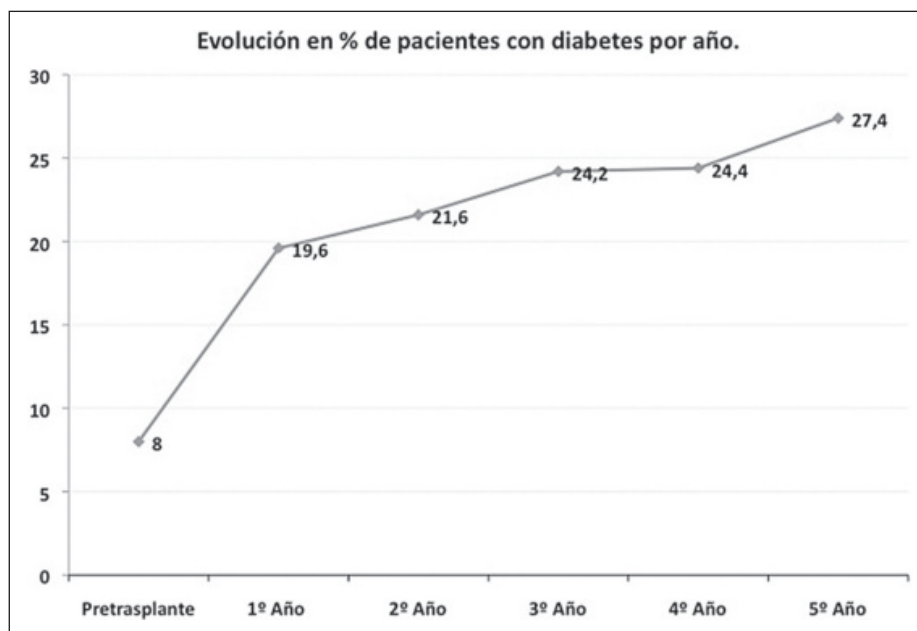


Fig. 4.

existe un alto porcentaje de pacientes con DMO patológica (82,7 %) aumentando un 4,1% al año de trasplante. Lo mismo ocurre con los T score en las 3 zonas medidas (Tabla III), el porcentaje de pacientes con T score patológico (osteopenia y osteoporosis) medido en la zona lumbar aumenta un 6% de los seis meses al año postrasplante, en la zona del fémur aumenta un 3,8%, y en la zona cubito-radial lo hace en un 6,2%.

En función del sexo de la muestra se observa que este incremento de la proporción de pacientes con DMO patológica a los 12 meses tras el trasplante se produce en los hombres, con un 7,5%, sin embargo en las mujeres se observa un leve descenso (2,2%) (Ta-

bla IV). Este hecho también se produce en las distintas regiones anatómicas analizadas, con un aumento del porcentaje de hombres con DMO patológica del 8,7% en la zona lumbar, del 10,2% en fémur, y del 8,3% en cúbito y radio, frente al leve descenso del 2% en zona lumbar, del 6% en fémur y del incremento del 3,6% en cúbito y radio que se observa en las mujeres.

Discusión

Los pacientes trasplantados renales presentan un cuadro de enfermedad renal crónica de varios años de

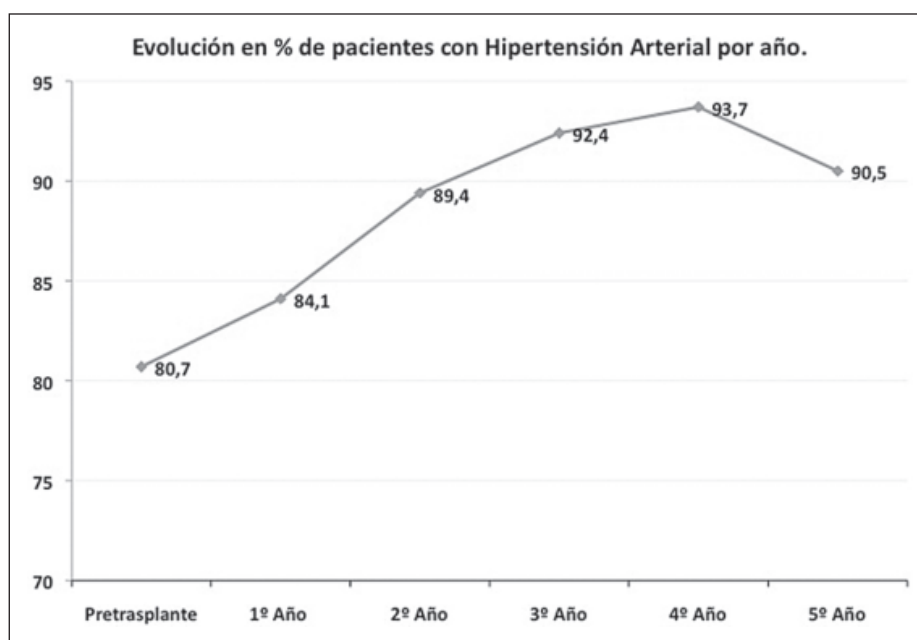


Fig. 5.

Tabla II <i>Porcentaje de DMO patológica de los 6 meses al año postrasplante</i>		
	<i>DMO a los 6 meses</i>	<i>DMO al año</i>
Normal	17.3%	13.4%
Patológica	82.7%	86.6%

evolución, por lo que muchos de ellos ya sufrían trastornos lipídicos antes del trasplante^{14,15}. El metabolismo de los lípidos no se normaliza con la recuperación de la función renal después del trasplante¹⁶, por lo que la dislipemia postrasplante renal es una alteración metabólica relativamente frecuente especialmente en el

primer año después del trasplante, lo que conlleva un gran interés clínico, no sólo por la elevada incidencia de eventos cardiovasculares postrasplante, sino por su posible contribución al desarrollo de nefropatía crónica del injerto¹⁷.

En nuestros pacientes hemos encontrado que en el primer año postrasplante los niveles de colesterol total se incrementaron de un 18% a un 49% durante el primer año, disminuyendo ligeramente en los años 4 años sucesivos, aunque continúan elevados en comparación con la etapa pretrasplante; en consecuencia también se incrementaron los niveles de HDL Y LDL. El aumento del lipoproteínas de alta densidad tras trasplante podría estar asociada con una producción excesiva de estas, con la eliminación de toxinas urémicas por el riñón trasplantado y por la administración crónica de corti-

Tabla III <i>Porcentajes de DMO patológica de los 6 meses al año postrasplante medidos por áreas</i>					
<i>Localización</i>	<i>T Score</i>	<i>DMO a los 6 meses</i>		<i>DMO al año</i>	
Lumbar	Normal	37%	37%	30.8%	30.8%
	Osteopenia	32,9%	63%	38.4%	69.2%
	Osteoporosis	30,1%		30.8%	
Fémur	Normal	35.6%	35,6%	31.8%	31.8%
	Osteopenia	49.3%	64,4%	51.5%	68.2%
	Osteoporosis	15.1%		16.7%	
Cubito-Radio	Normal	18,4%	18,4%	12.2%	12.2%
	Patológica	44.8%	81.6%	54.5%	87.8%
	Osteoporosis	36.8%		33.3%	
		100%	100%	100%	100%

Tabla IV
Porcentaje de DMO patológica de los 6 meses al año postrasplante por sexos

Sexo	DMO	DMO a los 6 meses	DMO al año
Varón	Normal	17%	9.5%
	Patológica	83%	90,5%
Mujer	Normal	17,8%	20%
	Patológica	82,2%	80%
		100%	100%

costeroideos¹⁸. Varios investigadores han señalado que el aumento en los niveles HDL en trasplantados renales no tendría efecto protector contra las complicaciones aterogénicas^{19,20}. Este fenómeno está todavía por dilucidar, pero podría estar relacionado con los cambios de la calidad en el HDL, descenso en la concentración de colesterol en la fracción HDL-2 y también, por la intensiva oxidación del LDL²¹.

Aunque estudios previos se han centrado principalmente en la elevación del colesterol sérico^{22,23}, nuestros datos ponen de manifiesto el progresivo aumento de los valores de triglicéridos y de la dislipemias des-

pués del trasplante renal; la dislipemia afecta a un alto índice de pacientes (Fig. 3), y está condicionada por la duración de la insuficiencia renal previa al trasplante, la dieta, el tratamiento hipolipemiente, y la predisposición genética²⁴.

La gran mayoría de los trabajos publicados inciden en señalar el aumento del IMC que se produce tras el trasplante renal²⁵⁻²⁶, hecho que coincide con los resultados obtenidos en este trabajo (Fig. 2), mas que sumado al progresivo aumento de las cifras los valores de triglicéridos, son un factor agravante para la aparición de diabetes como se ha podido constatar en este trabajo (Fig. 4) y la aparición de enfermedades cardiovasculares e hipertensión arterial (Fig. 5).

La osteoporosis y la osteopenia son una grave complicación en los pacientes trasplantados renales y afecta al 50% y 80% de todos los receptores de riñón, como consecuencia de ello, entre un 11% y un 40% que sufren fracturas patológicas. Aunque se ha demostrado que la pérdida ósea es más elevada dentro de los primeros 6 a 18 meses después del trasplante renal,^{27,28} en nuestra muestra hemos encontrado una pérdida continua de masa ósea lo que hace aumentar el riesgo de fracturas, hecho que se va agravado por la edad avanzada, la deficiencia de calcio en la dieta, la deficiencia de vitamina D, la inactividad física, y el problema añadido de la dislipemia y alto peso corporal.

Tabla V
Porcentaje de DMO patológica de los 6 meses al año postrasplante medidos por áreas y sexos

Sexo	Localización	T Score	DMO a los 6 meses		DMO al año	
Hombre	Lumbar	Normal	38.1%	38.1%	26.8%	26.8%
		Osteopenia	33.3%	61.9%	39,1%	73.2%
		Osteoporosis	28.6%		34.1%	
	Fémur	Normal	39.5%	39.5%	29.3%	29.3%
		Osteopenia	39.5%	60.5%	51.2%	70.7%
		Osteoporosis	21%		19.5%	
	Cubito-Radio	Normal	13.6%	13.6%	5.3%	5.3%
		Patológica	59.1%	86.4%	57.9%	94.7%
		Osteoporosis	27.3%		36.8%	
Mujer	Lumbar	Normal	35.5%	35.5%	37.5%	37.5%
		Osteopenia	32.2%	64.5%	37.5%	62.5%
		Osteoporosis	32.3%		25%	
	Fémur	Normal	30%	30%	36%	36%
		Osteopenia	63.3%	70%	52%	64%
		Osteoporosis	6.7%		12%	
	Cubito-Radio	Normal	25%	25%	21.4%	21.4%
		Patológica	25%	75%	50%	78.6%
		Osteoporosis	50%		28.6%	
100%				100%		

En conclusión, tras el trasplante renal se produce un gran incremento de la hiperlipidemia que se asocia con un patrón característico de alteración de lípidos con elevación del colesterol total, lipoproteínas de baja densidad, lipoproteínas de alta densidad, y el consiguiente aumento de los triglicéridos; por otro lado, la evidente pérdida de masa ósea conlleva un alto riesgo de sufrir fracturas graves, poniendo en peligro además el injerto renal, la calidad de vida del paciente.

Referencias

- Jardine AG, Gaston RS, Fellstrom BC, Holdaas H. Prevention of cardiovascular disease in adult recipients of kidney transplants. *Lancet*. 2011; 378(9800):1419-1427.
- García I, Errasti P, Lavilla FJ, Ballester B, Manrique J, Rossich E, Purroy A. Effects of cerivastatin in dyslipemia and other cardiovascular risk factors after renal transplantation. *Transplant Proc*. 2002; 34(1):401-402.
- Bilbao I, Castells L, Rojas L, Cancino J, Dopazo C, Castro E, Pou L, Andino R, Margarit C. Immunosuppression based on mycophenolate mofetil in stable liver transplanted patients. *Int Immunopharmacol*. 2006;20(13):1977-1983.
- Fernández Castillo R, De Alarcon RM, Esteban RJ, Haouari O, Planell E, Perán F, Bravo JA. Bone mineral density in patients with renal hyperparathyroidism undergoing surgery: relations-hip with bone parameters. *Med Clin (Barc)*. 2010;135:156-159.
- Dumler F, Kilates C. Metabolic and nutritional complications of renal transplantation. *J Ren Nutr*. 2007;17(1):97-102.
- Sharif A, Moore R, Baboolal K. Influence of lifestyle modification in renal transplant recipients with postprandial hyperglycemia. *Transplantation*. 2008;85:353-358.
- Favaloro R, Peradejordi M, Bertolotti A, Diez M, Favaloro L, Gomez C, Martinez L, Moscoloni S. Results of heart transplantation: 16 years' experience in a center in Argentina. *Transplant Proc*. 2010; 42(1):321-323.
- Cabrerizo JL, Zalba EB, Perez CJ. Valor pronóstico del filtrado glomerular en el síndrome coronario agudo: ¿índice de Cockcroft o ecuación MDRD? *Med Clin (Barc)*. 2010;134:624-629.
- Martin K, Olgaard K, Coburn J. Diagnosis, assessment, and treatment of bone turnover abnormalities in renal osteodystrophy. *Am J Kidney Dis*. 2004;43:558-565.
- Stephan A, Barbari A, Karam A, Kilani H, Kamel G, Masri A. Hyperlipidemia and graft loss. *Transplant Proc*. 2002;8(6): 2423-2425.
- Nazemian F, Naghibi M. Weight-gain-related factors in renal transplantation. *Exp Clin Transplant*. 2005;3(1):329-332.
- Tonelli M, Moye L, Sacks FM, Kiberd B, Curhan G; Cholesterol and Recurrent Events (CARE) Trial Investigators. Pravastatin for secondary prevention of cardiovascular events in persons with mild chronic renal insufficiency. *Ann Intern Med*. 2003;138:98-104.
- Seliger SL, Weiss NS, Gillen DL. HMG-CoA reductase inhibitors are associated with reduced mortality in ESRD patients. *Kidney Int*. 2002;61:297-304.
- Kisielnicka E, Zdrojewski Z, Wróblewska M, Kortas B, Rutkowski B. Lipid disturbances in a two-year follow-up after successful kidney transplantation. *Transplant Proc*. 2000;32(6): 1358-1362.
- Chmielewski M, Zdrojewski Z, Rutkowski B. Benefits and menaces related to the use of statins in patients after renal transplantation. *Ann Transplant*. 2002;7:6-10.
- Tse KC, Lam MF, Yip PS, Li FK, Lai KN, Chan TM. A long-term study on hyperlipidemia in stable renal transplant recipients. *Clin Transplant*. 2004;18(3):274-280.
- Hernández D, Álvarez A, Torres A. Cardiovascular risk profile in nondiabetic renal transplant patients: cyclosporine versus tacrolimus. *Transplant Proc*. 2003;35:1727-1729.
- Martins L, Ventura A, Costa S, Henriques A, Dias L, Sarmento A. Long-term complications after renal transplantation. *Transplant Proc*. 2003;35(3):1083-1084.
- Vathsala A, Weinberg RB, Schoenberg L, mGrevel J, Goldstein RA, Van Buren CT, Lewis RM, Kahan BD. Lipid abnormalities in cyclosporineprednisone treated renal transplant recipients. *Transplantation*. 1989;48(1):37-43.
- Kobayashi N, Okubo M, Marumo F, Uchida H, Endo T, Nakamura H. De novo development of hypercholesterolemia and elevated high-density lipoprotein cholesterol: apoprotein A-I ratio in patients with chronic renal failure following kidney transplantation. *Nephron*. 1983;35(4):237-240.
- Ettinger WH, Bender WL, Goldberg AP, Hazzard WR. Lipoprotein lipid abnormalities in healthy renal transplant recipients: persistence of low HDL2 cholesterol. *Nephron*. 1987;47(1): 17-21.
- Booth JC, Joseph JT, Jindal RM. Influence of hipercolesterolemia on patient and graft survival in recipients of kidney transplants. *Clin Transplant*. 2003;17:101-105.
- Boratynska M, Banasik M, Watorek E, Klinger M, Dorobisz A, Szyber P. Influence of hipercolesterolemia and acute graft rejection on choronic nephropathy development in renal transplant recipient. *Transplant Proc* 2003;35(6):2209-2212.
- Beddhu S, Samore MH, Roberts MS, Stoddard GJ, Pappas LM, Cheung AK. Creatinine production, nutrition, and glomerular filtration rate estimation. *J Am Soc Nephrol* 2003; 14:1000-1005.
- Keshaviah PR, Nolph KD, Moore HL, Prowant B, Emerson PF, Meyer M, Twardowski ZJ, Khanna R, Ponferrada L, Collins A. Lean body mass estimation by creatinine kinetics. *J Am Soc Nephrol* 1994; 4:1475-1485.
- Leichtman AB, Cohen D, Keith D, O'Connor K, Goldstein M, McBride V, Gould CJ, Christensen LL, Ashby VB. Kidney and pancreas transplantation in the United States, 1997-2006: the HRSA Breakthrough Collaboratives and the 58 DSA Challenge. *Am J Transplant* 2008;8(4):946-957.
- Gill JS, Rose C, Pereira BJ, Tonelli M. The importance of transitions between dialysis and transplantation in the care of end-stage renal disease patients. *Kidney Int* 2007;71:442-447.
- Molnar MZ, Streja E, Kovesdy CP, Bunnapradist S, Sampaio MS, Jing J, Krishnan M, Nissenson AR, Danovitch GM, Kalantar-Zadeh K. Associations of body mass index and weight loss with mortality in transplant-waitlisted maintenance hemodialysis patients. *Am J Transplant* 2011;11: 725-736.



Original/Síndrome metabólico

Reduction of serum advanced glycation end-products with a low calorie Mediterranean diet

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Abstract

Dietary intake of advanced glycation end-products (AGEs) increases circulating and tissue levels of these substances, contributing to a state of increased oxidative stress and inflammation. A low dietary AGE intervention has been shown to reduce body AGE content. Mediterranean diets (MD) are theoretically considered low in AGEs, but the specific effects of a MD on AGEs serum levels has not been tested.

Methodology: forty-seven overweight and obese premenopausal women underwent a three-month calorie restriction treatment (20 kcal / kg initial weight) with a Mediterranean-type diet that excluded wine intake. The adherence to the MD was assessed before and at the end of treatment using an on-line questionnaire, which scores from 0 to 14 (minimal to maximal adherence). Body composition, insulin resistance, lipoproteins and carboxymethyl-lisine (CML) serum levels were measured at both time periods. Serum CML was assessed through ELISA (enzyme-linked immunosorbent assay). Compliance to calorie restriction was assessed according to weight loss (< or > 5 % initial weight).

Results: mean body weight, body fat, waist circumference, total cholesterol, triglycerides and serum CML fell significantly, together with an increase in the Mediterranean score, although none of the patients reached the highest score. Significant changes in CML and insulin resistance were observed in 17 women classified as compliant to calorie restriction, but not in the 27 participants who were considered adherent to the MD (according to improvement of the Mediterranean Score).

Conclusions: CML serum levels can be reduced through calorie restricted - Mediterranean-type diet. We could not reach a high enough MD score, so we cannot

REDUCCIÓN SÉRICA DE PRODUCTOS FINALES DE GLICACIÓN AVANZADA SÉRICOS CON UNA DIETA BAJA EN CALORÍAS TIPO MEDITERRÁNEO

Resumen

La ingesta dietaria de productos finales de glicación avanzada (AGEs) aumenta los niveles séricos y tisulares de estas sustancias, lo que contribuye a un estado de mayor estrés oxidativo e inflamación. Una intervención dietaria con bajo contenido de AGEs ha demostrado reducir el contenido de AGEs en el cuerpo. La dieta mediterránea (DM) se considera teóricamente baja en AGEs, pero los efectos específicos de este tipo de intervención en los niveles séricos de AGEs no ha sido probado.

Metodología: cuarenta y siete mujeres premenopáusicas con sobrepeso u obesidad se sometieron a tres meses de restricción calórica (20 kcal por kg de peso corporal inicial) con una dieta de tipo mediterráneo que excluía la ingesta de vino. La adherencia a la DM se evaluó al comienzo y al final del tratamiento utilizando una encuesta on-line, con puntuaciones de 0 a 14 (mínima a máxima adherencia a la DM). La composición corporal, la resistencia a la insulina, los niveles séricos de lipoproteínas y carboximetil-lisina (CML) se midieron en ambos períodos. El CML sérico se evaluó mediante ELISA (ensayo inmunoenzimático). La adherencia a la restricción calórica se evaluó de acuerdo con la pérdida de peso (< o > 5% del peso inicial).

Resultados: la media de peso corporal, grasa corporal, circunferencia de la cintura, colesterol total, triglicéridos y CML sérica disminuyeron significativamente, junto con un aumento en el puntaje de adherencia a la DM, aunque ninguno de los pacientes alcanzó la máxima puntuación. Hubo cambios significativos en los niveles de CML y de resistencia a la insulina en 17 mujeres clasificadas como adherentes a la restricción calórica, pero no en las 27 participantes que fueron consideradas adherentes a la DM (de acuerdo con la mejoría en el puntaje de la encuesta).

Conclusiones: los niveles séricos de CML disminuyeron tras la restricción calórica con una dieta tipo mediterránea. Dado que no se pudo alcanzar la puntuación máxima

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Recibido: 11-III-2015.
Aceptado: 3-IV-2015.

conclude whether the MD itself has an additive effect to caloric restriction.

(*Nutr Hosp.* 2015;31:2511-2517)

DOI:10.3305/nh.2015.31.6.8936

Key words: *Advanced glycation end-products (AGEs). Mediterranean diet. Oxidative stress. Inflammation.*

Abbreviations

MD: Mediterranean Diet.

AGEs: Advanced Glycation End-products.

CML: Carboxymethyl-lisine.

ELISA: Enzyme-linked immunosorbent assay.

Introduction

Since Keys et. al. described a lower cardiovascular risk in certain Mediterranean countries¹, attributing the lesser mortality mainly to the ratio of monounsaturated to saturated fatty acids², numerous evidence has gathered respect to the beneficial cardiovascular effect of the Mediterranean Diet (MD). These original observations have been confirmed by epidemiological studies³ as well as large primary prevention trials such as the PREDIMED⁴. It is worth mentioning that MD implies several food patterns and other behavioral and cultural traditions^{5,6} and was declared as Intangible Cultural Heritage of Humanity by UNESCO. The traditional Chilean diet can be considered as a Mediterranean-type diet⁷, but in the last 20 years a variety of processed foods described as “the western diet” have invaded Chilean kitchens, in association with an increased prevalence of obesity and secondary comorbidities, mainly diabetes and cancer⁸, threatening young women in particular⁹.

A great deal of research has aimed to study the role of specific nutrients contained in the MD and what are the mechanisms involved in disease prevention. Antioxidant vitamins, resveratrol and red wine polyphenols have been emphasized, due to their known antioxidant effects^{10,11} and improvement of vascular reactivity¹².

High dietary intake of advanced glycation end-products (AGEs) has been associated with metabolic derangements, oxidative stress and inflammation¹³, which can be successfully managed by simple changes in cooking methods¹⁴. Overall, the low AGE diet is similar to the MD, but less restrictive in the sense that all kind of meats and animal products are allowed as long as they are prepared under conditions of high humidity and lower heat^{15,16}. MD involves patterns of food consumption rather than specific foods and recipes. These dietary patterns can be assessed through scores that rate weekly consumption of specific food groups, mainly non-refined cereals (whole grain bread and pasta, brown rice, etc), fruit, vegetables, legumes,

en la encuesta de DM, no podemos concluir si la propia DM tiene un efecto aditivo a la restricción calórica.

(*Nutr Hosp.* 2015;31:2511-2517)

DOI:10.3305/nh.2015.31.6.8936

Palabras clave: *Productos finales de glicación avanzada. Dieta mediterránea. Estrés oxidativo. Inflamación.*

potatoes, fish, meat and meat products, poultry, full fat dairy products (like cheese, yoghurt, milk), as well as olive oil and alcohol intake¹⁷, according to the Mediterranean Pyramid¹⁸.

Although traditional Chilean cooking used to be healthy, we have previously demonstrated that among adult Chileans, especially the younger ones dietary recalls show elevated ingestion of AGEs¹⁹, contributing to the obesity epidemics.

The aim of the current study was to analyze the effects of a low calorie dietary intervention, following MD food recommendations, in young premenopausal overweight or obese women. We specifically assessed the effect of the intervention on body composition, metabolic variables, and serum levels of carboxymethyllysine (CML).

Methodology

Fifty premenopausal women aged between 25 and 45 years with a BMI between 25 and 32 kg/m² (overweight or obese) and interested in losing weight were initially screened at our Clinical Research Center (CEDINTA). Exclusion criteria were: diabetes mellitus, hypothyroidism, history of cancer, liver or kidney failure, or pregnancy. The study protocol followed ethical guidelines included in the Declaration of Helsinki and was approved by our local Ethics Committee. Each participant signed an informed consent before beginning the study (registered at www.clinicaltrials.gov number NCT01508091).

At baseline and after a 3-month period of caloric restriction using a Mediterranean-type diet, each participant filled-in an on-line dietary recall called *Alimentate Sano - Fitbook (Healthy Feeding - Fitbook)* designed by Chilean investigators²⁰, which estimates adherence to a Mediterranean-type diet, through 14 items. Intake of vegetables (except potatoes), fruits, legumes, seeds and dried fruits, whole grain cereals, lean meats, seafood, low fat and fermented dairy products, vegetable oils (olive, canola or avocado), and moderate wine intake at meal times are classified as healthy (higher scores), while fatty or processed meats, high fat or non-fermented milk, sugar and excessive wine or no wine ingestion are considered non-healthy. Each item is scored as 0, 0.5 or 1, considering habitual intake and whether its quality is considered as beneficial or unhealthy. Final scores range from 0 (lack of adherence to MD) to 14 (maximal adherence).

In addition, each participant underwent anthropometric measurements (height, weight, waist and hip circumferences) and body composition measurements (total, bone, fat and lean body mass) using a Lunar Encore double beam densitometer (DEXA), at baseline and at completion of the study.

Also at baseline and after the intervention, fasting blood samples were withdrawn for measurement of glucose, insulin, thyroid hormones and lipoproteins and an oral glucose tolerance test (OGTT), quantifying glucose and insulin levels 60, 90 and 120 min following a 75 g glucose challenge. Insulin resistance was evaluated by calculating the index of Matsuda²¹ and the Homeostasis Model Assessment (HOMA-IR)²². Both serum glucose and insulin were measured by Roche kits.

Serum samples were tested for εN-carboxymethyllysine (CML) by enzyme-linked immunosorbent assay (ELISA), in a competitive assay, according to Makita et al²³ with some minor modifications. Briefly, 96-well ELISA plates (EIA/RIA plate, Costar, Cambridge, MA) were coated with 100μL/well of 3μg/mL CML-BSA (Cell Biolabs, USA) in coating buffer (0.1 M sodium bicarbonate, pH 9.6) overnight at 4°C. Wells were washed three times with 150μL washing buffer (PBS 0.05% Tween-20 and 1 mM Na₃N), then blocked with 100μL blocking buffer (PBS 1% BSA) for 1h. After three rinses with washing buffer, 50μL of sample was added, followed by 50μL of anti-CML antibody 1:2000 (Ab3097, Abcam, USA) in blocking buffer and were incubated at room temperature for 2h with gentle agitation on a horizontal rotary shaker. Wells were then rinsed and the secondary antibody diluted 1:4000 in blocking buffer was then added to each well and the plates were incubated at 37°C for 1 h. After rinsing with washing buffer, 150μL pNPP substrate (Sigma, USA) was added to each well. Optical density at 405nm was determined by an ELISA reader (Start Fax 4200, Awardness technology) after 15 to 30 min. The intra-assay variation was ±2.4% and the inter-assay variation ±4.6%.

The intervention consisted in the prescription of a low calorie Mediterranean Diet (MD) (20 Kcal per kg initial body weight), with 5 daily meals, during 3 months. Distribution of macronutrients was 50 % carbohydrates, 25- 30 % lipids and 20 to 25 % protein (at least 1 g per kg initial body weight). One of the meals was provided by the research team, including dried fruits (175 Kcal/serving of 30 g), cereal bars (69 Kcal/serving of 20 g) or whole grain cookies (153 Kcal/serving of 3 cookies), to be ingested from one to three times per week, in order to improve compliance with dietary recommendations. Specific instructions were cutting out ingestion of pastry, sugared beverages, red meats, full fat dairy products, white bread, potatoes, rice and pasta, while stimulating intake of fish, poultry, vegetables and whole grain cereals in adequate portions. Patients were followed weekly by the research dietitian, to record weight changes and discuss meal

alternatives when adherence was less than appropriate, reinforcing the selection of less caloric and more Mediterranean types of foods and ensuring adequate protein intake. No specific indications concerning cooking methods were advised. Patients were recommended to follow healthy lifestyles including increased physical activity, but this was not an active part of the intervention.

Compliance with the diet was not assessed by dietary recalls due to lack of precision and habitual underreporting^{24,25}, but instead according to changes in body weight defining compliant participants as those who achieved a weight reduction of > 5 % initial weight and non-compliant as those who did not achieve this goal. Adherence to the Mediterranean food selection was evaluated by the *Healthy Feeding – Fitbook* Score, considering both the total score and comparing baseline to final scores.

Results

Fifty premenopausal women were included in this study, aged 33 ± 5 years; three dropped out due to personal problems, so 47 were available for final analysis. Initial body mass index (BMI) ranged from 24.8 to 32.5 kg/m², while percentage of body fat fluctuated between 34 and 49 %. Table I depicts anthropometric and body composition measurements by DEXA at baseline and after the 3-months dietary intervention. Table II shows the changes in laboratory variables before and after the treatment period, highlighting a significant fall in CML, total cholesterol and triglyceride serum levels. Regarding parameters that define the metabolic syndrome at baseline, two participants had altered fasting glucose (fasting glucose ≥ 100 mg/dL), six were glucose intolerant (120 min serum glucose ≥ 140 mg/dL), nine were hypertriglyceridemic (serum TG > 150 mg/dL), blood pressure was elevated (> 135/85 mm Hg) in two participants and waist circumference was > 88 cm in 40. Nine participants had three or more criteria for diagnosis of the Metabolic Syndrome before the intervention and five at completion of the study.

The Mediterranean Diet Score at baseline averaged 4.98 ± 2, oscillating between 1 and 10. After the dietary intervention it improved significantly, reaching 8.17 ± 1.6 (p < 0.01) ranging from 4.5 – 11 points, but none reached 14 points. The change in this score was significantly correlated with the fall of cholesterol levels (Spearman's rho = - 0.3, p = 0.045) but was not associated with changes in CML or triglyceride concentrations. Figure 1 depicts non significant changes in CML serum levels according to improvement (more than 2 points) or no improvement in the Mediterranean Score (less than 2). The analysis was repeated considering a higher improvement of the score (> or < 4 points), again observing a comparable insignificant decrease of serum CML in both groups (data not shown).

Table I
Anthropometric data before and after treatment

	Baseline (n = 47)	After diet (n = 47)	P
Weight (kg)	72.2 ± 6.9	69.2 ± 6.8	< 0.001
Height (kg)	160.3 ± 6.0	160.3 ± 6.0	
BMI (kg/mt ²)	28.1 ± 2.0	26.9 ± 2.2	< 0.001
Waist (cm)	94.5 ± 6.1	90.0 ± 6.5	< 0.001
Hip (cm)	104.5 ± 5.3	102.5 ± 5.2	< 0.001
Total body fat (kg)	30.1 ± 4.5	28.2 ± 4.7	< 0.001
Trunk fat (kg)	15.8 ± 2.7	14.5 ± 2.8	< 0.001
Fat mass index (kg/mt ²)	11.7 ± 1.7	11.0 ± 1.8	< 0.001
Total lean mass (k)	39.2 ± 3.7	38.6 ± 3.7	0.002
Bone mineral content (kg)	2.4 ± 0.2	2.4 ± 0.2	0.477

Table II
Laboratory variables before and after treatment

	Baseline (n = 47)	After diet (n = 47)	P
Carboxymethyl-lisine (ug/ml)	0.6 (0.1 – 1.3)	0.4 (0.1 - 1.4)	0.0001
Fasting serum glucose (mg/dl)	86.9 ± 1.3	89.2 ± 1.3	0.188
120 Min serum glucose (mg/dl)	99 (38-202)	106 (33 – 176)	0.475
Fasting serum insulin (u/dl)	8.6 (1.8 – 30.2)	7.6 (1.7 -51.5)	0.844
120 Min serum insulin (u/dl)	56.5 (4.6 – 252.6)	48.6 (4.1 – 203.9)	0.247
HOMA-IR	1.7 (0.4 – 6.4)	1.6 (0.3 - 12.8)	0.589
Total cholesterol (mg/dl)	184 ± 37	173 ± 32	0.010
HDL cholesterol (mg/dl)	58 (36 – 79)	52 (34 - 91)	0.233
Triglycerides (mg/dl)	96 (49 – 409)	87 (42 – 299)	0.021
Serum creatinine (g/dl)	0.72 ± 0.12	0.73 ± 0.09	0.511

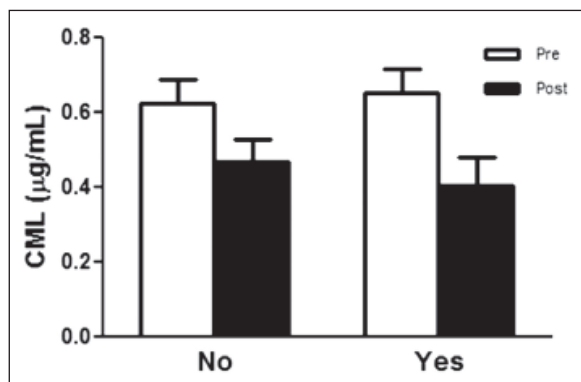


Fig. 1.—CML serum levels according to improvement of the mediterranean score.

Non significant serum levels CML (mean + SD) before (white) and after (black) dietary treatment, according to changes of the Mediterranean Score (NO : < 2 points improvement after the intervention, YES : > 2 points improvement after the intervention).

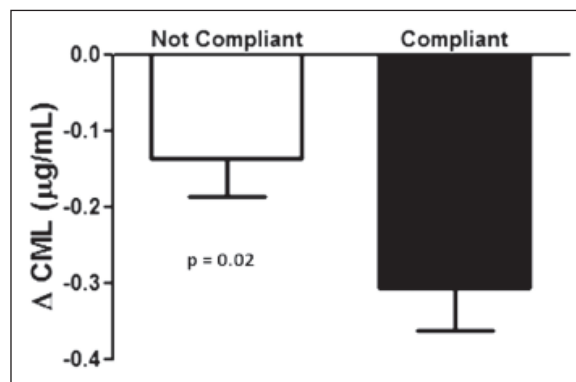


Fig. 2.—Delta CML serum levels according to compliance to caloric restriction.

Changes in CML serum levels according to compliance with the intervention. Not Compliant (white bar): lost < 5 % body weight versus Compliant (black bar): Lost > 5 % body weight; p = 0.02.

At baseline, CML serum levels did not correlate with BMI, waist circumference or body fat. After 3 months, 17 participants were compliant (loss of more than 5% of initial body weight) and 30 were non-compliant. Table III depicts changes in laboratory variables comparing both groups. There were significantly higher reductions in CML and HOMA-IR among compliant participants. Changes in CML serum levels were significantly associated with changes in fasting glucose (Spearman rho = 0.3 p = 0.03), but not with changes in serum lipids, Mediterranean Score, HOMA-IR, BMI nor body fat.

Discussion

In the current study we observed that reducing caloric intake and stimulating preference for foods contained in Mediterranean type diets, except for wine, positively influenced body fat, serum CML and lipoproteins in overweighted to obese premenopausal women.

In this trial we recommended energy restriction while simultaneously suggesting Mediterranean foods (such as legumes, whole grain cereals, fish, fermented milk and olive oil), establishing criteria of compliance to these two components. Adherence to energy restriction was assessed by % weight loss, and adherence to the Mediterranean diet was verified by changes in a previously validated score. This type of energy restriction is different from the regular low fat diet traditionally recommended for the treatment of obesity, because of its higher content in fat, specifically monounsaturated fatty acids contained in olive oil, and also emphasis in certain groups of foods. Our results indicate that the Mediterranean Score increased significantly, but did not reach 13 or 14 as expected, so compliance in this respect was far from perfect. Actually, in spite of weekly sessions with the dietitian, the Mediterranean Scores obtained were comparable to that of the control group in the PREDIMED study⁴. A possible explanation is that patients did not consume all the foods recommended in this type of diet due to its price, because in spite of local production,

in Chile olive oil and fish are very expensive, thus less ingested by the general population.

Serum CML levels fell independently of changes in the *Healthy Feeding - Fitbook Score*. A potential explanation for this lack of association is that MD questionnaires do not take into account cooking methods and consumption of processed foods as specific dietary recalls designed to quantify AGEs intake¹⁶.

Since compliance with the MD was less than expected, we could not evaluate its individual effects over the measured variables. In contrast, adherence to calorie restriction was assessed by changes in body weight, the best indicator of energy balance, more reliable than dietary recalls²⁶, and our results suggest that compliance with this intervention was responsible for the reduction of serum CML. Even though we did not specifically prescribe a low AGE diet by overseeing cooking methods, the low calorie diet necessarily implied reducing intake of pastry, processed and fried red fatty meats, cheese, and other greasy snacks while simultaneously decreasing portions of most meals except for vegetables, indirectly reducing intake of AGEs. Comparable results were found by Gugliucci et. al.³² in a 2 month reduced calorie diet in overweight/obese Japanese men and women, observing a 7.2 % decrease of fluorescent serum AGEs. Other interventions have aimed to reduce circulating AGEs using dietary recommendations directed to reducing AGEs intake¹⁶, observing weight maintenance²⁷ or weight loss²⁸, depending on associated calorie restriction. In our study we observed a 39 % decrease of serum CML in the whole sample, which was higher among compliant women (53 versus 30 %, p = 0.017).

Western-type diets contain elevated quantities of AGEs²⁹, which can be absorbed in the digestive tract causing an increase of serum and tissue levels, with adverse consequences on health^{13,27}. This study confirms that it is possible to reduce circulating levels of these substances by decreasing caloric intake globally. A low AGE diet has already been shown to reduce circulating AGE levels¹⁴, and the effects of calorie restriction plus low AGEs intake have been recently demonstrated in

Table III
*Changes in laboratory variables comparing compliant versus non-compliant women**

	Compliant (n = 17)	Non-compliant (n = 30)	P
Delta carboxymethyl-lisine (ug/ml)	-0.35 (-0.6 - 0.1)	-0.10 (-0.8 - 0.2)	0.020
Delta fasting serum glucose (mg/dl)	-4.0 (-21 - 22)	4.3 (-24 - 23)	0.124
Delta fasting serum insulin (u/dl)	-1.0 (-6.7 - 6.2)	0.8 (-15.9 - 37)	0.068
Delta homa-ir	-0.2 (-1.6 - 1.3)	0.3 (-3.1 - 9.5)	0.039
Delta total cholesterol (mg/dl)	-171.2 ± 41.2	-175.3 ± 48.4	0.773
Delta hdl cholesterol (mg/dl)	-1.82 ± 9.0	-0.76 ± 8.6	0.692
Delta tryglycerides (mg/dl)	-23 (-110 - 86)	-6 (-95 - 90)	0.382

*Compliance to caloric restriction was classified according to loss of > 5 % body weight (compliant) or < 5 % loss (non-compliant).

Mexican obese men²⁸. This study adds information on the effects of a Mediterranean type of calorie restriction, without intentionally trying to lower AGEs intake in young overweight/obese Chilean women. In our earlier studies we have detected high AGEs intake (mainly in breakfast cereals, sweet snacks, powder milk, and melted cheese) especially among younger people, as the present sample¹⁹. We have measured the content of CML and other AGEs in the most frequently consumed foodstuffs (unpublished data), confirming that our progressively obese population is exposed to an elevated dietary intake of these glycotoxins. The Mediterranean diet protects from development of cardiovascular diseases and diabetes³⁰, and can be considered as a low-AGE diet¹⁶. Although MD is a form of low AGE diet, not every low AGE diet is Mediterranean. In the present intervention we made sure that patients consumed at least 1 g/kg protein, specially from animal origin such as eggs, dairy products, fish and white meats, to prevent from loss of lean body mass, so if these were cooked at high temperatures or be provided as processed foods (powder milk or canned sea products) their content in AGEs could be elevated. Respecting the MD component of our diet, it is noteworthy that adoption of MD in western countries is usually assessed through semiquantitative scores derived from dietary recalls or filled in by the patient as in this study, but these methods have been highly questioned recently^{24,25}. Moreover, the Mediterranean Pyramid has been modified several times³¹, and requires locally defined portions to assess food patterns, so the method we employed in this study although debatable, is very similar to other published Mediterranean Scores. Adherence to other kinds of low-calorie interventions can also lower the intake of glycotoxins and serum AGEs simply due to reduction in nutrient intake³².

In conclusion, a significant reduction of CML serum levels was achieved by effectively reducing calorie intake while simultaneously favoring Mediterranean nutrients, without specifically indicating to lower ingestion of foods containing elevated amounts of AGEs. Dietary recalls are inadequate to track the precise alimentary selections of each patient, but according to the attained *Fitbook* scores, our patients did not follow all our indications, so we could not address the separate contribution of the Mediterranean Diet on AGEs serum levels.

Acknowledgements

To Mrs Nancy Cruz who recruited all the participants in the study and to all the patients that volunteered to participate.

References

1. Aravanis C, Corcondilas A, Dontas AS, Lekos D, Keys A. *Circulation*. 1970;41:188-100.
2. Keys A, Menotti A, Karvonen MJ, Aravanis C, Blackburn H, Buzina R, Djordjevic BS, Dontas AS, Fidanza F, Keys MH. The diet and 15-year death rate in the seven countries study. *Am J Epidemiol*. 1986; 124: 903-15.
3. Dalen JE, Devries S. Diets to prevent coronary heart disease 1957-2013: what have we learned? *Am J Med*. 2014;127:364-9.
4. Estruch R, Ros E, Salas-Salvadó J, Covas MI, Corella D, Arós F, Gómez-Gracia E, Ruiz-Gutiérrez V, Fiol M, Lapetra J, Lamuela-Raventós RM, Serra-Majem L, Pintó X, Basora J, Muñoz MA, Sorlí JV, Martínez JA, Martínez-González MA; PREDIMED Study Investigators. Primary prevention of cardiovascular disease with a Mediterranean diet. *N Engl J Med*. 2013;368:1279-90.
5. Bach-Faig A1, Berry EM, Lairon D, Reguant J, Trichopoulos A, Dernini S, Medina FX, Battino M, Belahsen R, Miranda G, Serra-Majem L; Mediterranean Diet Foundation Expert Group. Mediterranean diet pyramid today. Science and cultural updates. *Public Health Nutr*. 2011;14:2274-84.
6. Trichopoulou A, Lagiou P. Healthy traditional Mediterranean diet: an expression of culture, history and lifestyle. *Nutrition Reviews* 1997;55:383-9.
7. Rozowski J, Castillo O. Is the Chilean diet a Mediterranean-type diet? *Biol Res*. 2004;37:313-9.
8. Aballay LR, Eynard AR, Díaz M del P, Navarro A, Muñoz SE. Overweight and obesity: a review of their relationship to metabolic syndrome, cardiovascular disease, and cancer in South America. *Nutr Rev*. 2013;71:168-79.
9. Garmendia ML, Alonso FT, Kain J, Uauy R, Corvalán C. Alarming weight gain in women of a post-transitional country. *Public Health Nutr*. 2014;17:667-73.
10. Urquiaga I, Strobel P, Perez D, Martínez C, Cuevas A, Castillo O, Marshall G, Rozowski J, Leighton F. Mediterranean diet and red wine protect against oxidative damage in young volunteers. *Atherosclerosis*. 2010;211:694-9.
11. Simopoulos AP. The Mediterranean diets: What is so special about the diet of Greece? The scientific evidence. *J Nutr* 2001; 131:3065S-73S.
12. Carrizzo A, Puca A, Damato A, Marino M, Franco E, Pompeo F, Traficante A, Civitillo F, Santini L, Trimarco V, Vecchiarelli C. Resveratrol improves vascular function in patients with hypertension and dyslipidemia by modulating NO metabolism. *Hypertension*. 2013; 62: 359-66.
13. Vlassara H, Uribarri J. Advanced glycation end products (AGE) and diabetes: cause, effect, or both? *Curr Diab Rep*. 2014;14:453-461.
14. Uribarri J, Cai W, Ramdas M, Goodman S, Pyzik R, Chen X, Zhu L, Striker GE, Vlassara H. Restriction of advanced glycation end products improves insulin resistance in human type 2 diabetes: potential role of AGER1 and SIRT1. *Diabetes Care*. 2011;34:1610-6.
15. Goldberg T, Cai W, Peppas M, Dardaine V, Baliga BS, Uribarri J, Vlassara H. Advanced glycoxidation end products in commonly consumed foods. *J Am Diet Assoc*. 2004;104:1287-91. Erratum in: *J Am Diet Assoc*. 2005 ;105:647.
16. Uribarri J, Woodruff S, Goodman S, Cai W, Chen X, Pyzik R, Yong A, Striker GE, Vlassara H. Advanced glycation end products in foods and a practical guide to their reduction in the diet. *J Am Diet Assoc*. 2010;110:911-16.
17. Panagiotakos DB, Pitsavos C, Arvaniti F, Stefanadis C. Adherence to the Mediterranean food pattern predicts the prevalence of hypertension, hypercholesterolemia, diabetes and obesity, among healthy adults; the accuracy of the MedDietScore. *Preventive Medicine* 2007; 44: 335-340.
18. Willett WC, Sacks F, Trichopoulou A, Drescher G, Ferro-Luzzi A, Helsing E, Trichopoulos D. Mediterranean diet pyramid: a cultural model for healthy eating. *Am J Clin Nutr*. 1995;61:1402S-1406S.
19. Jara N, Leal MJ, Bunout D, Hirsch S, Barrera G, Leiva L, de la Maza MP. Dietary intake increases serum levels of carboxymethyl-lysine (CML) in diabetic patients. *Nutr Hosp*. 2012; 27:1272-8.
20. Leighton F, Polic G, Strobel P, Perez D, Martinez C, Vasquez L, Castillo O, Villarreal L, Echeverria G, Urquiaga I, Mezzano

- D, Rozowski J. Health impact of Mediterranean diets in food at work. *Public Health Nutr.* 2009; 12: 1635-43.
21. Matsuda M, DeFronzo RA. Insulin sensitivity indices obtained from oral glucose tolerance testing: comparison with the euglycemic insulin clamp. *Diabetes Care* 1999;22:1462-70.
 22. Stern SE, Williams K, Ferrannini E, DeFronzo RA, Bogardus C, Stern MP. Identification of individuals with insulin resistance using routine clinical measurements. *Diabetes* 2005;54:333-9.
 23. Makita, Z., Vlassara, H., Cerami, A., Bucara, R. Immuno-chemical detection of advanced glycosylation end products. *J. Biol. Chem.* 1992; 267: 5133-36.
 24. Kipnis V, Midthune D, Freedman L, Bingham S, Day NE, Riboli E, Ferrari P, Carroll RJ. Bias in dietary-report instruments and its implications for nutritional epidemiology. *Public Health Nutr.* 2002. 5: 915-923.
 25. Kipnis, V, Subar AF, Midthune D, Freedman LS, Ballard-Barbash R, Troiano RP, Bingham S, Schoeller DA, Schatzkin A, Carroll RJ. Structure of dietary measurement error: results of the OPEN biomarker study. *Am J Epidemiol*, 2003. 158: 14-21; discussion 22-6.
 26. Dhurandhar NV, Schoeller D, Brown AW, Heymsfield SB, Thomas D, Sorensen T, Speakman JR, Jeansson M, Allison DB. Energy balance measurement: when something is not better than nothing. *Int J Obes (Lond)*. 2014; 13. (Epub ahead of print).
 27. Uribarri J, Cai W, Pyzik R, Goodman S, Chen S, Zhu L, Ramdas M, Striker GE, Vlassara H. Suppression of native defense mechanisms, SIRT1 and PPARc by dietary glycoxidants precedes disease in adult humans; relevance to lifestyle-engendered chronic diseases. *Amino Acids*. 2014; 46:301-9.
 28. Macías-Cervantes MH, Rodríguez-Soto JMD, Uribarri J, Díaz-Cisneros FJ, Cai Weijiang, Garay-Sevilla ME. Effect of an advanced glycation end product-restricted diet and exercise on metabolic parameters in adult overweight men. *Nutrition* 2014 in press.
 29. Hull GLJ, Woodside JV, Ames JM, Cuskelly GJ. Ne-(carboxymethyl) lysine content of foods commonly consumed in a Western style diet. *Food Chemistry* 2012; 131: 170-174.
 30. Salas-Salvadó J, Bulló M, Estruch R, Ros E, Covas MI, Ibarrola-Jurado N, Corella D, Arós F, Gómez-Gracia E, Ruiz-Gutiérrez V, Romaguera D, Lapetra J, Lamuela-Raventós RM, Serra-Majem L, Pintó X, Basora J, Muñoz MA, Sorlí JV, Martínez-González MA. Prevention of Diabetes With Mediterranean Diets: A Subgroup Analysis of a Randomized Trial. *Ann Intern Med*. 2014;160:1-10.
 31. Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulos A, Dernini S, Medina FX, Battino M, Belahsen R, Miranda G, Serra-Majem L; Mediterranean Diet Foundation Expert Group. Mediterranean diet pyramid today. Science and cultural updates. *Public Health Nutr.* 2011; 14: 2274-84.
 32. Gugliucci A, Kotani K, Taing J, Matsuoka Y, Sano Y, Yoshimura M, Egawa K, Horikawa C, Kitagawa Y, Kiso Y, Kimura S, Sakane N. Short-Term Low Calorie Diet Intervention Reduces Serum Advanced Glycation End Products in Healthy Overweight or Obese Adults. *Ann Nutr Metab* 2009;54:197-201.



Original/*Nutrición enteral*

A home enteral nutrition (HEN); Spanish registry of NADYA-SENPE group; for the year 2013

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Abstract

Aim: to present the results of the Spanish home enteral nutrition (HEN) registry of the NADYA-SENPE group for the year 2013.

Material and methods: from January 1st to December 31st 2013 data was recorded for the HEN registry and further descriptive and analytical analysis was done.

Results: in this period 3223 patients (50.6% men) and a total of 3272 episodes of HEN were registered in 33 Spanish hospitals. The rate of prevalence was of 67,11 patients/million habitants/ year 2013. A high percentage of patients (98,24%) were older than 14 years. Adult's mean age was 69,14 years (sd 17,64) and men were younger than women p-value <0,001. Children mean age was 2,38 years (sd 4,35). The most frequent indication for HEN was neurological disease for children (49,1%).

REGISTRO DEL GRUPO NADYA-SENPE DE NUTRICIÓN ENTERAL DOMICILIARIA EN ESPAÑA; AÑO 2013

Resumen

Objetivo: exponer los resultados del registro de nutrición enteral domiciliaria (NED) del año 2013 del Grupo NADYA-SENPE.

Material y métodos: se recopilaron los pacientes introducidos en el registro desde el 1 de enero al 31 de diciembre de 2013, procediendo al análisis descriptivo y analítico de los datos.

Resultados: durante este periodo se registraron 3.223 pacientes, (50,6% varones) y un total de 3.272 episodios de NED en 33 hospitales españoles. La tasa de prevalencia fue de 67,11pacientes/millón de habitantes/año 2013. El 98,24% de los enfermos tenía más de 14 años. La media de edad de los adultos fue de 69,14 años (dt 17,64) y la mediana se situó en 73 años (IIQ 58-83), siendo los varones más jóvenes que las mujeres; p-valor < 0,001. Los niños tuvieron una edad media de 2,38 años (dt 4,35). La enfermedad que con más frecuencia motivó el uso de la NED fue la patología neurológica en niños (49,1%) y en adultos (60,6%). La vía de administración más utilizada en los niños fue la gastrostomía (51%), siendo los niños más

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Recibido: 17-III-2015.
Aceptado: 18-IV-2015.

and for adults (60,6%). Gastrostomy was the most used administration route for children (51%) while younger ones were fed with NGT (p-value 0,003) also older adults (48%) were fed with this type of tube (p-value <0,001). The most frequent reasons for cessation of treatment was death, 44,4% were children and 54,7% were adults.

Conclusions: The number of patients and hospitals registered increased in the last years while the other variables maintain steady. The registry developed allowing contrasted analysis of data in order to get more information.

(Nutr Hosp. 2015;31:2518-2522)

DOI:10.3305/nh.2015.31.6.8983

Key words: *Enteral nutrition. Nutritional support. Home care services. Registries.*

Introduction

The home enteral nutrition (HEN) is the therapeutic method to restore or maintain nutritional status, by the administration at home of the necessary nutrients via the digestive tract in patients who can't have a regular consume of food due to their clinical situation.

This modality of artificial feeding of patients at home responds to the need to reintegrate patients back to their usual environment avoiding long periods of hospitalization, allowing familiar conciliation and improving the perceived quality of life of family and patient¹. In turn, it allows the availability of empty beds, which reduce the hospitalization and healthcare costs related to the complications proper of a long hospitalization period^{2,3}.

The home and ambulatory artificial nutrition group of the Spanish Society of Enteral and Parenteral Nutrition (NADYA-SENPE) has since 1992 a registry that collects the characteristics of the HEN and periodically communicates their results^{1,5-11}. From its beginning the collected information included the oral via but from the year 2011 only the information related to the nutrition administrated by any type of tube was taken, not including patients whom are fed though oral via even though they are having defined artificial formulas.

The aim of this work is to communicate NADYA group registry results for the year 2013.

Material and Methods

From January 1st to December 31st 2013 data was recorded for the HEN registry of NADYA-SENPE group (www.nadya-senpe.com) for patients who had enteral tube feeding. The date of query was 01-03-2015. For data processing adults and pediatric patients aged 14 years or less were considered. For prevalence rate calculation the data registered of the study population by the National Statistic Institute (INE) (<http://www.ine.es>) for the year 2013 was used.

pequeños los que se alimentaban por SNG (p-valor 0,003) y en los adultos (48%), siendo estos pacientes los de mayor edad (p-valor <0,001). El motivo más frecuente de finalización del tratamiento fue la muerte del paciente; 44,4% en niños y 54,72 en adultos.

Conclusiones: el número de pacientes y de hospitales registrados aumentan en relación con los años anteriores, mientras que las demás variables mantienen un equilibrio estacionario. El registro ha evolucionado, permitiendo un análisis contrastado de los datos, lo que nos ofrece mayor información.

(Nutr Hosp. 2015;31:2518-2522)

DOI:10.3305/nh.2015.31.6.8983

Palabras clave: *Nutrición enteral. Soporte nutricional. Cuidados domiciliarios. Registros.*

Descriptive techniques were applied for absolute frequency calculation and the related to the qualitative variables and in the case of the quantitative variables means and their standard deviation (SD) (or medians and interquartile range- IQR-, depending on distribution) were used. This was done in order to clarify about the exiting distribution.

For the analysis between variables chi-square, t-student and ANOVA test were used. The most relevant outcomes are detailed in the tables and figures. Quality control was done using cross-table data, when errors were found the original sources of the data were consulted. For data analysis Statistical Package for the Social Sciences SPSS® 22.0 was used.

Results

In this study 3.223 patients and a total of 3.272 episodes of HEN were registered (Fig. 1). Patients were from 33 Spanish hospitals with a mean of 94 patients for each hospital, a great variability was seen (max. 509-min. 2). The rate of prevalence was of 67,11 patients/million habitants/ year 2013, 50,6% of them were men.

Children: A total of 55 were registered, they represented 1,76% of the study sample. They belonged to 14 Spanish hospitals (max. 20-min1) with a total of 56 episodes due to one child had 2 episodes of HEN. Girls represented 54,5% of the sample. The mean age was 2.38 years (SD 4.35) and the median was placed in 0 years (IQR 0-2) significant differences were not found for the mean age between girls and boys, p-value 0,692. The indication for HEN was neurological disease with aphagia or severe dysphagia in 49,1% of the patients (Fig. 2). The principal via of administration was gastrostomy in 51% of them and the nasogastric tube (NGT) in 47,6%, the younger ones were preferably fed by the NGT p-value 0,003. Median time of nutritional support was of 706 days (IQR 539-900). Nine episodes of HEN were finalized due to death in 44,4% of them, a 33% returned to oral via while in

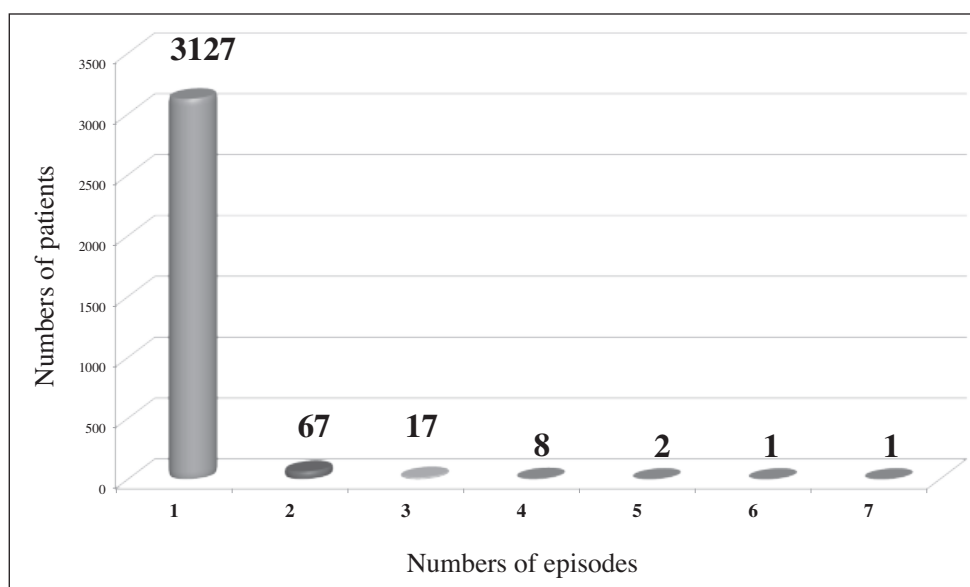


Fig. 1.—Home Enteral Nutrition episodes recorded during 2013.

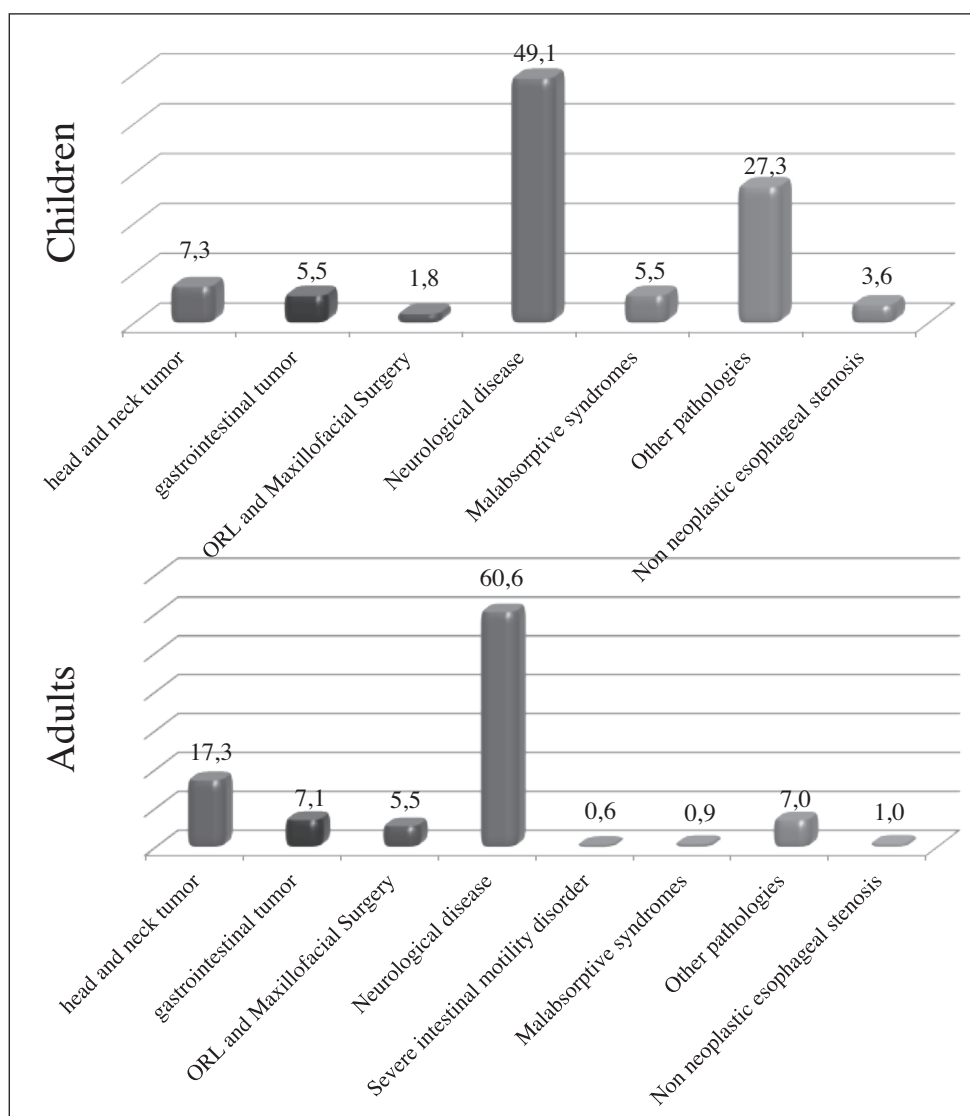


Fig. 1.—Home Enteral Nutrition episodes recorded during 2013.

22,2% presented other reasons. No relation was found between age and finalized reasons with a p-value of 0,422. Formulas needs were supplied in 63,3% by pharmacy and for 27,3% by hospitals, primary care for 3,6% of cases and commercial company in 1,8%. Consumables were provided in 78.2% of cases by the hospital, 16.4% by the primary care service and 5.5 listed as 'not required'.

Adults: A total of 3168 adults were registered and represented 98.24% of study simple. Belonged for 32 Spanish hospitals (max 507-min 1) and presented a total of 3216 episodes of HEN. Men were 50,7% of the sample. The mean age was 69,14 years (SD 17,64) and median placed in 73 years (IQR 58-83) men were younger then women with a p-value<0,001. The most frequent diagnosis that ned the use of HEN was neurological disease with aphagia or severe dysphagia in 60,6% of the cases (Fig. 2). The principal via of administration was NGT in 48,0% followed by gastrostomy in 40,8% of the cases with a higher mean age for NGT patients compared with patients who had another administration via p-value<0,001 and patients with jejunostomy were the youngest ones p-value<0,001. The median time of nutritional support was 589 days (IQR 206-950). Death was the reason for the finalization of 943 episodes of HEN (29,32%), in 17,1% because they could be fed by oral via, other 0,32% passed to parenteral nutrition and in 27,86% was for another reasons. The mean age of those who passed to oral via was lower than deceased patients p-value 0,001 and than patients that finalized for another reasons p-value<0,001. Physical activity in 49,4% of patients was reduced to bed-couch and required total assistance in 56,5% of them (Fig. 3). Nutritional formulas needs were supplied in 67,2% by pharmacy and in 25,7% of the cases by hospital. Consumables were given in 57,0% of cases by hospital, for 29% by the primary care services and the rest of patients listed as not required'.

Discussion

From the beginning of NADYA registry, the number of episodes of home enteral nutrition is constantly

increasing year after year, while we can observe in the literature that 2010 was the last year were enteral nutrition was registered by oral via¹⁰ this fact must be considered if the aim to show the evolution in these last years of the number of patients and/or episodes to avoid wrong conclusions.

Also a higher number of participating centers with registered patients were observed but this was not seen for all the centers of our group. This is one of the disadvantages of the voluntary registries¹²; its compliance must be simultaneous with the daily work of healthcare that each day has to be responding.

For years the concern of the NADYA group through its registry is to offer the maximum information about artificial nutrition in Spanish and ensure that this information allows us to learn about the characteristics of the patients although we are aware that not all patients with HEN are collected. In this sense, we can interpret that during this years patients that had this type of treatment have majorly neurological diseases and that the elder adults have the tendency to be fed by NGT while the youngest adults will be fed by a GEP tube.

The duration of the episodes has increased; a total of 351 days were seen for the years 2011 and 2012 this can explain that despite the chronicity of the patient if is properly fed in his home this can increase his life expectancy. But we must contemplate the possibility of a small bias related to the updated of patients in the registry.

The available data about children could probably be under-represented as in the case of the adults because there wasn't a total and exhaustive participation of the centers with HEN patients. In addition, due to the existence of a specific registry of pediatric patients with ambulatory and home enteral nutrition (NEPAID)¹³.

We consider that NADYA-SENPE registry is still very useful to estimate the overall and community trend of EN prescription and the characteristics of patients that receive healthcare from the National Health System. Without forbidding that some limitations have yet not been solved, as the registry is voluntary, the data must be simple to facilitate its collection and make possible increase the participation. Also is desirable that related complications could be registered

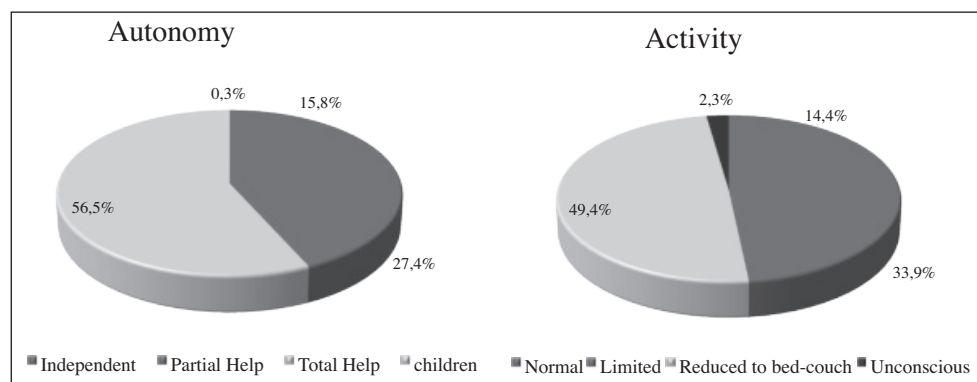


Fig. 3.—Level of autonomy and activity of patients with Home Enteral Nutrition.

and the data related to the evolution of patients could be updated in real time, avoiding potential loss of follow-up. In the last years progress has been made improving the quality of entered data by incorporation an outlier data search protocol and it has been possible to get data that allows us do hypothesis contrast. It could be interesting to incorporate as a result measure a quality of life questionnaire of these patients¹⁴. We hope to continue on improving the structure of the registry and increasing for each year the number of participating centers.

References

1. Wanden-Berghe C, Matía Martín P, Luengo Pérez LM, Cuerda Compes C, Burgos Peláez R, Álvarez Hernández J, Grupo NADYA –SENPE. Home enteral nutrition in Spain; NADYA registry 2011-2012. *Nutr Hosp*. 2014;29(6):1339-44.
2. Planas Vilá M, Wanden-Berghe Lozano C, Cuerda Compes MC y Grupo NADYA-SENPE. Guía de nutrición enteral domiciliaria en el Sistema Nacional de Salud. 2ª ed. Madrid: Ministerio de Sanidad y Consumo; 2008. ISBN 978-84-7670-695-4.
3. Stratton RJ, Elia M; British Artificial Nutrition Survey (BANS). A cost-utility analysis in patients receiving enteral tube feeding at home and in nursing homes. *Proc Nutr Soc*. 2008; 67(OCE): E111.
4. NADYA-SENPE. Grupo de Nutrición Artificial Domiciliaria Y Ambulatoria. [sede Web] Madrid, España: Sociedad Española de Nutrición Parenteral y Enteral; 1995, [actualizada 2015, citada 11 marzo 2015] disponible en: <https://nadya-senpees.sserver.es/index.php/login?language=es>
5. Cuerda C, Chicharro ML, Frías L, García Luna PP, Cardona D, Camarero E et al. Registro de la nutrición enteral domiciliaria en España en el año 2006 (Grupo NADYA-SENPE). *Nutr Hosp* 2008; 23 (2): 95-9.
6. Luengo LM, Chicharro ML, Cuerda C, García Luna PP, Rabassa A, Romero A et al. Registro de nutrición enteral domiciliaria en España en el año 2007. *Nutr Hosp* 2009; 24 (6): 655-60.
7. Pedrón-Giner C, Puiggrós C, Calañas A, Cuerda C, García-Luna PP, Irlés JA et al. Registro del grupo NADYA-SENPE de Nutrición Enteral Domiciliaria en España en el año 2008. *Nutr Hosp* 2010; 25 (5): 725-9.
8. Gómez Candela C, Cos Blanco AI, Iglesias Rosado C, Planas Vilá M, Castellá M, García Luna PP, et al. Nutrición enteral domiciliaria. Informe anual 1999 Grupo NADYA-SENPE. *Nutr Hosp*. 2002;17(1):28-33.
9. Wanden-Berghe C, Puiggrós C, Calañas A, Cuerda C, García-Luna PP, Rabassa-Soler A et al. Registro español de nutrición enteral domiciliaria del año 2009; Grupo NADYA-SENPE. *Nutr Hosp* 2010; 25 (6): 959-63.
10. Frías L, Puiggrós C, Calañas A, Cuerda C, García-Luna PP, Camarero E, Grupo NADYA-SENPE. Nutrición enteral domiciliaria en España: registro NADYA del año 2010. *Nutr Hosp*. 2012;27(1):266-69.
11. Wanden-Berghe C, Matía Martín P, Luengo Pérez LM, Cuerda Compes C, Burgos Peláez R, Álvarez Hernández J, Grupo NADYA-SENPE. Home enteral nutrition in Spain; NADYA registry 2011-2012. *Nutr Hosp*. 2014;29(6):1339-44.
12. Wanden-Berghe C, Sanz-Valero J, Culebras J, Red de Malnutrición en Iberoamérica Red MeI-CYTED. Información en Nutrición Domiciliaria: La importancia de los registros. *Nutr Hosp*. 2008; 23 (3): 220-5.
13. NEPAD. Grupo de Nutrición Enteral Pediátrica Ambulatoria y Domiciliaria. [sede Web] Madrid, España: Sociedad Española de Gastroenterología Hepatología y Nutrición Pediátrica; [citada 11 marzo 2015] disponible en: <https://www.gastroinf.es/GT%20NEPAD>.
14. Wanden-Berghe C, Sanz-Valero J, Escriba-Agüir V, Castelló-Botia I, Guardiola-Wanden-Berghe R. Evaluation of quality of life related to nutritional status. *British Journal of Nutrition*. 2009; 101: 950-60.



Original/*Alimentos funcionales*

Mediterranean countries facing the Mediterranean diet, are we still on track? The example of Southern Spain midlife women

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Abstract

Introduction and objectives: the overall intake of a cohort of middle aged women of Granada was studied along with their body composition, anthropometric and sociodemographic characteristics to evaluate if this population does really follow a Mediterranean Diet.

Methods: 206 women aged 53.3 ± 5.5 years old, were evaluated for their body composition, anthropometric and sociodemographic characteristics, dietary patterns, Mediterranean diet score and bone mineral density. Results were additionally analyzed across weight status categories.

Results: 86% of the sample was overweight or obese and 14% was normal-weight (no woman was underweight). Mean body fat percentage of the sample was 40.3%. Values of bone mineral density showed a t-score average of -1.26 standard deviations. Energy intake decreased as weight status increased ($p < 0.05$), as well as protein intake ($p < 0.05$) but no differences were observed for carbohydrates or fat. Deviations from the Daily Recommended Intakes were observed as well as a moderate adherence (23% of the sample) to the Mediterranean Diet with no significant differences among weight status categories.

Conclusions: results indicated a progressive distancing from the Mediterranean dietary pattern and an unbalanced diet no correlated to the weight status group, so whether these dietary habits along with the unbalanced diet reported are prolonged over time the overweight and obese population will increase as well as the risk of developing chronic diseases, and will finally concur with the high prevalence of cardiovascular and osteoporosis risk over this population.

(Nutr Hosp. 2015;31:2523-2532)

DOI:10.3305/nh.2015.31.6.8862

Key words: Women's Health. Mediterranean diet. Obesity. Cardiovascular disease. Osteoporosis.

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Recibido: 17-II-2015.
1.^a Revisión: 8-III-2015.
Aceptado: 10-III-2015.

LOS PAÍSES MEDITERRÁNEOS ANTE LA DIETA MEDITERRÁNEA, ¿SEGUIMOS EN EL BUEN CAMINO? EL EJEMPLO DE LAS MUJERES DE MEDIANA EDAD DEL SUR DE ESPAÑA

Resumen

Introducción y objetivos: se estudió la ingesta dietética de una cohorte de mujeres de mediana edad de Granada, junto a sus características antropométricas y sociodemográficas, para evaluar si esta población sigue una dieta mediterránea.

Métodos: se evaluó la composición corporal, características antropométricas y sociodemográficas, patrones dietéticos y adhesión a la dieta mediterránea de 206 mujeres con una edad media de 53.3 ± 5.5 años. Adicionalmente, estos resultados fueron analizados por categorías de peso corporal.

Resultados: el 86% de la muestra presentó sobrepeso u obesidad, mientras el 14% presentó normopeso. La masa grasa corporal media fue de el 40.3%. Los valores de densidad mineral ósea presentaron un t-score medio de -1.26 desviaciones estándar. Se observó que la ingesta dietética, así como el consumo de proteína, disminuyeron a medida que aumentó el peso corporal ($p < 0.05$ en ambos casos); sin embargo, no se observaron estas diferencias en la ingesta de hidratos de carbono ni de grasas. Existieron desviaciones respecto a las ingestas dietéticas de referencia y una moderada adhesión a la dieta mediterránea, sin observarse diferencias significativas entre las distintas categorías de peso corporal.

Conclusiones: los resultados sugieren un distanciamiento progresivo del patrón de dieta mediterránea y una dieta desequilibrada y no correlacionada con el peso corporal, de manera que si estos hábitos dietéticos se mantienen en el tiempo la población con sobrepeso y obesidad se incrementará y, de la misma manera, el riesgo de desarrollar enfermedades crónicas asociadas, coincidiendo finalmente con la elevada prevalencia de riesgo cardiovascular y de osteoporosis observada actualmente en esta población.

(Nutr Hosp. 2015;31:2523-2532)

DOI:10.3305/nh.2015.31.6.8862

Palabras clave: Salud de la mujer. Dieta mediterránea. Obesidad. Enfermedad cardiovascular. Osteoporosis.

Abreviaturas

MD: Mediterranean Diet.
CVD: Cardiovascular Disease.
DRIs: Dietary Reference Intakes.
BMI: Body Mass Index.
WHO: World Health Organisation.
NW/OW/OB: Normalweight/ Overweight/ Obesity.
WC: Waist Circumference.
MDS: Mediterranean Diet Score.

Introduction

Although Spain is one of the countries which represent the Mediterranean Diet (MD), last studies suggest that food consumption patterns and energy and nutrient intakes have changed markedly in the last forty years, differing somewhat at present from the traditional and healthy MD¹⁻². This phenomena is not unique in Spain, other countries traditionally associated to the MD are also experiencing the trend of adopting a more “westernised” lifestyle combined with limited awareness on health issues, poor dietary habits, and a sedentary lifestyle which provides an explanation for the increased risk of cardiovascular diseases (CVD) among the adult Mediterranean population³⁻⁵.

The biological and physiological changes that occur during menopause in midlife women, along with inadequate dietary habits may result in an increased risk of developing health problems leading by obesity and diabetes, CVD, osteoporosis and certain types of cancer⁶ which could reduce this population quality of life, increase their morbidity and mortality and as a consequence, increase the healthcare expenditure⁷.

In this context, MD is considered a benefit to human health in general and in women in particular, in terms of both primary and secondary prevention of CVD and other chronic diseases⁸⁻⁹ as well as for its benefits on the physiological and psychological changes that occur in menopause¹⁰. Many studies suggest a positive association between MD adherence and a significant reduction of overall mortality, cardiovascular, cancer, osteoporotic and neurodegenerative diseases incidence or mortality with just a slight increase of adherence to the MD^{3,9,11}. Although not all studies show a protective effect of the MD on body weight and obesity¹²⁻¹⁷, the evidence suggests a beneficial role of this dietary pattern and some of these studies show that the MD has a beneficial effect regarding body weight reduction and obesity¹⁸⁻²⁰.

Therefore the aims of this study are (i) to assess the level of adherence to the MD of a group of midlife south Spanish women as well as their dietary food habits, the level of compliance with the Dietary Reference Intakes (DRIs) and (ii) to study the impact and influence of weight status on these outcomes.

Methods

Participants and study design

The data reported here were obtained within the framework of a large-scaled study in the province of Granada, Andalusia. A cross-sectional epidemiological survey was conducted from February 2010 to June 2013. The recruitment of participants was performed by researchers from the Department of Physiology at the University Granada and by physicians from the main Primary Care Centers via personal interview or information panels. The inclusion criteria were: (a) women, (b) age ranged 45-65 years old, (c) not to have acute or terminal illness, (d) willingness to participate in the research. After being informed of the purpose and procedures of the study, 206 women aged 53.3±5.5 years old were included in the present study.

All the measurements were performed in a single day and by the same qualified and trained researchers to reduce inter-examiners variations. The study was reviewed and approved by the Ethics Committee of the University of Granada and informed consent was obtained from each subject.

Procedures

Anthropometry and body composition

A portable eight-polar tactile-electrode impedanciometer (InBody R20; Biospace, Gateshead, UK) was used to measure weight, body fat and skeletal muscle mass. The validity of this instrument has been reported elsewhere²¹. Height was measured using a stadiometer (Seca 22, Hamburg). Body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared and categorized following the World Health Organization (WHO) criteria: underweight (<18.5 kg/m²), normal-weight (NW) (18.5-24.99 kg/m²), overweight (OW) (25.0-29.99 kg/m²) and obese (OB) (≥30.0 kg/m²)²². Waist circumference (WC) was measured with the woman standing at the middle point between the ribs and ileac crest (Harpenden anthropometric tape, Holtain Ltd). Bone mineral density was measured by means of a quantitative portable ultrasound scanner (CUBA Clinical™, Sunlight Omnisense™) which measures absolute and relative values. The average relative value of bone quality used was T-score, which according to experts convened by WHO, has been recommended to define the risk of osteoporosis²³.

Dietary intake

Food consumption was assessed by a 48-h recall method validated by our group in several publications²⁴⁻²⁵, in which the participants were interviewed and asked

to recall all foods consumed during the preceding 48 hours²⁶. The data recorded concerned the type of food, the amount of food consumed, the method of preparation and the ingredients used. Note was taken of the recipes, condiments, fats or oils used and the brands of the foods²⁷.

The questionnaire was based on open-ended questions, and photographs were used as a reference for portion size. Food intakes were converted into energy and nutrients with the help of the Spanish Food Composition database²⁸, using the program *Alimentación y Salud 2120-AYS-48929-40690 Version 2.0*, designed by the Institute of Nutrition and Food Technology, University of Granada. Compliance with the DRIs was calculated using the current guidelines for the Spanish population²⁹.

Food Frequency questionnaire

It has been used a validated food frequency questionnaire, designed by Mataix et al. in 2000³⁰. It consists on a list of 78 foods on which respondent were asked the frequency of consumption (never or number of times per day, week, month or year).

Accordance with the adherence to the MD was evaluated with the Mediterranean Diet Score (MDS), an index created in 2006 by Panagiotakos et al.¹⁷ to evaluate the degree of adherence to the traditional Mediterranean dietary pattern, which represents the traditional MD consumed in Spain at around 1960³¹. It is composed of eleven variables which scores from zero to five depending on the type of food and on de consumption frequency. The MDS ranges from 0 to 55, so that higher values indicate better MD accordance. Cut-off point analysis carried out by the same group of scientists pointed out that the optimal value was 28 as it represented the minimal score at which a decrease in the relative risk of developing coronary syndromes was observed¹⁷. Furthermore, individuals in the highest tertiles of the MDS¹⁷, had 46% lower odds (odds ratio=0.54, 95% CI 0.44-0.66) of having acute coronary syndromes as compared to the individuals in the lower tertile¹⁷.

Lifestyle and clinical history

The data for this questionnaire were compiled by personal interview with their physicians using a structured questionnaire developed by the National Health Survey (Ministry of Health and Consumer Affairs, 2001)³².

Statistical analysis

The data were tested for normality before statistical analysis (i.e., skewness and kurtosis tests and his-

tograms for normality), and are presented as means (typical error), unless otherwise indicated. The association between weight status and the study outcomes was examined by one-way analysis of covariance (ANCOVA) after adjustment for age. When significant, pairwise comparisons with Bonferroni's adjustment were performed to keep the experiment wise error rate to $\alpha=0.05$ and to identify between which groups the differences were significant (e.g. OW vs. OB). Nominal variables such as the differences on obesity status categories were analysed using Chi-squared test. All analyses were performed using the Statistical Package for Social Sciences (IBM-SPSS, version 20.0 for Windows), and the level of significance was set at 0.05. Additionally, standardized effect size statistics were estimated in all the comparisons among weight status categories. We used *Cohen's d* and its exact confidence interval for all (parametric) variables. The exact confidence intervals for *Cohen's d* were obtained by means of the non-centrality parameter of the non-central Student's distribution using Wolfram-Mathematica 8.0.

Results

Socioeconomic analysis showed that more than 50% of the individuals had a medium-income status, 80% were housewives, unemployed or retired, had no studies or primary education and 92% live with at least one relative (Table I). A positive relationship between age, occupational and socioeconomic status, household members and weight was found ($p<0.05$).

Anthropometric characteristics of the study participants are shown in Table II. 86% of the sample was OW or OB (no woman was underweight). Mean body fat percentage of the sample was 40.32% with an average value of WC of 91.4 cm. Values of bone mineral density, expressed as t-score, showed an average of -1.26 standard deviations.

Table III shows daily intakes and level of compliance with DRIs of energy and nutrients depending on BMI after being adjusted for age (data from 48-h recall). Energy intake was lower as weight status increased ($p<0.05$). Pairwise analysis showed differences between the NW compared to the OW and OB groups (both $p<0.05$). Likewise protein intake decreased as weight status increased ($p<0.05$) and pairwise analysis showed differences between the NW compared to the OW and OB groups (both $p<0.05$). No differences between weight status groups were observed for carbohydrates, total fat, saturated, monounsaturated or polyunsaturated fats. Regarding DRIs, cholesterol, protein and total fat intakes exceed it while carbohydrate intake remained under the recommendations for all weight groups. Vitamin intakes did not differ among groups except for vitamin B2 and biotin, whose intakes decreased as weight status increased and in which pairwise analysis showed differences between the NW compared to the OB group ($p<0.05$). Mine-

Table I
Sociodemographic characteristics of the study sample

		BMI (kg/m ²)			p-value
		≤24.99%	25-29.99%	≥30%	
Age	45-54 years N=129 (62.6%)	11.6	62	26.4	<i>p</i> <0.001
	55-65 years N=77 (37.4%)	18.2	33.8	48.1	
	Total	14.1	51.5	34.5	
Occupational Status	Housewife/Retired N=111 (53.6%)	12.4	47.2	40.4	<i>p</i> =0.038
	Unemployed/Temporal work N=59 (28.9%)	6.2	64.6	29.2	
	Working N=36 (17.5%)	27.6	41.4	31	
	Total	13.3	51.2	35.5	
Socioeconomic Status	Low income N=76 (37%)	13.1	47.5	39.3	<i>p</i> =0.045
	Medium income N=119 (57.6%)	9.5	55.8	34.7	
	High income N=11 (5.5%)	44.4	33.3	22.2	
	Total	12.7	51.5	35.8	
Educational Status	No formal education N=28 (13.6%)	18.2	40.9	40.9	<i>p</i> =0.144
	Primary/secondary school N=135 (65.5%)	8.4	54.2	37.4	
	Professional Training/ University N=43 (20.9%)	38.1	20.2	15.5	
	Total	12.9	51.5	35.6	
Household	Alone N=16 (92.1%)	38.5	23.1	38.5	<i>p</i> =0.008
	Husband/parents/sons N=190 (7.9%)	10.5	53.9	35.5	
	Total	12.7	51.5	35.8	

BMI, body mass index.

ral intakes showed differences in sodium and chlorine whose intakes decreased as weight status increased and in which pairwise analysis showed differences between the NW compared to the OB group (both

p<0.05). Nutritional requirements for vitamin D, zinc and iodine intake were below the recommendations for all weight status groups.

Table IV shows the Food Consumption Pattern and the level of compliance with DRIs depending on BMI (data from Food Frequency Questionnaire). No significant differences between weight status groups were observed except for sweet consumption, in which pairwise comparisons showed differences between NW and OB group (*p*<0.05), and all groups exceed the DRIs. Other results were observed regarding the quality of the diet. None of the groups present an intake of cereals over the DRIs, neither of water, eggs, nor of fruit. Regarding meat, viscera and meat sub products (sausages, salami, etc.) and sweetened beverages, intakes exceed de DRIs.

Finally, MDS values did not show statistical differences across weight status categories and positioned women in the second tertile of the score³³.

Discussion

The findings of the study should be taken with caution due to the fact that the study sample was relatively small, of convenience, and not represen-

Table II
Anthropometry and body composition of the study sample

<i>Anthropometric measures</i>	<i>Mean (SD)</i>
Weight, kg	71.62 (12.59)
BMI, kg/m ²	29.72 (5.04)
Fat mass, %	40.32 (6.31)
WC, cm	91.36 (11.72)
WC>cutoff limits, %	58.1
WC/Height Ratio	0.58 (0.07)
WC/Height Ratio >cutoff limits, %	91.9
Weight Status, NW/OW/OB (%)	14.1/51.5/34.5
t-score, standard deviations	-1.26 (1.03)

Values expressed as mean (standard deviation), otherwise indicated; SD, standard deviation; BMI, body mass index; WC, waist circumference; NW, normal-weight; OW, overweight; OB obese.

Table III
Energy and Nutrient Intake of the study sample across weight status categories

	Intakes					%DRI		
	BMI (kg/m ²)			<i>p</i> -value	<i>Effect size</i>	BMI (kg/m ²)		
	≤24.99 (<i>n</i> =29)	25-29.99 (<i>n</i> =106)	≥30 (<i>n</i> =71)			≤24.99	25-29.99	≥30
Kcal	1968.24 (94.98) ^{*†}	1688.69 (50.25) [*]	1645.29 (61.26) [†]	0.014	0.64 (0.21-1.05)	107.37 (5.92)	93.18 (3.39)	88.12 (3.89)
Proteins, g	91.36 (4.90) ^{*†}	77.13 (2.59) [*]	75.06 (3.16) [†]	0.017	0.62 (0.21-1.03)	216.76 (13.03)	186.79 (7.47)	181.03 (8.57)
Carbohydrates, g	221.63 (12.20)	193.60 (6.45)	190.51 (7.87)	0.083	0.47 (0.07-0.88)	76.34 (2.88)	76.32 (1.65)	78.69 (1.90)
Total Fat, g	82.39 (5.25)	70.80 (2.78)	69.03 (3.39)	0.090	0.47 (0.07-0.88)	126.39 (5.62)	125.17 (3.23)	118.41 (3.70)
SFA, g	19.88 (1.51)	17.27 (0.80)	16.38 (0.97)	0.151	0.43 (0.03-0.84)	89.84 (5.48)	92.28 (2.90)	88.81 (3.54)
MUFA, g	36.42 (2.53)	32.37 (1.34)	31.93 (1.63)	0.298	0.33 (0.07-0.73)	138.58 (8.00)	145.61 (4.23)	145.42 (5.16)
PUFA, g	12.58 (1.55)	10.30 (0.82)	10.36 (1.00)	0.403	0.31 (0.09-0.72)	52.02 (5.21)	48.26 (2.75)	48.54 (3.36)
Cholesterol, mg	234.12 (27.24)	239.65 (14.41)	254.51 (17.57)	0.750	0.10 (0.30-0.50)	119.04 (15.19)	119.65 (8.72)	123.71 (10.00)
Fiber, g	23.06 (1.66)	20.16 (0.88)	20.97 (1.06)	0.301	0.37 (0.03-0.78)	89.68 (8.00)	83.53 (4.59)	87.69 (5.27)
Vit A, μg	1033.61 (177.00)	805.84 (93.64)	850.69 (114.16)	0.525	0.28 (0.13-0.68)	125.20 (29.92)	118.22 (17.17)	112.27 (19.69)
Vit B1, mg	1.77 (0.22)	1.59 (0.11)	1.63 (0.14)	0.764	0.18 (0.22-0.58)	222.91 (35.48)	216.72 (20.36)	212.07 (23.35)
Vit B2, mg	2.54 (0.23) [*]	1.96 (0.12)	1.88 (0.15) [*]	0.041	0.53 (0.12-0.94)	200.85 (23.09)	177.75 (13.25)	152.27 (15.20)
Vit B6, mg	2.21 (0.54)	2.33 (0.29)	1.83 (0.35)	0.551	0.19 (0.21-0.59)	133.95 (37.76)	162.00 (26.56)	114.81 (30.46)
Vit B12, μg	6.07 (2.16)	8.52 (1.14)	5.60 (1.39)	0.238	0.28 (0.12-0.68)	357.60 (74.50)	392.11 (42.74)	301.34 (49.02)
Vit C, mg	183.51 (19.64)	161.32 (10.39)	169.49 (12.67)	0.596	0.24 (0.16-0.65)	282.59 (37.56)	279.32 (21.55)	289.07 (24.71)
Vit D, μg	6.12 (1.05)	3.80 (0.56)	3.29 (0.68)	0.075	0.50 (0.09-0.91)	87.02 (19.66)	83.62 (11.28)	58.48 (12.94)
Vit E, mg	12.82 (1.26)	10.97 (0.67)	10.78 (0.81)	0.366	0.30 (0.10-0.71)	103.61 (12.57)	92.71 (7.21)	85.31 (8.27)
Niacin, mg	31.97 (3.25)	26.18 (1.72)	24.08 (2.10) ^b	0.127	0.45 (0.05-0.86)	230.63 (30.40)	208.71 (17.44)	174.11 (20.00)
Pantotenic Acid	4.82 (0.40)	4.69 (0.21)	4.87 (0.26)	0.861	0.11 (0.29-0.51)	-	-	-
Biotin, μg	14.13 (2.07) [*]	8.87 (1.10)	8.06 (1.34) [*]	0.041	0.55 (0.14-0.96)	-	-	-
Folate, μg	302.51 (25.92)	301.49 (13.71)	292.35 (16.71)	0.903	0.07 (0.33-0.47)	142.34 (15.57)	157.08 (8.93)	141.82 (10.24)
Sodium, mg	2357.74 (227.75) [*]	1832.40 (120.49)	1583.84 (146.89) [*]	0.014	0.69 (0.27-1.10)	117.36 (11.36)	91.83 (5.99)	79.22 (7.33)

Table III (cont.)
Energy and Nutrient Intake of the study sample across weight status categories

	<i>Intakes</i>					<i>%DRI</i>		
	<i>BMI (kg/m²)</i>			<i>p-value</i>	<i>Effect size</i>	<i>BMI (kg/m²)</i>		
	<i>≤24.99</i> <i>(n=29)</i>	<i>25-29.99</i> <i>(n=106)</i>	<i>≥30</i> <i>(n=71)</i>			<i>≤24.99</i>	<i>25-29.99</i>	<i>≥30</i>
Potassium,mg	3247.18 (194.61)	2910.21 (102.96)	2865.11 (125.51)	0.233	0.37 (0.04-0.77)	92.78 (5.58)	83.55 (2.94)	81.91 (3.60)
Calcium,mg	910.71 (57.06)	876.34 (30.19)	834.10 (36.80)	0.480	0.25 (0.15-0.65)	104.19 (8.31)	107.55 (4.77)	98.82 (5.47)
Phosphorus,mg	1308.45 (69.22)	1153.60 (36.62)	1141.34 (44.64)	0.102	0.45 (0.04-0.86)	182.40 (10.63)	165.19 (5.40)	164.72 (6.65)
Magnesium,mg	347.16 (21.75)	309.06 (11.51)	292.36 (14.03)	0.109	0.47 (0.06-0.88)	107.08 (7.33)	103.77 (4.21)	94.48 (4.82)
Iron,mg	14.97 (3.29)	16.27 (1.74)	16.77 (2.12)	0.899	0.07 (0.33-0.48)	122.29 (40.61)	150.68 (23.30)	162.66 (26.72)
Zinc,mg	8.51 (0.68)	7.60 (0.36)	6.94 (0.44)	0.142	0.43 (0.02-0.84)	54.01 (7.27)	51.78 (4.17)	49.50 (4.78)
Iodine, µg	102.73 (14.41)	101.13 (7.62)	85.67 (9.29)	0.392	0.22 (0.18-0.62)	77.27 (13.37)	87.89 (7.67)	77.32 (8.80)
Cooper, µg	12.08 (5.56)	7.67 (2.94)	4.98 (3.59)	0.558	0.24 (0.16-0.64)	-	-	-
Chlorine,mg	2648.73 (318.62)*	2028.76 (168.57)	1705.00 (205.50)*	0.046	0.55 (0.14-0.96)	-	-	-
Manganese,mg	12.84 (4.89)	8.27 (2.59)	3.67 (3.16)	0.318	0.35 (0.05-0.75)	-	-	-
Selenium, µg	83.22 (5.70)	67.38 (3.02)	71.28 (3.67)	0.073	0.60 (0.18-1.01)	149.51 (10.38)	123.07 (5.47)	129.69 (6.69)

Values expressed as mean (standard error).SFA, Saturated Fatty Acids; MUFA, Monounsaturated Fatty Acids; PUFA, Polyunsaturated Fatty Acids.

*.† Common superscripts in a same row indicate a significant difference ($P<0.05$) between the groups with the same symbol; Pairwise comparisons were performed with Bonferroni's adjustment.

tative of the region studied. On the other hand, the findings of the present study have highlighted some aspects which deeply differ from the nutrition goals for this population and concur with the general trend in Spain as well in other Mediterranean countries of showing a dangerous departure from the traditional MD which, from the 60s, has characterized this area^{2,34-37}. Concretely, our results indicated that, despite than more than 93.1% of the sample was over the cut-off limits³³ only the 23% were in the highest tertiles of the MDS.

Rates of OW and OB and central adiposity (as measured through the WC and WC/height ratio) were extremely high. In fact 60% and 91.4% of the sample were over the cutoff limits respectively³⁸. However, these alarming values do not differ from other epidemiological studies developed in Spain^{4,39-42}, neither from data from the WHO⁴³. Indeed, Andalusia stands out for being one of the communities with higher prevalence of OB in the country what clearly position these women at an increased CVD risk^{38,44}.

The macro and micronutrients analysis of the diet showed clear deviations from the Food Consumption Guidelines developed by the Spanish Society of Community Nutrition²⁹. We have observed an unbalanced daily intake of energy and macronutrients in favor of a higher consumption of proteins (190% of DRIs) and fat (122% of DRIs) and the low percentage of carbohydrates (76% of DRIs) (Fig. 1) which, as expected, is a general trend in the Spanish population^{1,37,45}. This concurs with the results observed regarding to the dietary patterns in which cereals, main source of this macronutrient, were below the recommendations in all weight status groups. As expected, the contrary has been observed in meat, viscera and sub products, which were far away from the recommended intakes. This may explain the high total cholesterol intake found too, and could agree with the high prevalence of OW and OB aforementioned. The lack of cereals in the diet, mainly whole grain cereals, is in accordance with the general trend observed in other studies in Spain^{1,45-46}, even in this group the intakes are slightly higher respect to

Table IV
Food frequency patterns of the study sample across weight status categories

	Intakes					%DRI		
	BMI (kg/m ²)			p-value	Effect size	BMI (kg/m ²)		
	≤24.99 (n=29)	25-29.99 (n=106)	≥30 (n=71)			≤24.99	25-29.99	≥30
Cereals ,svg/d	3.65 (0.24)	3.44 (0.12)	3.55 (0.15)	0.697	0.19 (0.21-0.60)	73.02 (4.77)	68.84 (2.44)	71.00 (2.99)
Dairy products svg/d	2.95 (0.22)	2.74 (0.11)	2.61 (0.14)	0.436	0.29 (0.11-0.70)	98.37 (7.45)	91.54 (3.81)	87.18 (4.66)
Vegetables (svg/d)	4.15 (0.30)	3.73 (0.15)	3.76 (0.18)	0.447	0.31 (0.09-0.71)	207.34 (14.78)	186.66 (7.55)	188.08 (9.25)
Fruits, svg/d	1.99 (0.23)	2.20 (0.12)	1.98 (0.15)	0.459	0.15 (0.55-0.25)	66.36 (7.79)	73.24 (3.98)	65.88 (4.88)
Meat and subproducts, svg/w	4.04 (0.36)	3.77 (0.18)	3.90 (0.22)	0.781	0.17 (0.23-0.57)	115.39 (10.21)	107.82 (5.22)	111.37 (6.39)
Fish, svg/w	5.12 (0.43)	4.40 (0.22)	4.83 (0.27)	0.245	0.37 (0.04-0.77)	146.29 (12.39)	125.72 (6.33)	137.87 (7.75)
Eggs, svg/w	2.32 (0.20)	2.04 (0.10)	2.19 (0.12)	0.389	0.31 (0.09-0.72)	66.36 (5.69)	58.40 (2.91)	62.73 (3.56)
Pulses, svg/w	2.94 (0.23)	2.77 (0.12)	2.71 (0.15)	0.701	0.18 (0.22-0.59)	117.64 (9.33)	111.00 (4.77)	108.37 (5.84)
Viscera and meat subproducts, svg/w	6.86 (0.84)	5.75 (0.43)	6.18 (0.53)	0.481	0.11 (0.51-0.29)	342.88 (41.98)	287.46 (21.46)	308.95 (26.28)
Sugar and Sweets, svg/w	9.99 (1.40)	8.81 (0.72)*	6.63 (0.88)*	0.036	0.49 (0.08-0.89)	666.23 (93.50)	587.16 (47.79)	441.86 (58.53)
Fats, svg/w	3.04 (0.15)	2.88 (0.08)	2.98 (0.09)	0.537	0.14 (0.55-0.26)	-	-	-
Alcoholic beverages, svg/w	3.70 (0.69)	2.58 (0.41)	2.06 (0.50)	0.221	0.32 (0.73-0.08)	-	-	-
Non-alcoholic beverages, svg/w	2.88 (1.12)	3.15 (0.57)	3.71 (0.70)	0.759	0.14 (0.54-0.26)	192.27 (74.47)	209.77 (38.06)	247.46 (46.61)
Water (ml/day)	1205 (130)	1310 (65)	1317 (80)	0.737	0.18 (0.58-0.22)	60.24 (6.48)	65.54 (3.31)	65.85 (4.05)
MDS	34.04 (0.95)	33.14 (0.49)	33.64 (0.60)	0.651	0.20 (0.19-0.61)	-	-	-

Values expressed as mean (standard error). MDS, Mediterranean Diet Score

*.† Common superscripts in a same row indicate a significant difference (P<0.05) between the groups with the same symbol; Pairwise comparisons were performed with Bonferroni's adjustment.

those previously mentioned. Since the 1960's, cereals and its derivatives have shown a marked decrease (434 g/day in 1964 vs. 214 g/day in 2006)¹ and still is bread the most important food within this group in which has been observed that white bread consumption represented 2/3 of total bread intake while whole bread represented 1/3. Although last studies have demonstrated that the consumption of dietary fiber and whole grain intake is inversely related to obesity, type two diabetes, cancer and CVD⁴⁷⁻⁴⁸, it seems like the message has not been taken hold onto the general population, who is still in the wrongly believe that bread contributes to weight gain, which is not true in the case of who-

le grain type⁴⁶. In the same trend is the consumption of eggs which was under the recommendations in all weight status groups following a decrease since the 2000 (4.6 medium-size eggs/week vs 3.7 medium-size eggs/week in 2006)^{1,49}. The decline in egg consumption is probably due to the general concern that eggs are 'unhealthy', based on their cholesterol content. Although it is true that eggs contain cholesterol, it must be remembered that the consumption of saturated fatty acids has a higher influence on cholesterol levels than dietary cholesterol¹. Fruits consumption still remained under the recommendations accordingly to other Spanish studies^{1,45}. Nevertheless, its consump-

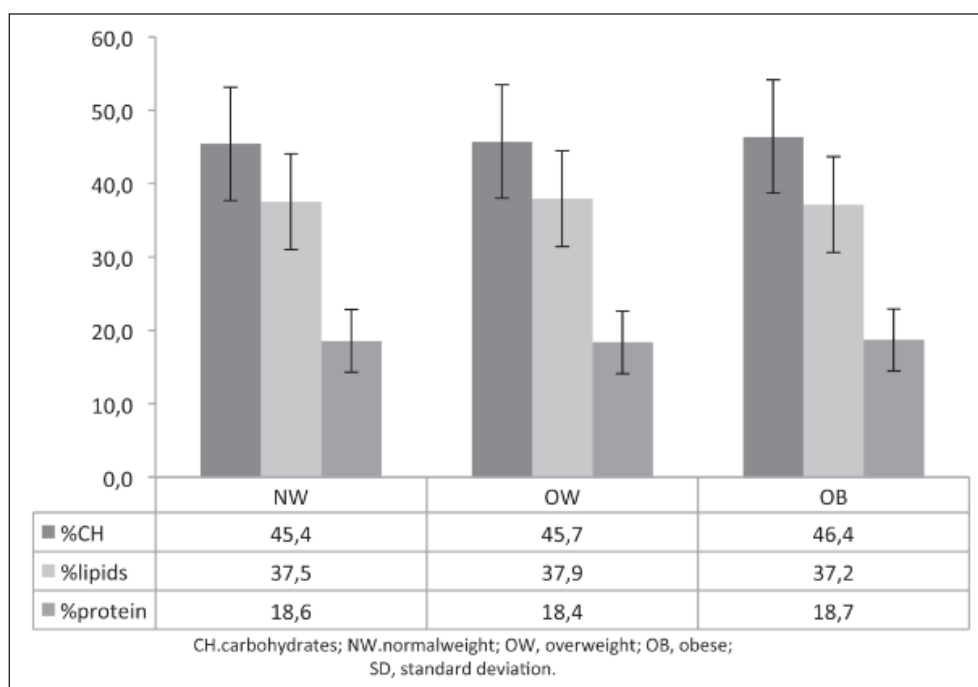


Fig. 1.—Percentaje of Kcal provided by macronutrients across weight status categories.

tion, when compared with 1964 data, has nearly doubled^{1,45,49}. Finally water consumption it has been also found to be inadequate with almost the whole sample below the 2/3 of the recommendations. Nonetheless, comparisons with other studies have been difficult to conduct due to the lack of consensus about the methodology used⁵⁰⁻⁵¹ and the scarcity of them⁵². Since water is considered an essential nutrient for life it should be taken into account in every nutrient assessment study. Unfortunately, most studies underestimate water collection as part of the diet, since it contributes with no calories and no nutrients.

In contrast, it has been observed a marked rise on total food intake, far away from recommendations especially based on viscera and meat sub products, sugar, sweets and sweetened beverages². The high meat consumption observed in this study concurs with the general trend in Spain which has remained constant in the last decade⁵². Despite sweet consumption greatly exceeded the DRIs for all weight status groups, its consumption and its relation with OW and OB status is still uncertain, as studies provide a lack of consensus and inconsistent results⁵³. Indeed, the results observed showed a negative correlation with BMI, as well as for Energy intake, which should be considered cautiously since it is well known that overweight and obese persons are likely to underreport intake during dietary recall⁵⁴, representing one potential limitation of our study. Nevertheless, the relationship between the consumption of sugar-sweetened beverages and body weight has become a matter of much public and scientific interest⁵⁵. Added sugar has been evidenced as a contributor to weight gain in children and adults⁵³ and probably to the risk of diabetes, fractures, and dental

caries⁵⁵. The lack of a significant difference in the present study between groups may be due to the effect size, characterised by a small sample size representing the NW group.

When analysing these results as a whole and comparing it with similar studies¹, is observed that MD is at risk precisely in the Mediterranean population, and that risk does exist not only in the OW and OB population but throughout the study sample independently of their weight status, so whether these dietary habits along with the unbalanced diet reported are prolonged over time the overweight and obese population will increase as well as the risk of developing any of the aforementioned chronic diseases, and will finally concur with the high prevalence of cardiovascular⁴⁰ and osteoporosis risk over this population⁵⁶.

There are several limitations inherent in our study design. The study was observational in its nature and, although likely to be reflective of usual dietary patterns, may be subject to selection bias. Results may be biased by the use of a convenience sample and by the selection of patients who consented to the study. The study results are partially based on patient self-report, which is subject to the influence of memory and other subjective factors as the general trend of underreport by obese and overweight patients⁵⁴. In addition, the study lacked of a high sample size and it was carried out only in midlife women, so that future studies should be replicated in other age groups. On the other hand, this study examined a complete range of nutritional behaviors and patterns in a single report, it was corrected by a potential confounder (age), with the use of published validation studies for most of the measurements^{5,24-25} including dietary assessment, which

allowed us to deeply explore nutritional status. Finally, the present study, further categorized the sample by weight status categories (i.e. NW, OW and OB) in order to test the presence or absence of significant differences between dietary habits and nutrient intake across weight status categories.

Conclusions

Despite that dietary guidelines warn against unhealthy-related eating behaviors, these results point to a deficient dissemination and implementation of these guidelines, as well as a progressive distancing from the Mediterranean dietary pattern. This study should stimulate further research, involving larger sample sizes, on MDS and other health indicators in understudied populations because it may in effect have the potential to find out the main deviations of the traditional MD and healthy patterns that have characterized the Mediterranean countries, and could be the key to the development of customized educational programs aimed to be effective. Indeed, initiatives such as improving nutritional education and lifestyle in this population from primary care centers could help reduce the burden of chronic diseases and their associated costs.

Finally, taking into account that in Spain most of midlife women have an important role in education and nutritional habits of their household, the beneficiaries of these initiatives could be extended and reach beyond the purpose of this project.

Conflict of interest

The authors report no conflict of interest.

Source of funding

This study was in part financially supported by the Andalusian Junta, within the framework of a large-scaled study in the province of Granada, PI339/2008, “*Evaluación y Educación Nutricional de un grupo de mujeres peri y menopáusicas integradas en un estudio de intervención multidisciplinar*”. It is also part of main’s authors PhD.

References

- Varela-Moreiras G, Avila JM, Cuadrado C, del Pozo S, Ruiz E, Moreiras O. Evaluation of food consumption and dietary patterns in Spain by the Food Consumption Survey: updated information. *Eur. J. Clin. Nutr.* 2010;64 Suppl 3:S37-43.
- Varela-Moreiras G, Ruiz E, Valero T, Avila JM, del Pozo S. The Spanish diet: an update. *Nutr. Hosp.* 2013;28 Suppl 5:13-20.
- Manios Y, Moschonis G, Grammatikaki E, Katsaroli I, Kanellou P, Tanagra S. Nutrition education in postmenopausal women: changes in dietary and cardiovascular indices. *Maturitas* 2006;55(4):338-47.
- Rodriguez-Rodriguez E, Lopez-Plaza B, Lopez-Sobaler AM, Ortega RM. [Overweight and obesity among Spanish adults]. *Nutr. Hosp.* 2011;26(2):355-63.
- Aparicio VA, Ortega FB, Baeza AC, Fernandez MM, Senhaji M, Ruiz JR, et al. Fitness, fatness and cardiovascular profile in South Spanish and North Moroccan women. *Nutr. Hosp.* 2011;26(5):1188-92.
- Eckel RH, Kahn R, Robertson RM, Rizza RA. Preventing cardiovascular disease and diabetes: a call to action from the American Diabetes Association and the American Heart Association. *Circulation* 2006;113(25):2943-6.
- Haring B, Leng X, Robinson J, Johnson KC, Jackson RD, Beyth R, et al. Cardiovascular disease and cognitive decline in postmenopausal women: results from the Women’s Health Initiative Memory Study. *J Am Heart Assoc* 2013;2(6):e000369.
- Saulle R, Semyonov L, La Torre G. Cost and cost-effectiveness of the Mediterranean diet: results of a systematic review. *Nutrients* 2013;5(11):4566-86.
- Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. *Am. J. Clin. Nutr.* 2010;92(5):1189-96.
- Munoz MA, Fito M, Marrugat J, Covas MI, Schroder H, Investigators RH. Adherence to the Mediterranean diet is associated with better mental and physical health. *Brit J Nutr* 2009;101(12):1821-27.
- Perk J, De Backer G, Gohlke H, Graham I, Reiner Z, Verschuren M, et al. European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts). *Eur. Heart J.* 2012;33(13):1635-701.
- Giugliano D, Esposito K. Mediterranean diet and metabolic diseases. *Curr. Opin. Lipidol.* 2008;19(1):63-8.
- Pitsavos C, Panagiotakos DB, Tzima N, Chrysoshoou C, Economou M, Zampelas A, et al. Adherence to the Mediterranean diet is associated with total antioxidant capacity in healthy adults: the ATTICA study. *Am. J. Clin. Nutr.* 2005;82(3):694-9.
- Ryan M, McInerney D, Owens D, Collins P, Johnson A, Tomkin GH. Diabetes and the Mediterranean diet: a beneficial effect of oleic acid on insulin sensitivity, adipocyte glucose transport and endothelium-dependent vasoreactivity. *QJM* 2000;93(2):85-91.
- Dai J, Jones DP, Goldberg J, Ziegler TR, Bostick RM, Wilson PW, et al. Association between adherence to the Mediterranean diet and oxidative stress. *Am. J. Clin. Nutr.* 2008;88(5):1364-70.
- Psaltopoulou T, Naska A, Orfanos P, Trichopoulos D, Moun-takalakis T, Trichopoulou A. Olive oil, the Mediterranean diet, and arterial blood pressure: the Greek European Prospective Investigation into Cancer and Nutrition (EPIC) study. *Am. J. Clin. Nutr.* 2004;80(4):1012-8.
- Panagiotakos DB, Pitsavos C, Stefanadis C. Dietary patterns: a Mediterranean diet score and its relation to clinical and biological markers of cardiovascular disease risk. *Nutr Metab Cardiovasc Dis* 2006;16(8):559-68.
- McManus K, Antinoro L, Sacks F. A randomized controlled trial of a moderate-fat, low-energy diet compared with a low fat, low-energy diet for weight loss in overweight adults. *Int. J. Obes. Relat. Metab. Disord.* 2001;25(10):1503-11.
- Mendez MA, Popkin BM, Jakszyn P, Berenguer A, Tormo MJ, Sanchez MJ, et al. Adherence to a Mediterranean diet is associated with reduced 3-year incidence of obesity. *J. Nutr.* 2006;136(11):2934-8.
- Morales-Falo EM, Sanchez-Moreno C, Esteban A, Alburquerque JJ, Garaulet M. [Quality of the diet “before and during” a weight loss treatment based on Mediterranean Diet; behavioural therapy and nutritional education]. *Nutr Hosp* 2013;28(4):980-7.

21. Malavolti M, Mussi C, Poli M, Fantuzzi AL, Salvioi G, Battistini N, et al. Cross-calibration of eight-polar bioelectrical impedance analysis versus dual-energy X-ray absorptiometry for the assessment of total and appendicular body composition in healthy subjects aged 21-82 years. *Ann. Hum. Biol.* 2003;30(4):380-91.
22. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: executive summary. Expert Panel on the Identification, Evaluation, and Treatment of Overweight in Adults. *Am. J. Clin. Nutr.* 1998;68(4):899-917.
23. Cook RB, Collins D, Tucker J, Zioupos P. The ability of peripheral quantitative ultrasound to identify patients with low bone mineral density in the hip or spine. *Ultrasound Med. Biol.* 2005;31(5):625-32.
24. Mataix J, Aranda P, Lopez-Jurado M, Sanchez C, Planells E, Llopis J. Factors influencing the intake and plasma levels of calcium, phosphorus and magnesium in southern Spain. *Eur. J. Nutr.* 2006;45(6):349-54.
25. Mataix J, Aranda P, Sanchez C, Montellano MA, Planells E, Llopis J. Assessment of thiamin (vitamin B1) and riboflavin (vitamin B2) status in an adult Mediterranean population. *Br J Nutr* 2003;90(3):661-6.
26. Bingham SA, Cassidy A, Cole TJ, Welch A, Runswick SA, Black AE, Thurnham D, Bates C, Khaw KT, Key TJ & Day NE: Methods for data collection at an individual level. Manual on methodology for food consumption studies. Edited by ME Cameron & WA van Staveren. Oxford: Oxford University Press; 1988.
27. Gómez J, Montellano MA, García L, Llopis J. "Manual de fotografías para encuestas alimentarias" Servicio de Publicaciones. Universidad de Granada. Granada. 1992
28. Mataix J, Mañas M, Llopis J, Martínez de Victoria E, Juan J, Borregón A: Tablas de composición de alimentos españoles. Edited by: Universidad de Granada. Granada; 1998.
29. Moreiras O CA, Cabrera L, Cuadrado C, editor. *Tablas de composición de alimentos/Guía de Prácticas*, 2013.
30. Mataix J, Llopis J, Martínez de Victoria E. et al. Valoración del estado nutricional de la Comunidad Autónoma de Andalucía. Consejería de Salud. 2000.
31. Helsing E. Traditional diets and disease patterns of the Mediterranean, circa 1960. *Am. J. Clin. Nutr.* 1995;61(6 Suppl):1329S-37S.
32. Ministry of Health and Consumer Affairs: Encuesta nacional de salud, Madrid, Spain: 2001
33. Panagiotakos DB, Pitsavos C, Arvaniti F, Stefanadis C. Adherence to the Mediterranean food pattern predicts the prevalence of hypertension, hypercholesterolemia, diabetes and obesity, among healthy adults: the accuracy of the MedDietScore. *Prev Med* 2007;44(4):335-40.
34. Leon-Munoz LM, Guallar-Castillon P, Graciani A, Lopez-Garcia E, Mesas AE, Aguilera MT, et al. Adherence to the Mediterranean diet pattern has declined in Spanish adults. *J. Nutr.* 2012;142(10):1843-50.
35. Zazpe I, Sanchez-Tainta A, Toledo E, Sanchez-Villegas A, Martinez-Gonzalez MA. Dietary patterns and total mortality in a Mediterranean cohort: the SUN project. *J Acad Nutr Diet* 2014;114(1):37-47.
36. Ciprian D, Navarrete-Munoz EM, Garcia de la Hera M, Gimenez-Monzo D, Gonzalez-Palacios S, Quiles J, et al. [Mediterranean and Western dietary patterns in adult population of a Mediterranean area; a cluster analysis]. *Nutr Hosp* 2013;28(5):1741-9.
37. Ortega Anta RM, Lopez Sobaler AM. [Primeras Jornadas UCM-ASEN Avances y controversias en nutrición y salud]. *Nutr Hosp* 2014;30 Suppl 2:1-104.
38. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. *Obes Rev* 2012;13(3):275-86.
39. Llana P, Inarrea J, Gonzalez C, Alonso A, Arnott I, Ferrer-Barriendos J. Differences in health related quality of life in a sample of Spanish menopausal women with and without obesity. *Maturitas* 2007;58(4):387-94.
40. Grau M, Ellosua R, Cabrera de Leon A, Guembe MJ, Baeza-Diez JM, Vega Alonso T, et al. Cardiovascular Risk Factors in Spain in the First Decade of the 21st Century, a Pooled Analysis With Individual Data From 11 Population-Based Studies: the DARIOS Study. *Rev Esp Cardiol (Engl Ed)* 2011;64(4):295-304.
41. Gutierrez-Fisac JL, Guallar-Castillon P, Leon-Munoz LM, Graciani A, Banegas JR, Rodriguez-Artalejo F. Prevalence of general and abdominal obesity in the adult population of Spain, 2008-2010: the ENRICA study. *Obes Rev* 2012;13(4):388-92.
42. Fernandez-Ruiz VE, Paniagua-Urbano JA, Sole-Agusti M, Ruiz-Sanchez A, Gomez-Marin J. [Prevalence of metabolic syndrome and cardiovascular risk in an urban area of Murcia]. *Nutr Hosp* 2014;30(5):1077-83.
43. Who media center. Fact sheet N° 311. Visited 26th September, 2014. Available at <http://www.who.int/mediacentre/factsheets/fs311/en/>
44. Guallar-Castillon P, Perez RF, Lopez Garcia E, Leon-Munoz LM, Aguilera MT, Graciani A, et al. Magnitude and management of metabolic syndrome in Spain in 2008-2010: the ENRICA study. *Rev Esp Cardiol (Engl Ed)* 2014;67(5):367-73.
45. Molina-Montes E, Sanchez-Cantalejo E, Martinez C, Contreas JM, Molina E, Sanchez MJ. Compliance with dietary and nutrient recommendations in the European Prospective Investigation into Cancer and Nutrition (EPIC)-Granada cohort at recruitment. *Nutr. Hosp.* 2012;27(2):572-82.
46. Bautista-Castano I, Sanchez-Villegas A, Estruch R, Martinez-Gonzalez MA, Corella D, Salas-Salvado J, et al. Changes in bread consumption and 4-year changes in adiposity in Spanish subjects at high cardiovascular risk. *Br. J. Nutr.* 2013;110(2):337-46.
47. Lattimer JM, Haub MD. Effects of dietary fiber and its components on metabolic health. *Nutrients* 2010;2(12):1266-89.
48. Moreno Franco B, Leon Latre M, Andres Esteban EM, Ordovas JM, Casasnovas JA, Penalvo JL. Soluble and insoluble dietary fibre intake and risk factors for metabolic syndrome and cardiovascular disease in middle-aged adults: the AWHs cohort. *Nutr Hosp* 2014;30(6):1279-88.
49. Ubeda N, Basagoiti M, Alonso-Aperte E, Varela-Moreiras G. [Dietary food habits, nutritional status and lifestyle in menopausal women in Spain]. *Nutr. Hosp.* 2007;22(3):313-21.
50. Nissensohn M, Castro-Quezada I, Serra-Majem L. Beverage and water intake of healthy adults in some European countries. *Int. J. Food Sci. Nutr.* 2013;64(7):801-5.
51. Marcos A, Manonelles P, Palacios N, Warnberg J, Casajus JA, Perez M, et al. Physical activity, hydration and health. *Nutr Hosp* 2014;29(6):1224-39.
52. Varela-Moreiras G. LIBRO BLANCO DE LA NUTRICIÓN, Fundación Española de la Nutrición (FEN). 2013.
53. Parnell W, Wilson N, Alexander D, Wohlers M, Williden M, Mann J, et al. Exploring the relationship between sugars and obesity. *Public Health Nutr* 2008;11(8):860-6.
54. Kretsch MJ, Fong AKH, Green MW. Behavioral and body size correlates of energy intake underreporting by obese and normal-weight women. *Journal of the American Dietetic Association* 1999;99(3):300-06.
55. Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. *Am. J. Clin. Nutr.* 2013;98(4):1084-102.
56. Strom O, Borgstrom F, Kanis JA, Compston J, Cooper C, McCloskey EV, et al. Osteoporosis: burden, health care provision and opportunities in the EU: a report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA). *Arch Osteoporos* 2011;6(1-2):59-155.



Original/*Nutrición parenteral*

A home and ambulatory artificial nutrition (NADYA) Group Report, Home Parenteral Nutrition in Spain, 2013

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Abstract

Aim: to communicate the results of the Spanish Home Parenteral Nutrition (HPN) registry of the NADYA-SENPE group for the year 2013.

Material and methods: data was recorded online by NADYA group collaborators that were responsible of the HPN follow-up from 1st January to 31st December 2013.

Results: a total of 197 patients and 202 episodes of HPN were registered from 35 hospitals that represents a rate of 4,22 patients/million habitants/year 2013. The median age was 53 years (IQR 40 – 64) for 189 adult patients and 7 months (IQR 6 – 35,5) for children. The most frequent disease in adults was neoplasm (30,7%) followed by other diseases (20,1%) and mesenteric ischemia (12,7%). Short bowel syndrome and intestinal obstruction (25,9%) were in 35.7% cases the indications for HPN.

NUTRICIÓN PARENTERAL DOMICILIARIA EN ESPAÑA DURANTE 2013, INFORME DEL GRUPO DE NUTRICIÓN ARTIFICIAL DOMICILIARIA Y AMBULATORIA NADYA

Resumen

Objetivo: comunicar los datos del registro de Nutrición Parenteral Domiciliaria (NPD) del grupo de trabajo NADYA-SENPE del años 2013.

Material y métodos: recopilación de los datos del registro “on-line” introducidos por los colaboradores del grupo NADYA responsables del seguimiento de la NPD desde el 1 de enero de 2013 al 31 de diciembre de 2013.

Resultados: se registraron 197 pacientes, procedentes de 35 hospitales, lo que representa una tasa de 4,22 pacientes/millón habitantes/año 2013, con 202 episodios de NPD. La edad media de los 189 pacientes mayores de 14 años fue de 53 años (IIQ 40 – 64), y en los niños de 7 meses (IIQ 6 – 35,5). La patología más frecuente en los adultos fue la neoplasia (30,7%) seguida por otras patologías (20,1%) y la isquemia mesentérica (12,7%). En el 35,4% de los casos el motivo de indicación fue el síndrome de intestino corto, seguido de la obstrucción intestinal (25,9%).

En los niños el diagnóstico más frecuente fueron las alteraciones congénitas intestinales y ‘otros diagnósticos’.

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Recibido: 1-IV-2015.
Aceptado: 21-IV-2015.

The most frequent diagnosis for children were the congenital intestinal disorders and other diagnosis, both with a (37,5%) and short bowel syndrome and intestinal obstruction were the indication for treatment, each was present in 50% of the sample.

Tunneled catheters (50%) and subcutaneous reservoirs (27,7%) were frequently used. The septic complications related with catheter were commonly frequent with a rate of 0.74 infections/1000 HPN days.

HPN duration presented a median of 1,69 days. A total of 86 episodes finalized during the year, death was the principal reason (45%), followed by "resumed oral via" (43,75%) while it happened inversely for children, 66,7% of them resumed oral via and 16,7% deceased. Fifteen per cent were considered for intestinal transplant, children were proportionally candidates, p-value 0.002.

Conclusions: the number of participating centers and registered patients increased progressively respect to preceding years. Since 2003 Neoplasm is still being the principal pathological group. Death is adult's principal reason for finalizing HPN and "resuming oral via" for children. Despite that NADYA registry is consolidate as a essential source of relevant information about the advances in Home Artificial Nutrition in our country, currently is in an improvement process of the available information about patients characteristics with a special emphasis on children even though they still being a minority group.

(Nutr Hosp. 2015;31:2533-2538)

DOI:10.3305/nh.2015.31.6.9052

Key words: Home Parenteral Nutrition. Parenteral Nutrition. Nutritional support. Home care services. Registries. Epidemiology.

Introduction

Home Parenteral Nutrition (HPN) consists in the administration of parenteral nutrition solutions in patient's environment¹. By this way it ensures that patients need feeding by parenteral via because otherwise couldn't survive, can choose freely their home as place of treatment. In occasions patient's functional status allows to get integrated socially and to return to job or study again.

At the end of 1960s the first news about this type of nutritional care were in United States of America. The first hospital discharge of HPN in patient happened in December² of 1969 further were other events as Jeejeebhoy et al experience in 1973 that published "Total parenteral nutrition at home for 23 months, without complication, and with good rehabilitation. A study of technical and metabolic features"³. They instantly noticed³ that to achieve this objective; ensuring a safe way of patient's home nourishment, increasing his quality of life with a better conformability and higher survival expectancies, it was necessary to have a multidisciplinary team able to perform each stage of a complex program that includes; patients selection plus the caregiver and patient's training in the solution's administration and catheter care⁴.

ambas con un 37,5 %, y la causa de la indicación el síndrome de intestino corto y la obstrucción intestinal, que se repartieron el 50% de la muestra.

Los catéteres más utilizados fueron los tunelizados (50%) y los reservorios subcutáneos (27,7%). Las complicaciones más frecuentes fueron las sépticas, relacionadas con el catéter, con una tasa de 0,74 infecciones/1.000 días de NPD.

La duración de la NPD presentó una mediana de 1,69 años. Durante el año finalizaron 86 episodios, la principal causa de la finalización en adultos fue el fallecimiento (45%) seguido del 'paso a la vía oral' (43,75%) y en los niños a la inversa 66,7% pasan a vía oral y 16,7% fallecen. Se consideraron candidatos para trasplante intestinal el 15% de los pacientes, siendo proporcionalmente los candidatos niños, p-valor 0,002.

Conclusiones: se observa un aumento progresivo de los centros participantes y de los pacientes registrados respecto a años anteriores. El principal grupo patológico sigue siendo oncológico, ocupando el primer lugar desde 2003. La principal causa de finalización de la NPD es en los adultos el fallecimiento y en los niños el 'paso a vía oral'. Aunque el registro NADYA es un registro consolidado y ha sido y es fuente imprescindible de información relevante para el conocimiento de los avances de la Nutrición Artificial Domiciliaria en nuestro país, se encuentra en proceso de mejorar la información que ofrece sobre las características de los pacientes, con especial atención en el grupo de niños, aunque estos siguen siendo un número reducido.

(Nutr Hosp. 2015;31:2533-2538)

DOI:10.3305/nh.2015.31.6.9052

Palabras clave: Nutrición Parenteral Domiciliaria. Nutrición Parenteral. Soporte nutricional. Cuidados domiciliarios. Registros. Epidemiología.

Since 1992 the group of Home and Ambulatory Artificial Nutrition (NADYA) of Spanish Society of Enteral and Parenteral Nutrition⁵ (NADYA-SENPE) develops educational and training material addressed for professionals, patients and their relatives as manuals, clinical guides, training videos to collaborate in HPN quality and safeness. Thus in order to recognize the real situation of this type of treatment and patient's characteristic in the Spanish context. NADYA registry stays up to date and realizes annual reports for this treatments⁶⁻¹⁰.

Material and Methods

A descriptive analysis was performed of collected data for NADYA-SENPE group registry (www.nadyasenpe.com). Registered data of patients with HPN from 1st January to 31st December of 2013 was the criteria for this work.

For data processing adults and pediatric patients aged 14 years or less were considered. Descriptive techniques were applied for calculation of absolute and relative (percentage) frequencies of variables and in the case of the quantitative variables means or medians and its standard deviation (SD) or interquartile range

(IQR) were used depending on variable distribution. The most relevant outcomes were detailed in tables and figures. When it was possible the analysis between variables, chi-square, t-student and ANOVA test were used. The annual population mean for the year 2013 available at the National Statistic Institute Website (INE) (<http://www.ine.es>) was used as denominator for prevalence rate calculation. Quality control was done using cross-table data, when errors were found the original sources of the data were consulted. For data analysis Statistical Package for the Social Sciences SPSS® 22.0 was used.

Results

A total of 197 patients from 35 hospitals were registered, the geographic distribution of patients and their correspondent centers is shown in figure 1. A great variability was found for patients distribution with a mean of 5,5 for each hospital (min. 1 y max. 17) and a mode of 1 patient. The rate of prevalence was of 4,22 patients/million habitants/ year 2013, with 202 episodes of HPN.

The median age between 189 (95,9%) of the adults (> 14 years) was 53 years (IIQ 40 – 64), the youngest patient was 16 years and the oldest was 84 years. Women were 53,3% of them. The most frequent disease present in adults (Fig. 2) was neoplasm (30,7%) fo-

llowed by another pathologies (20,1%) and mesenteric ischemia (12,7%). Short bowel syndrome (35,4%) and intestinal obstruction (25,9%) were the indications for HPN (Fig. 3). Tunneled catheters (49,1%) and subcutaneous reservoirs (28,8%) were frequently used. HPN duration presented a median of 613 days IQR 132 – 1412 (1,68 years; IQR 0,4 – 3,8). HPN was the only nutritional support in 49,7% of the patients, oral food intake was present in 40,2% of total patients while HPN was supplemented with enteral nutrition in 10,1%. A total of 80 episodes were finalized during the year (Fig. 4), death was the principal reason in 45% and resuming to oral via was in 43,7%. The main supplier of parenteral nutrition bags was the reference hospital in 70,6% followed by catering company in 23,7%. Also consumables were administrated by the hospital in 87,3% and from primary healthcare services for 20,6% of the patients.

Eight (4,1%) children were registered which represented a prevalence rate of 1,13 children/million habitation ≤ 14 years/year 2013. Fifty per cent of them were girls and the median age of all children was 7 months (IQR 6– 35,5). The most frequent diagnosis (Fig. 2) were “intestinal congenital disorders” and “other diagnosis”, both of them represented a frequency of 37,5% and the main reason for HPN indication was “Short bowel syndrome” and “intestinal obstruction”, each was present in 50% of the sample (Fig. 3). Tunneled catheters (71,4%) and peripherally inserted

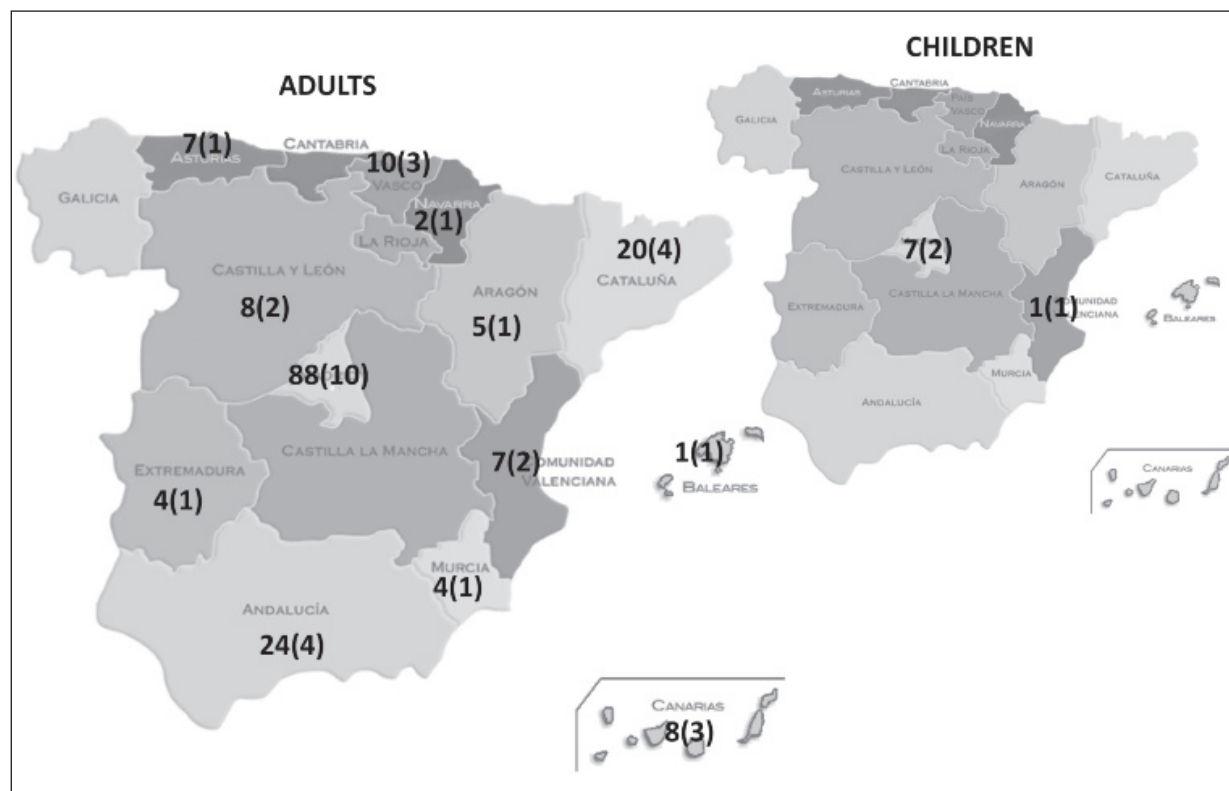


Fig. 1.— Number of participating patients and centers in NADYA registry for 2013 in each Autonomous Community.

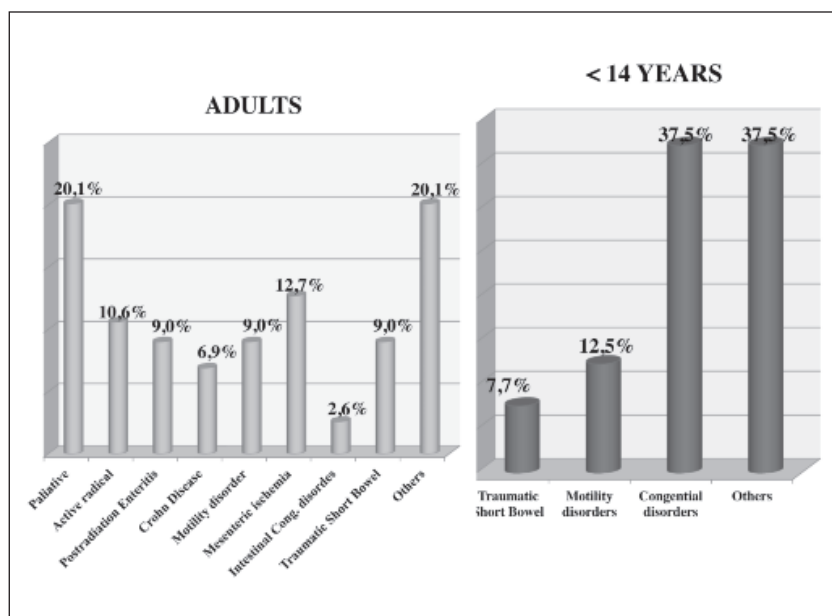


Fig. 2.— Diagnosis of patients with HPN during the year 2013.

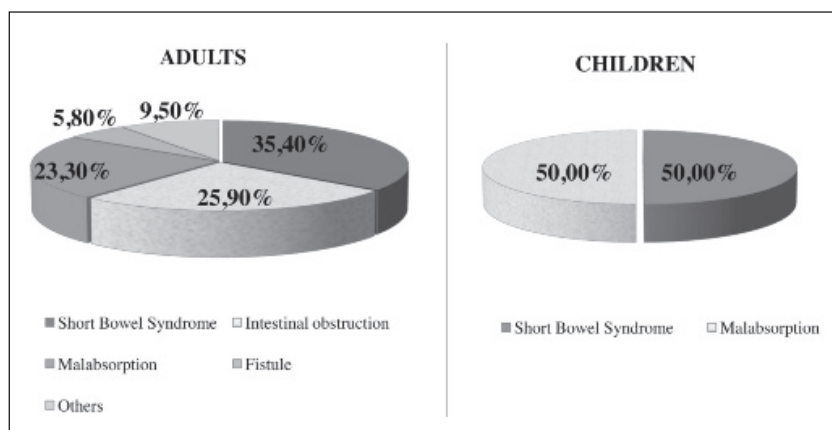


Fig. 3.— HPN indication for patients of NADYA registry 2013.

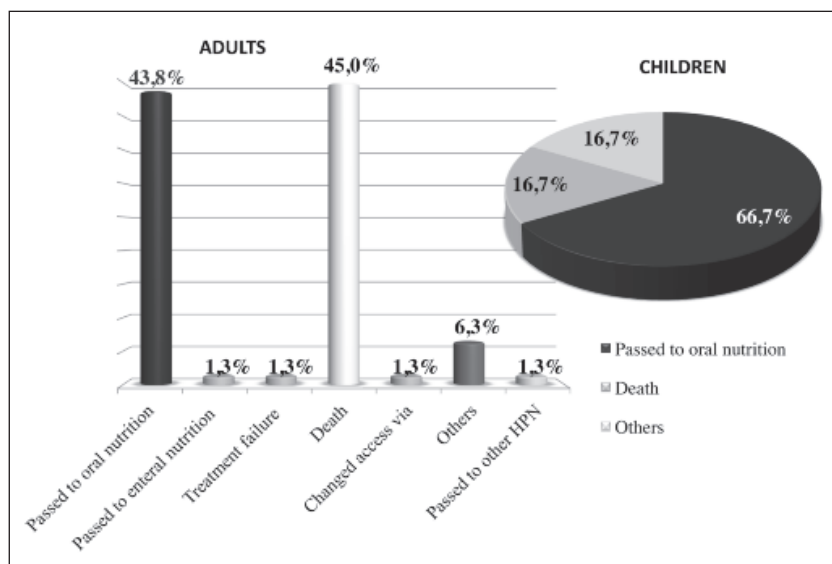


Fig. 4.— Reasons of HPN episodes finalization during the year 2013.

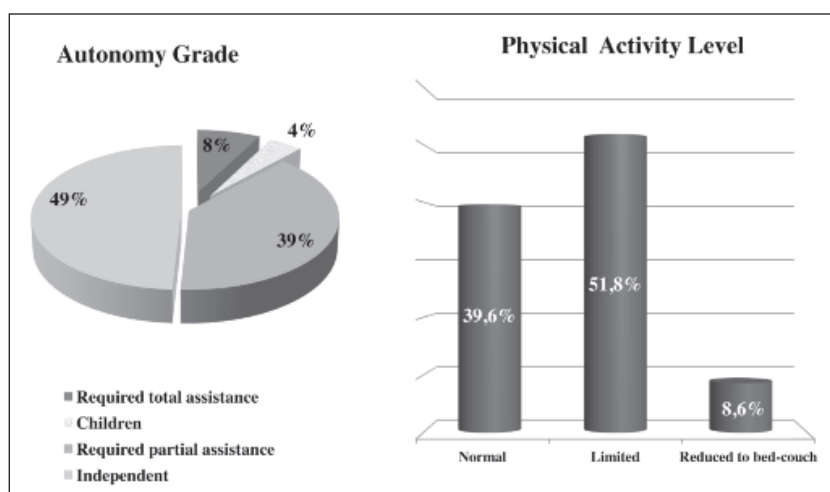


Fig. 5.— Physical activity level and autonomy grade of HPN patients during 2013.

central catheters (28,6%) were commonly used. The duration of HPN had a median of 2.025 days IQR 186 – 4.327 (5,55 years; IQR 0,5 – 11,8). It consisted in the unique nutritional support in 25% of episodes, 75% of the total kept oral intake. During the year, 6 (75%) episodes finalized, the main reason was resuming to oral via in 66,7% (Fig. 4). The common supplier of parenteral nutrition formula was the catering company (62,2%) followed by the reference hospital (37,5%), but consumables for HPN administration were supplied in 100% by the reference hospital.

In all the registries the reason of finalization was related to the diagnosis group, resuming to oral via was presented in higher proportion in intestinal disease group compared to neoplasm group, p-value 0.002. Sepsis related to catheter was the most frequent complication with a rate of 0,47 infections/1000 days of HPN, no differences were found between children and adults (p-value 0,590); followed by metabolic type 0,27/1000 days (p-value 0,106) and others related to catheter with 0,21/1000 days (p-value 0,436).

Fifteen per cent of the patients were candidates for intestinal transplantation; children were proportionally candidates, p-value 0,002.

Physical activity was limited in 51,8% of patients and it was normal and self-dependent in 49,2% (Fig. 5).

Discussion

A progressive increase is observed as in previous reports of this type of treatments supplied at home but with a special emphasis for the higher number of participant centers, (19 in 2006; 21 in 2007; 24 in 2008 and 2009; 23 in 2010) which increase also progressively^{1,5,6}.

There is still exiting two principal diagnosis groups for the HPN patients, the neoplasm and gastrointestinal patients. The administration of HPN is increasing in cancer patients, it seems to be a tendency but there is no available updated data from previous registries

to make a comparison of it. Even for terminal cancer patients with intestinal obstruction receiving palliative treatment at home⁹.

For this year the registration of the venous type access has increased considerably in 84,3% (52,9% of the total patients in 2007; 32,7% in 2009; 83,2% in 2012)^{6,7}. Tunneled catheter is still being the most frequently used, even though it decreased from a 62% in 2011 to 49,1% for this year, it happened at the expense of a considerable increase of subcutaneous reservoirs⁶. The use of this type of catheters could be explained by the prevalence of cancer patients in this registry, because they already have this route of vascular access used for chemotherapeutic treatment before beginning the HPN.

The number of reported complications is still being lower than those recorded in the same context (Spanish Territory) in series published by any of the centers at an individual level, lately Higuera et al 2014, published a retrospective revision of their HPN patients from 1986, founding a rate of 3,58 infections/1000 days of HPN¹⁰. No significant differences were found between children and adults complications.

Although death is still being the most frequent reason for HPN episodes finalization⁶⁻⁸, an equal tendency of “resumed oral via” was observed and of which are primarily responsible the episodes in patients with gastrointestinal diseases.

Children are considered candidates for intestinal transplant in a higher proportion. Despite the fact that the number of children had been maintained stable in the last years (between 8 and 10 since 2006) it decreased to 15% of the total of registered patients, this data is still stable respect to the year 2012 in which they were 14,8% candidates, being this the first year that the number decreased abruptly after being maintained steady with a range between 23% and 29%; (27% in 2006; 26% in 2007; 29% in 2008; 23% in 2009; 24,68% in 2010 y 24,68% in 2012)^{1,6-8,13}.

The hospital is still being the principal supplier of parenteral nutrition bags as well as consumables for

its administration, but it is observed that the catering company is in main supplier for children, this fact changed because previously the hospital assumed all pediatric patients¹³, now two thirds of the children receive the bags at home prepared “à la carte” as prescribed by the attending physician and elaborated by a specialized company.

NADYA registry seeks to offer every year a deep and exhaustive analysis of the most relevant characteristics of home artificial nutrition in Spain. Obviously, continues on having important limitations. The most important one is being a voluntary registry which essentially depends on the scientific munificence of its participants, generally are healthcare professionals with overloaded assistance care that dedicate time to collaborate with NADYA. This makes our team assume that for some variables there could be “bias information” even though of the quality control that the data is subjected such as the number of registered complications that depends on the awareness of participants about its importance for having more reliable data. Another limitation is the small number of registered children, in comparison to the prevalence recorded in Juana-Roa¹¹ study that found 27 children with a prevalence rate of 4,01 children/ million habitants $\leq$ 14 years / year 2008 by surveying the pharmacy services of 713 Spanish hospitals.

A future goal that could be appropriate for NADYA registry is to registered evolutionary clinical parameters of patients¹².

We appreciate the collaboration of all NADYA-SENPE group members for their disinterested dedication to keep on active the registry of home artificial nutrition patients.

We would like to invite all the professionals that monitors patients with enteral or home parenteral nutrition to include them in this registry in order to learn more with the highest reliability and quality about the reality of patients with home artificial nutrition in our country.

We also want to acknowledge and thank the support of Braun SA in the maintenance of the registry.

References

1. Wanden-Berghe C, Puiggrós JC, Calañas A, Cuerda C, García-Luna PP, Rabassa-Soler A et al. Registro español de nutrición enteral domiciliaria del año 2009. Grupo NADYA-SENPE. *Nutr Hosp* 2010; 25 (6): 959-963.
2. Shils ME, Wright LM, Turnbull A, Brescia F. Long-term parenteral nutrition through an external arteriovenous shunt. *N Eng. J.* 1970; 283:324-44. <http://www.ncbi.nlm.nih.gov/pubmed/?term=Shils+ME%2CWright+LM%2C+Turnbull+A%2C+Brescia+F.+1970.+Longterm+parenteral+nutrition+through+an+external+arteriovenous+shunt.+N.+Engl.+J.+Med.+283%3A324%E2%80%93344>.
3. Jeejeebhoy KN, Zohrab WJ, Langer B, Phillips MJ, Kuksis A, Anderson GH. Total parenteral nutrition at home for 23 months without complication and with good nutrition. A study of technical and metabolic features. *Gastroenterology*. 1973;65:811-20. <http://www.ncbi.nlm.nih.gov/pubmed/?term=Jeejeebhoy+KN%2C+Zohrab+WJ%2C+Langer+B%2C+Phillips+MJ%2C+Kuksis+A%2C+Anderson+GH.+1973.+Total+parenteral+nutrition+at+home+for+23+months+without+complication+and+with+good+nutrition.+A+study+of+technical+and+metabolic+features.+Gastroenterology+65%3A811%E2%80%93820>.
4. Shils ME. A program for TPN at home. *Am. J. Clin. Nutr.* 1975;28:1429-35. <http://www.ncbi.nlm.nih.gov/pubmed/?term=Shils+ME.+1975.+A+program+for+TPN+at+home.+Am.+J.+Clin.+Nutr.+28%3A1429%E2%80%931435>.
5. NADYA-SENPE. Grupo de Nutrición Artificial Domiciliaria Y Ambulatoria. [sede Web] Madrid, España: Sociedad Española de Nutrición Parenteral y Enteral; 1995, [actualizada 2015, citada 11 marzo 2015] disponible en: <https://nadya-senpees.sserver.es/index.php/login?language=es>.
6. Wanden-Berghe C, Moreno Villares JM, Cuerda Compés C, Carrero C, Burgos R, Gómez Candela C, et al. Grupo NADYA Nutrición Parenteral Domiciliaria en España 2011 y 2012; informe del grupo de nutrición artificial domiciliaria y ambulatoria NADYA. *Nutr Hosp*. 2014;29(6):1360-65.
7. Puiggrós C, Gómez-Candela C, Chicharro L, Cuerda C, Virgili N, Martínez N, et al. Registro de la Nutrición Parenteral Domiciliaria (NPD) en España de los años 2007, 2008 y 2009 (Grupo NADYA-SENPE). *Nutr Hosp* 2011; 26: 220-7.
8. Wanden Berghe C, Gómez Candela C, Chicharro L, Cuerda C, Martínez Faedo C, Virgili N y cols. Registro del año 2010 de Nutrición Parenteral Domiciliaria en España: Grupo NADYA-SENPE. *Nutr Hosp* 2011; 26 (6): 1277-82.
9. Chermesh I, Mashiach T, Amit A, Haim N, Papier I, Efergan R, et al. Home parenteral nutrition (HTPN) for incurable patients with cancer with gastrointestinal obstruction: do the benefits outweigh the risks?. *Med Oncol*. 2011;28(1):83-8.
10. Higuera I, García-Peris P, Camblor M, Bretón I, Velasco C, Romero R, et al. Outcomes of a general hospital-based Home Parenteral Nutrition (HPN) program; report of our experience from a 26-year period. *Nutr Hosp*. 2014;30(2):359-65.
11. Juana-Roa J, Wanden-Berghe C, Sanz-Valero J. La realidad de la nutrición parenteral domiciliaria en España. *Nutr Hosp*. 2011;26(2):364-68.
12. Fernandes G¹, Kaila B, Jeejeebhoy KN, Gramlich L, Armstrong D, Allard JP. Canadian home parenteral nutrition (HPN) registry: validation and patient outcomes. *JPN J Parenter Enteral Nutr*. 2012;36(4):407-14.
13. Puiggrós C, Chicharro ML, Gómez-Candela C, Virgili N, Cuerda C, Gómez-Enterría P, et al. Grupo NADYA-SENPE. Registro de la Nutrición Parenteral Domiciliaria (NPD) en España del año 2006 (Grupo NADYA-SENPE). *Nutr Hosp*. 2008;23(1):6-11.



Original/Investigación animal

Effect of the intake of liquids rich in polyphenols on blood pressure and fat liver deposition in rats submitted to high-fat diet

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Abstract

Introduction: seeking better quality of life, the number of studies on functional foods and disease prevention is growing fast. Whole red grape juice (WRGJ) and red wine (RW) stand out, which are rich in polyphenols, showing antioxidant and anti-inflammatory activity.

Objective: to evaluate the effect of WRGJ and RW intake and resveratrol solution (RS) on blood pressure and fat liver deposition of rats fed with high-fat diet.

Material and methods: during 60 days, 50 *Rattus norvegicus* Wistar Albino adults were divided into: control group (CG) - balanced diet, hyperlipidic group (HG), red wine group (RWG), grape juice group (JGG) and resveratrol group (RG) - hyperlipidic diet. Feed and water were offered *ad libitum* to all groups. WRGJ, RW and RS were offered daily to JG, WG and RG, respectively. Blood pressure was measured using tail plethysmograph. The animals were anesthetized, sacrificed and the liver was removed, weighed and fat was extracted using Soxhlet extractor.

Results: no difference in weight gain, feed intake, liver weight and diastolic blood pressure among groups was observed. However, systolic blood pressure (mmHg) and liver fat concentration (g%) were lower ($p < 0.05$) in JGG than in HG, WG and RG, but similar to CG.

Conclusions: the daily consumption of WRGJ minimizes the effects of high-fat diet on systolic blood pressure

EFFECTO DE LA INGESTA DE LÍQUIDOS RICOS EN POLIFENOLES SOBRE LA PRESIÓN ARTERIAL Y DE LA DEPOSICIÓN DE GRASA HEPÁTICA EN RATAS SOMETIDAS A DIETA RICA EN GRASAS

Resumen

Introducción: en busca de una mejor calidad de vida, crece el número de estudios sobre alimentos funcionales y la prevención de enfermedades. Destacan el jugo de uva roja (JU) y el vino tinto (VT), que son ricos en polifenoles, y tienen efecto antioxidante y antiinflamatorio.

Objetivo: evaluar el efecto de la ingesta de JU, VT y solución de resveratrol (SR) sobre la presión arterial y la deposición de grasa hepática en ratas alimentadas con una dieta rica en grasas.

Métodos: durante 60 días, 50 adultos de *Rattus norvegicus* Wistar Albino fueron divididos en grupos: control (GC) - dieta equilibrada y hiperlipídica (GH), vino tinto (GV), jugo de uva (JV) y resveratrol (GR) - dieta rica en grasas. El alimento y el agua se ofrecieron *ad libitum* a todos los grupos. JU, VT y SR se ofrecen diariamente a la GS, GV y GR, respectivamente. Se midió la presión arterial en la cola mediante manguito inflable. Los animales fueron anestesiados y sacrificados y se les extirpó el hígado, que fue pesado y del cual se extrajo la grasa con el extractor Soxhlet.

Resultados: no hubo diferencia en la ganancia de peso, consumo de alimento, peso del hígado y presión arterial diastólica entre los grupos. Sin embargo, la presión arterial sistólica (mmHg) y la concentración de grasa en el hígado (g%) fueron menores ($p < 0,05$) en los GJ que en GH, GV y GR, pero similar a la GC.

Conclusiones: el consumo diario de JU minimiza los efectos de la dieta alta en grasas en la presión arterial sis-

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Recibido: 10-I-2015.

1.ª Revisión: 18-II-2015.

Aceptado: 10-III-2015.

and prevents nonalcoholic fatty infiltration in the liver of animals, which was not observed in the consumption of RW or resveratrol solution.

(*Nutr Hosp.* 2015;31:2539-2545)

DOI:10.3305/nh.2015.31.6.8655

Key words: *Polyphenols. High-fat diet. Blood pressure. Fatty liver. Wistar rats.*

tólica y previene la infiltración grasa no alcohólica en el hígado de los animales, que no se observó en el consumo de VT o resveratrol aislado en solución.

(*Nutr Hosp.* 2015;31:2539-2545)

DOI:10.3305/nh.2015.31.6.8655

Palabras clave: *Polifenoles. Dieta rica en grasas. Presión arterial. Hígado graso. Ratas Wistar.*

List of abbreviations

WRGJ: Whole red grape juice.
RW: Red wine.
RS: Resveratrol solution.
CG: Control group.
HG: Hyperlipidic group.
WG: Red wine group.
JG: Grape juice group.
RG: Resveratrol group.
NCDs: Non-communicable chronic diseases.
NAFLD: Non-alcoholic fatty liver disease.

Introduction

Lifestyle and facilities of the modern world have influenced the eating habits of the population, encouraging the consumption of high-calorie diets with carbohydrate and / or lipid overload, known as “western” or “fast food” diets¹.

As a result of this new food trend, the consumption of diets with high fat content has increased the risk of overweight and obesity, and hence the risk of the development of non-communicable chronic diseases (NCDs) such as cardiovascular diseases and certain liver diseases^{2,3,4}.

Therefore, there has been an increase in the number of studies on the functional properties of foods and bioactive compounds that promote health and prevent diseases. Among these compounds, polyphenols stand out, which are found in abundance in the diet and have different physiological properties already recognized, whose relation with the prevention of diseases has been widely researched^{5,6,7}.

Polyphenols are known to beneficially affect a variety of inter and intracellular enzyme systems capable of modulating the immune function, inflammatory processes, vascular reactivity, antioxidant mechanisms, cell proliferation and platelet function^{5,6}.

In foods, various types of polyphenols can be found in vegetable sources such as fruits, vegetables, oil seeds and aromatic herbs, for example. Whole red grape juice and red wine are rich in polyphenols and studies have shown potent antioxidant and anti-inflammatory action of these foods, mainly associated with polyphenol resveratrol present in grape and its derivatives^{6,7}.

In addition to studies on the functional properties of foods and the action of their bioactive compounds, the pharmaceutical industry has launched in the market capsules of different polyphenols, emphasizing their antioxidant protective properties against some diseases.

The lack of adverse effects upon oral administration of certain polyphenols such as resveratrol is the first step to elucidate whether this polyphenol can be used as a phytochemical. However, further studies should be carried out with *in vitro* and *in vivo* models in order to prove the health promotion properties of polyphenols before being indicated to humans⁸.

Thus, this study aims to evaluate the effect of the consumption of whole red grape juice, red wine and resveratrol solution on blood pressure and liver fat deposition of rats fed with high fat diet. The results of this study become relevant due to the possibility that the consumption of a food (grape juice) could provide protection against chronic diseases caused by the consumption of high-fat diets, showing that the consumption of foods with functional properties may be beneficial for health maintenance and protection against some diseases.

Objectives

This study aims to evaluate the effect of the consumption of whole red grape juice, red wine and resveratrol solution on blood pressure and liver fat deposition of rats fed with high fat diet.

Methods

The experiment was performed at the Laboratory of Experimental Nutrition (LABNE), *Emilia of Jesus Ferreiro* School of Nutrition, Fluminense Federal University. For the development of this work, 50 female adult *Rattus norvegicus* Wistar rats (90 days old), weighing about 200g were used. The animals were maintained in polypropylene identified individual cages for 60 days with constant temperature (22° C ± 2° C) and photoperiod of 12 hours.

The animals were divided into 5 groups (n = 10 / group): 1) Control Group (CG) - receiving control balanced diet based on casein and water; 2) Hyperlipidic

Group (HG) - receiving hyperlipidic diet based on casein and water; 3) Whole red grape juice group (JG) - receiving hyperlipidic diet based on casein, water and whole red grape juice (15 mL / day); 4) Red wine group (WG) - receiving hyperlipidic diet based on casein, water and red wine (10 mL / day), and 5) resveratrol group (RG) - receiving hyperlipidic diet based on casein, water and 15mL / day resveratrol solution.

Red wine, whole red grape juice and resveratrol solution were offered daily. Feed and filtered water were supplied weekly on free demand.

Diets (control and hyperlipidic) were prepared in the experiment site using ingredients described in table I, and control diet was prepared according to recommendations of the American Institute of Nutrition - 93M - focused on maintaining the nutritional needs of animals at adult age.

Red wine (Cabernet Sauvignon), whole red grape juice, resveratrol capsules (used for the preparation of

the resveratrol solution) and lard were obtained from local trade. Nutrition information of the drinks offered (grape juice and red wine) was obtained from labels and is described in Frame I.

Weight and feed intake of all animals were weekly recorded using precision scales (BioPrecisa® JY 50001, precision 0.01 g). Blood pressure was weekly measured using tail plethysmograph (Insight®) and expressed in mmHg. For this, animals were carefully handled so as to spontaneously come into the acrylic cylinder used for containment with internal dimensions (H x W x L) of 63 x 65 x 232 mm. Subsequently, they were kept in a heater (Insight®) at 42° C for 10 minutes. They were then placed in the apparatus for pressure measurement. Three pressure measurements were performed at each session.

At the end of the experiment, the animals were submitted to vaginal wash procedure for determining the stage of the estrus cycle and being in the “estrus”

Table I
Ingredient used for formulation of rations control and hyperlipidic offered in the experiment

<i>Ingredients</i>	<i>Ration Control g/100g ration</i>	<i>Ration Hyperlipidic g/100g ration</i>
<i>Casein *</i>	14,0	14,0
<i>Starch</i>	62,1	46,07
<i>Soy oil</i>	4,0	-
<i>Lard</i>	-	20,0
<i>Cellulose</i>	5,0	5,0
<i>Mix of vitamins¹</i>	1,0	1,0
<i>Mix of minerals²</i>	3,5	3,5
<i>B-choline</i>	0,25	0,25
<i>L-cystine</i>	0,18	0,18
<i>Sugar</i>	10,0	10,0
<i>Total</i>	100	100

Legend: *% of casein protein = 92,5% protein/100g casein; ¹Mix of vitamins (mg/kg ration): retinyl palmitate 2.4, cholecalciferol 0.025, bisulfite sodium benadiona 0.8, biotin 0.22, cyanocobalamin 0.01, riboflavin 6.6, thiamine hydrochloride 6.6 and tocopherol acetate 100; ²Mix of minerals (g/kg ration): Copper sulfate 0.1, ammonium molybdate 0.026, sodium iodate 0.0003, potassium chromate 0.028, zinc sulfate 0.091, calcium hydrogen phosphate 0.145, ammoniated iron sulphate 2.338, magnesium sulfate 3,37, manganese sulfate 1.125, sodium chloride 4.0, calcium carbonate 9,89 and potassium dihydrogenofosfato 14,75.

Frame I
Nutritional Information of whole red grape juice, red wine and resveratrol used in the experiment

	<i>Whole red grape juice</i>	<i>Red wine</i>	<i>Resveratrol solution</i>
<i>Carbohydrate (g / L) *</i>	15000	2900	5200
<i>Protein (g / L) *</i>	-	traces	-
<i>Lipid (g / L) *</i>	-	-	-
<i>Ethanol (g / L) *</i>	-	10600	-
<i>Resveratrol (mg / L) **</i>	0.381	1,323	1,53

Legend: * Source: Label each drink; ** Source: Data obtained by high performance liquid chromatography efficiency analysis (HPLC) during the experiment.

phase, animals were separated for sacrifice after fasting and a 6-h resting period.

Animals in the estrus phase were anesthetized by intraperitoneal injection of xylazine hydrochloride: ketamine (1: 1) at a dose of 0.1 mL / 200 g body weight, and then blood collection was performed.

After sacrifice, laparotomy was performed to remove the liver. The liver was weighed on a precision scale (BioPrecisa® JY 50001, precision 0.01 g) and its weight was standardized in g / 100 g body weight. It was subsequently dehydrated and macerated and the fat content was determined using Soxhlet extractor. The total fat content was expressed as g%.

The study was approved by the Ethics Committee on Animal Use, protocol number 00216/10. The experiment was conducted according to criteria established by the Brazilian College of Animal Experimentation / Brazilian Society of Sciences in Laboratory Animals.

The results were presented using descriptive statistics such as mean and standard deviation. One-way ANOVA was used to compare means among groups and Tukey test was used as post test. A 5% significance level was considered. To support the proposed analyses, Kurtosis and Skewness tests were used to verify the normality of data. Significance level of 5% was adopted using the GraphPad InStat software (version 3.10, 2009) to perform the analyses.

Results

At the end of the experiment, it was observed that all groups were homogeneous with respect to initial and final body weight. No difference in weight gain among groups was observed throughout the study; however, a trend of lower feed intake was observed in groups receiving high-fat diet compared to the control group, according to data presented in table II.

No difference in liver weight of animals was observed (Table II). However, there was lower ($p < 0.05$) fat deposition in the liver of animals receiving grape juice in relation to HG, WG and RG, but similar to the control group (Fig. 1).

Throughout the experiment, the blood pressure of animals was measured and it was found that diastolic blood pressure did not differ among groups, although the group receiving grape juice presented the lowest numerical value for this variable. However, animals from JG had lower systolic blood pressure level ($p < 0.05$) compared to HG, WG and RG groups, but similar to the CG (Fig. 2).

Discussion

Grape and its derivatives have several polyphenols able to promote health benefits due to their functional properties, and resveratrol is a compound highlighted in many studies^{10,11}. Grapes are not the only source of these polyphenols, but also grape juice, wine and currently isolated compound capsules¹¹. The resveratrol concentration in whole red grape juice (0.381mg / L) and red wine (1.323mg / L) used in this study are in agreement with literature that reports resveratrol concentration in grape juice produced in Brazil of 0.19-0.90mg / L¹⁰ and in red wine of 0.82-5.75mg / L¹².

Although diets were offered *ad libitum*, a trend of lower feed intake of groups receiving high-fat diet throughout the experiment was observed. The same was observed in the study by Moura et al¹³, who found that lower feed intake of group receiving diet rich in saturated fat, compared to the group consuming balanced diet, which corroborated our results. The trend of lower food consumption by animals receiving high-fat diet combined with grape juice and red wine consumption can be explained by the fact that these foods are extra source of energy for animals, increasing their satiety.

Table II
Means and standard deviation of initial and final body weight, body weight variation, feed intake and liver weight of the different study groups

	Initial body weight (g)	Final body weight (g)	Body weight variation (g)	Feed intake (g/100gBW)	Liver weight (g/100gBW)
CG	228,57±31,05	306,51±23,83	77,93±47,75	6,01±1,34	2,91±0,19
HG	211,63±37,07	298,00±55,25	86,37±51,79	5,15±1,16	2,77±0,16
WG	220,24±34,21	300,26±46,97	80,02±61,28	4,67±1,61	2,79±0,24
JG	219,68±32,59	296,47±39,28	76,79±54,15	4,84±1,29	2,59±0,26
RG	242,80±27,85	284,60±22,26	41,80±13,92	5,95±0,38	2,55±0,11
<i>p</i> valor*	0,3942	0,8864	0,5947	0,0674	0,019

Legend: Different letters represent significant differences between the groups ($p < 0.05$); Body weight (BW); Control Group (CG) - the balanced feed; Hyperlipidic group (HG) - fat diet; Group whole red grape juice (JG) - fat diet + whole red grape juice, red wine Group (WG) - fat diet + red wine, resveratrol group (RG) - fat diet + resveratrol solution.

Statistical analysis: one-way ANOVA and Tukey for mean comparison between groups.

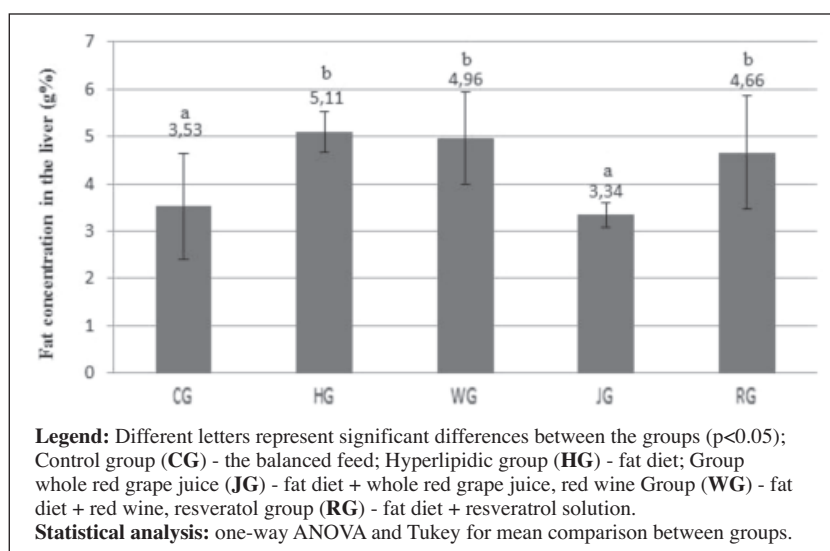


Fig. 1.— Mean concentration of fat in the liver of different groups (g%).

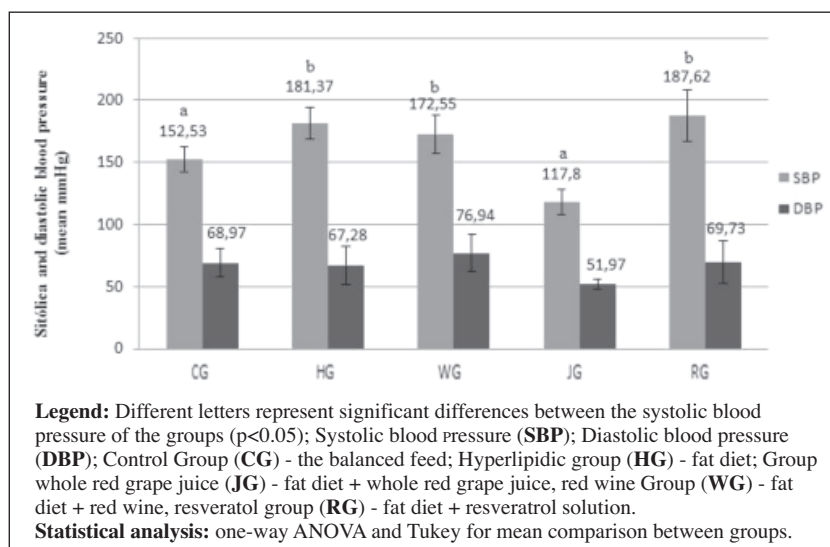


Fig. 2.— Means of systolic and diastolic pressure (mmHg) animals throughout the study.

Studies have shown that the consumption of high-fat diet is correlated with increase in the obesity prevalence in Brazil and worldwide. Increased body weight due to the use of this type of diet predisposes individuals to the development of NCDs^{14,15}. However, obesity development was not observed this study, since groups receiving high-fat diet showed no difference in weight gain compared to the group receiving balanced diet.

Studies with rats comparing the intake of high-protein and high-fat diets (66% lard) with balanced diet observed that the weight of the liver of animals fed with high-fat diet was not different from that of control group^{15,16,17}, which corroborates the findings of this study, since no difference in animals' liver weight was observed, regardless of type of diet consumed. However, literature shows that high consumption of saturated fatty acids is related to inflammatory processes and lipotoxicity of some organs, among them liver, resulting in non-alcoholic fatty liver disease (NAFLD)^{13,16,17,18,19}.

Thus, although animals did not present obesity, high-fat diet caused accumulation of hepatic fat compatible with the diagnosis of NAFLD, except in the group that consumed grape juice. Although the dietary intake of groups receiving high-fat diet with grape juice and red wine was similar, the liver fat accumulation in animals fed with red wine was higher. There is controversy about the effect of red wine on the liver fat deposition. A study has shown that red wine polyphenols are able to minimize oxidative stress and hepatic steatosis in rats fed with high-fat diet when consumed daily and moderately²⁰. However, according to our results, the consumption of wine seems to have adversely influenced the benefits of the drink polyphenols, which can be explained by the fact that alcohol can cause an increase in the amount of free radicals, early elimination of polyphenols in the blood and accelerated elimination of these bioactive compounds^{21,22}, which was not observed for groups receiving grape juice, which

appears to be related to the inhibition of the synthesis and deposition of liver fat in rats fed with high-fat diet that according to some researchers, is probably due to its content of polyphenols^{16,21,22} and not necessarily to the resveratrol content alone. In addition, the absence of alcohol and probably the better interaction and effect of different bioactive compounds present in grape juice should be stressed.

Similar to red wine, resveratrol solution was not capable of minimizing fat liver deposition in the study animals. Chachay et al²³ investigated eight-week administration of resveratrol in humans with NAFLD and found that the compound alone did not significantly improve any characteristic of the disease when compared to placebo, but led to increased concentration of liver enzymes, increased oxidative stress in the liver of this group. This is probably because foods have other important constituents that make the action of polyphenols, particularly resveratrol, more effective than when the compound is consumed alone. The consumption of polyphenols through capsules should be done with caution because it can generate overdose and, in the case of resveratrol, there are still questions about its effective and safe doses and what are the effects of its consumption on the long term²⁴.

Fat accumulation in the liver predisposes individuals to other risk factors for NCDs such as hypertension¹⁴. Rats fed with high-fat diet after 12 weeks showed a significant increase in systolic blood pressure compared to those fed with low-fat diet¹⁹. These findings corroborate the results observed in this study, where animals with higher fat liver deposition also had higher systolic blood pressure, although no difference in the diastolic blood pressure among groups was observed.

According to results, in addition to the benefits found in the consumption of whole red grape juice with respect to hepatic steatosis, the drink also seems to show a protective effect on systolic blood pressure.

It has been reported that purple and green grape juice compounds are cardioprotective^{21,22,25,26,27}, mainly because polyphenols present in the beverage present antioxidant and anti-inflammatory capacity. Moreover, polyphenols found in whole red grape juice prevent the increase in low-density lipoprotein concentrations and prevent oxidation, minimizing the formation of atheromatous plaques on the arterial walls and preventing platelet aggregation and oxidative damage^{28,29}. Another study has shown that the greatest benefit of grape juice is its ability to act on the endothelium by increasing the nitric-oxide synthesis and preserve endothelium-dependent vasodilation due to its antioxidant role²⁵.

Regarding resveratrol, some findings have shown that the compound appears to prevent endothelial dysfunction by increasing nitric-oxide synthesis expression in the endothelium, in addition to acting in the redox process^{28,29}. However, according to Leifert and Abeywardena³⁰, the ingestion of high doses of resver-

atrol generates compound peaks 1.5 hours after consumption, but urinary excretion is rapid, leading to a reduction of 77% polyphenols up to 4 hours. These findings may explain the fact that the consumption of resveratrol solution has not promoted protection on blood pressure values in this study. This is because the solution provided higher compound concentration compared to red wine and grape juice. However, one should take into account the possibility of beneficial interactions between nutrients and bioactive compounds in the diet, leading to promotion of protection against diseases, which does not seem to occur when using the bioactive compound in the form of capsule. Often, the action of a substance can be enhanced by its association with other compounds present in the food matrix and when consumed alone may not have the expected effect.

Conclusions

The results of this study suggest that the consumption of whole red grape juice seems to be able to minimize the effects of high-fat diet, reducing the risk of developing hypertension and nonalcoholic fatty liver disease, while the consumption of red wine and resveratrol alone did not show any benefit in preventing these diseases.

Acknowledgments

The authors would like to thank the Research Foundation of the State of Rio de Janeiro (FAPERJ-APQ1), the Pro-Rectorate of Research, Graduate Studies and Innovation of the Federal Fluminense University (PROP-PI – UFF), to the National Research Council (CNPq) for granting the scientific initiation scholarship and to the Program in Applied Science for Health Products.

References

1. Lopes C, Oliveira A, Santos AC, Ramos E, Gaio AR, Severo M. Consumo alimentar no Porto. ed. Porto: Faculdade de Medicina da Universidade do Porto; 2006. [acesso em: 2014 Mai 7]. Disponível em: www.consumoalimentarporto.med.up.pt
2. Pou SA, Niclis C, Aballay LR, Tumas N, Román MD, Muñoz SE, et al. Cáncer y patrones alimentarios en Argentina. *Nutr Hosp*. 2014;29(3):618-628
3. Zambon L, Duarte FO, Freitas LF, Scarmagnani FR, Dâmaso AR, Duarte ACGO et al. Efeitos de dois tipos de treinamento de natação sobre a adiposidade e o perfil lipídico de ratos obesos exógenos. *Rev Nutr*. 2009;22(5):707-15.
4. Levy RB, Claro RM, Mondini L, Sichieri R, Monteiro CA. Distribuição regional e socioeconômica da disponibilidade domiciliar de alimentos no Brasil em 2008-2009. *Rev Saude Publica*. 2012;46(1):6-15.
5. Vogel P, Machado IK, Garavaglia J, Zani VT, Souza DD, Dal Bosco SM. Polyphenols benefits of olive leaf (*Olea europaea* L.) to human health. *Nutr Hosp*. 2015; 31(3):1427-1433 1431.
6. Pereira RJ, Cardoso MDG. Metabólitos secundários vegetais e

- benefícios antioxidantes. *Journal of Biotechnology and Biodiversity*. 2012;3(4):146-52.
7. Lucile TABE, da Mota RV, Lajolo FM, Genovese MI. Compostos fenólicos e capacidade antioxidante de cultivares de uvas *Vitis labrusca* L. e *Vitis vinifera* L. *Cienc. Tecnol. Aliment*. 2007;27(2):394-400.
 8. David JMP, David PJ, Santos VLCS, de Lurdes M, Santos MLS, Mota MD. Resveratrol: Ações e benefícios à saúde humana. *Diálogos & Ciência – Revista de Rede de Ensino FTC*, ano v, n. 10, 2007
 9. Malovaná S, Montelongo FJG, Pérez JP, Delgado MAR. Optimisation of sample preparation for the determination of trans-resveratrol and other polyphenolic compounds in wines by high performance liquid chromatography. *Analytica Chimica Acta*, 2001;428:245-253.
 10. Sautter CK, Denardin S, Alves AO, Mallmann, CA, Penna NG, Hecktheuer LH. Determinação de resveratrol em sucos de uva no Brasil. *Ciênc. Tecnol. Aliment*. 2005;25(3):437-42.
 11. Romero AIP, Ibern MG, Lamuela RMR, de La Torre MCB. Piceid, the major resveratrol derivative in grape juices. *J. Agric Food Chem*. 1999; 47(4): 1533-1536
 12. Souto AA, Carneiro MC, Sefrin M, Senna MJH, Conz A, Gobbi K. Determination of trans-resveratrol concentrations in Brazilian red wines by HPLC. *Journal of Food Composition and Analysis*. 2001 14:441-445.
 13. Moura LPD, Dalia RA, Araújo MBD, Sponton ACDS, Pauli JR, Moura RFD, et al. Alterações bioquímicas e hepáticas em ratos submetidos a uma dieta hiperlipídica/hiperenergética. *Rev. nutr*. 2012;25(6):685-93.
 14. World Health Organization [homepage na internet]. Obesity and Overweight. [acesso em 10 abr 2013]. Disponível em: <http://www.who.int/mediacentre/factsheets/fs311/en/index.html>.
 15. Perichart PO, Balas NM, Rodríguez CA, Muñoz MC, Monge UA, Vadillo OF. Correlates of Dietary Energy Sources with Cardiovascular Disease Risk Markers in Mexican School-Age Children. *J. Am. Diet. Assoc*. 2010;110:253-60.
 16. Buchner I, Medeiros, N, Lacerda, DDS, Normann, CA, Gemelli, T, Rigon, P, et al. Hepatoprotective and Antioxidant Potential of Organic and Conventional Grape Juices in Rats Fed a High-Fat Diet. *Antioxidants*. 2014;3(2):323-38.
 17. Borba AJD, Rocha MGM, da Silva MF, Tibúrcio DTDS, Pereira SADL, dos Reis LC, et al. Dieta hiperlipídica-proteica utilizada para emagrecimento induz obesidade em ratos. *Rev. nutr*. 2011;24(4):519-28.
 18. Charbonneau A, Unson CG, Lavoie JM. High-fat diet-induced hepatic steatosis reduces glucagon receptor content in rat hepatocytes: potential interaction with acute exercise. *The Journal of physiology*. 2007;579(1):255-67.
 19. Deji N, Kume S, Araki SI, Soumura M, Sugimoto T, Isshiki K, et al. Structural and functional changes in the kidneys of high-fat diet-induced obese mice. *American Journal of Physiology-Renal Physiology*. 2009;296(1):118-26.
 20. Westerterp MSP. Effects of energy density of daily food intake on long-term energy intake. *Physiology & behavior*. 2004;81(5):765-71.
 21. Yadav M, Jain S, Bhardwaj A, Nagpal R, Puniya M, Tomar R, et al. Biological and medicinal properties of grapes and their bioactive constituents: an update. *Journal of medicinal food*. 2009;2(3):473-84.
 22. Dani C, Oliboni LS, Pasquali MA, Oliveira MR, Umezu FM, Salvador M, et al. Intake of purple grape juice as a hepatoprotective agent in Wistar rats. *Journal of medicinal food*. 2008;11(1):127-32.
 23. Chachay VS, Macdonald GA, Martin JH, Whitehead JP, O'Moore STM, Lee P, et al. Resveratrol Does Not Benefit Patients with Non-alcoholic Fatty Liver Disease. *Clinical gastroenterology and hepatology: the official clinical practice journal of the American Gastroenterological Association*. 2014;12(12):2092-2103.
 24. Beltrán DR, Rull A, Rodríguez SF, Iswaldi I, Herranz LM, Aragónes, G, et al. Continuous administration of polyphenols from aqueous rooibos (*Aspalathus linearis*) extract ameliorates dietary-induced metabolic disturbances in hyperlipidemic mice. *Phytomedicine*. 2011;18(5):414-24.
 25. Nematbakhsh M, Zolfaghari B, Eshraghi F, Safari T, Pezeshki Z, Sorooshzadeh SMA. The effects of unripe grape extract on systemic blood pressure, nitric oxide production, and response to angiotensin II administration. *Pharmacognosy research*. 2013;5(2):60.
 26. Quinones M, Miguel M, Aleixandre A. The polyphenols, naturally occurring compounds with beneficial effects on cardiovascular disease. *Nutr Hosp* 2012; 27 (1): 76-89.
 27. Soares AAF, Corte CLD, Andrade ER, Marina R, González P, Barrio JP. Purple grape juice as a protector against acute x-irradiation induced alterations on mobility, anxiety, and feeding behaviour in mice. *Nutr Hosp*. 2014;29(4):812-821.
 28. Petrovski G, Gurusamy N, Das DK. Resveratrol in cardiovascular health and disease. *Annals of the New York Academy of Sciences*. 2011;1215(1):22-33.
 29. Rodrigues AD, Scheffel TB, Scola G, Santos MTD, Fank B, de Freitas, SCV, et al. Neuroprotective and anticonvulsant effects of organic and conventional purple grape juices on seizures in Wistar rats induced by pentylenetetrazole. *Neurochemistry international*. 2012;60(8):799-805.
 30. Leifert WR, Abeywardena MY. Cardioprotective actions of grape polyphenols. *Nutrition Research*. 2008;28(11):729-37.



Original/Investigación animal

Adipose tissue redistribution caused by an early consumption of a high sucrose diet in a rat model

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Abstract

Introduction: obesity is a major public health problem worldwide. The quantity and site of accumulation of adipose tissue is of great importance for the physiopathology of this disease.

Objectives: the aim of this study was to assess the effect of a high carbohydrate diet on adipose tissue distribution.

Methods: male Wistar rats, control (CONT) and high sucrose diet (HSD; 30% sucrose in their drinking water), were monitored during 24 weeks and total energy and macronutrient intake were estimated by measuring daily average consumption. A bioelectrical impedance procedure was performed at 22 weeks of treatment to assess body compartments and systolic arterial blood pressure was measured. Serum was obtained and retroperitoneal adipose tissue was collected and weighed.

Results: HSD ingested less pellets and beverage, consuming less lipids and proteins than CONT, but the same amount of carbohydrates. Retroperitoneal adipose tissue was more abundant in HSD. Both groups were normoglycemic; triglycerides, adiponectin and leptin levels were higher, while total cholesterol and HDL-cholesterol were lower in HSD; insulin, HOMA index and systolic blood pressure had a tendency of being higher in HSD.

Discussion: this model presents dyslipidemia and a strong tendency for insulin resistance and hypertension. Even though there was no difference in body compartments between groups, retroperitoneal adipose tissue was significantly increased in HSD. This suggests that a rearrangement of adipose tissue distribution towards the abdominal cavity takes place as a result of

REDISTRIBUCIÓN DEL TEJIDO ADIPOSO EN UN MODELO DE RATA DEBIDO AL ALTO CONSUMO DE SACAROSA DESDE EDAD TEMPRANA

Resumen

Introducción: la obesidad es uno de los mayores problemas de salud pública en todo el mundo. El momento en que se establece, la distribución y cantidad de tejido adiposo son de gran importancia para comprender su fisiopatología.

Objetivos: observar la distribución de tejido adiposo en una dieta alta en sacarosa desde una edad temprana en un modelo animal.

Métodos: se utilizaron ratas Wistar recién destetadas, animales control (CONT; agua ad libitum) y animales con dieta alta en sacarosa (HSD; 30% de sacarosa en el agua) durante 24 semanas. Se calcularon las kilocalorías y macronutrientes ingeridos diariamente; se evaluaron por impedancia bioeléctrica los compartimientos corporales, se midió la presión sistólica, se obtuvo el tejido adiposo retroperitoneal y el suero para medir parámetros bioquímicos.

Resultados: los animales HSD comieron y bebieron menos, obteniendo menos proteínas y lípidos, sin diferencia en los hidratos de carbono. El tejido adiposo fue más abundante en HSD. Ambos grupos CONT Y HSD fueron normoglucémicos; HSD tuvieron triglicéridos, adiponectina y leptina altos, y el colesterol y las HDL más bajos; la insulina, el HOMA y la presión sistólica tuvieron tendencia a ser mayores en HSD.

Discusión: este modelo presenta dislipidemia y una tendencia a tener resistencia a la insulina e hipertensión. A pesar de no haber una diferencia en los compartimientos corporales entre grupos, el tejido adiposo tuvo una localización específica en la espalda y fue más abundante en HSD. En conclusión, la distribución de grasa en el

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Recibido: 10-III-2015.

Aceptado: 3-IV-2015.

chronic high sucrose consumption, which contributes to a higher risk of suffering from metabolic and chronic degenerative diseases.

(*Nutr Hosp.* 2015;31:2546-2553)

DOI:10.3305/nh.2015.31.6.8935

Keywords: *Nutrition. Adipose tissue. Bioelectrical impedance. Sucrose. Obesity.*

Abbreviations

BIA: bioelectrical impedance analysis
BMI: body mass index
CONT: control
FFM: fat free mass
GLUT: glucose transporters
HCO: carbohydrates
HOMA: Homeostasis Model Assessment
HDL: high density lipoproteins
HSD: high sucrose diet
IL-6: interleukin-6
L: length
MMP: matrix metalloproteinase
TBF: total body fat
TBS: total body solids
TBW: total body water
TNF- α : tumor necrosis factor - α
VLDL: very low density lipoproteins
WBR: whole body resistance
WBXx: whole body reactance

Introduction

Nowadays, Western diets have become a major health problem due to highly energetic and rapidly available foods. In the long term, this can reflect in economical issues and social problems, since there is a negative impact on the governmental health care budget and is also cause of productivity loss in the working population. Once considered a problem only in high income countries, overweight and obesity are now dramatically on the rise in both low- and middle-income countries, particularly in urban settings¹. The risk of metabolic diseases due to overweight has been strongly linked to adipose tissue distribution, which is dependent of sex, genetic background, disease state, certain drugs and hormones, aging and environmental factors².

Obese children and adolescents face similar health risks as adults. Whilst symptoms may not become apparent until later in life, in many cases, damage from being overweight as a child has already been done, making it especially important for children to reach a healthy weight as early as possible¹.

Overweight and obesity are defined as abnormal or excessive adipose tissue accumulation that present health risks for a number of chronic diseases, inclu-

abdomen es consecuencia de una ingestión crónica alta en sacarosa, lo que predispone a padecer enfermedades crónico-degenerativas.

(*Nutr Hosp.* 2015;31:2546-2553)

DOI:10.3305/nh.2015.31.6.8935

Palabras clave: *Nutrición. Tejido adiposo. Bioimpedancia eléctrica. Sacarosa. Obesidad.*

ding metabolic diseases, cardiovascular diseases and cancer, reducing the life expectancy by up to 8 years³.

Adipose tissue can be accumulated in different depots, such as subcutaneous, ectopic, intramuscular, mesenteric and epididymal, but abnormally high deposition of visceral adipose tissue is known to present a higher risk of suffering from metabolic disorders^{4,5}.

Diets rich in simple carbohydrates (HCO), such as sucrose, have been strongly associated with an increased prevalence of obesity, type 2 diabetes and cardiovascular risk factors⁶, although controversy has risen on whether this type of diet contributes to an obese phenotype⁷ or simply promotes adipocyte hypertrophy, glucose intolerance, hyperinsulinemia, hyperlipidemia and an increased number of inflammatory cytokines⁸. Thus, several models have been designed in order to further study this multifactorial condition.

A rat model has been developed by administering a 30% sucrose solution as an unlimited beverage, causing metabolic disruptions by high HCO intake. The characteristics of this particular model are: moderate elevation of blood pressure, hypertriglyceridemia, hyperinsulinemia, excessive retroperitoneal⁹, renal damage¹⁰, high vascular reactivity and a high inflammatory state¹¹, which are in line with the risk factors that take to the metabolic syndrome.

However, a complete characterization of the model has not yet been published in relation to food intake and total body composition.

Objectives

The aim of this study was to characterize the effect of a high sucrose diet on blood parameters, body compartments and adipose tissue distribution.

Materials and methods

Animal model

Male Wistar rats (n=22) were fed during 24 weeks after weaning (starting weight: 70-95g) a standard rodent diet (Laboratory Rodent Diet 5001: protein 28.507%, fat 13.496%, HCO 57.996%, from which sucrose 3.7%, fructose 0.3%, glucose 0.22%, PMI Nutrition International, Brentwood, MO) and water ad libitum. The high sucrose diet (HSD) group (n=11) was

provided a 30% sucrose solution as their only liquid source. The other group were controls (CONT) (n=11) that received the same diet, with the exception of providing water as their liquid source. All animals were housed in proper facilities in groups of 6 animals per cage under artificial 12 hour light/dark cycles and a mean temperature of 22°C.

Morphological variables and blood pressure measurements

Animals were weighed on an electronic scale (1,500g capacity and accuracy of 1g) every two weeks. Length for body mass index (BMI) calculation was measured from the narium to the base of the tail¹². BMI was calculated by dividing the animal's weight (g) by the square of its length (cm²). Systolic arterial blood pressure was measured every 2 months in conscious animals using the tail-cuff method. The cuff was connected to a pneumatic pulse transducer (Narco Bio-systems Inc., Healthdyne Co.) and a programmed electro-sphygmomanometer. Six independent determinations were recorded with a Grass polygraph (model 79, Grass Medical Instruments, Quincy, MA) and the mean was calculated for each animal.

Food intake measurements

In order to estimate total energy intake and macronutrients from the diet, a weighed quantity of food and beverage were added daily at the same time of day (08:00 to 9:00 hours), and remains were collected and measured the day after in order to calculate by difference the average consumption. This was carried out throughout the 24 weeks of treatment. Drinking bottle spouts were rotated among the test and control animals when they were replenished and were monitored for leakage weekly.

Body composition procedure

At 22 weeks of age, the animals were submitted to an 8 hour fasting period. Rats were weighed and anaesthetized with a sodium pentobarbital solution (0.1mL per 100g of body weight, i.p.) in combination with saline solution. Once animals were completely anaesthetized, hair was removed from the dorsal surface and they were placed on a non-conductive surface. Their length (L) was measured from the narium to the pelvic-caudal junction with a non-elastic tape¹³. Afterwards, they were submitted to a bioelectrical impedance procedure (RJL Systems BIA Analyzer, model Quantum X) as described previously^{13,14} for obtaining body composition estimates using whole body resistance (WBR) and reactance (WBXc).

Four sterile 22G needles bent 1cm from the tip were used as electrodes and placed as firstly reported¹⁴ on

the shaved dorsal surface. Three replicate measurements of WBR and WBXc were recorded; this was done twice, after repositioning the animal between measurements. Average of WBR and WBXc measurements were used for analysis. To obtain fat free mass (FFM)¹⁵, total body water (TBW)¹⁴ and total body solids (TBS)¹³ of each animal, the following formulas were used:

$$\text{FFM (g)} = (141.25) (L)^2 / \text{WBR} - 0.02$$

$$\text{TBW (g)} = 15.47 + (97.44) (L)^2 / \text{WBR}$$

$$\text{TBS (g)} = \text{Body weight} - \text{TBW}$$

Total body fat (TBF) was obtained by subtracting total weight from the animals during the procedure minus FFM.

Serum measurements

After 24 weeks, both groups were sacrificed and blood samples were collected. Retroperitoneal adipose tissue was collected and weighed after sacrifice. Serum was obtained by blood centrifugation (15,000 rpm during 15 minutes at 4°C) and stored at -20°C until needed.

Glucose was measured with a commercial enzymatic kit (DCL- glucose oxidase Diagnostic Chemical Limited de Mexico, Mexico). Insulin was determined with a commercial rat specific radioimmunoassay kit (Linco Research, Inc. Missouri, USA) with 0.1ng/mL sensitivity and intra- and inter-assay coefficients of variation of 5 and 10%, respectively. Homeostasis Model Assessment (HOMA) was used as an index to measure the degree of insulin resistance and was calculated as follows: $(\text{insulin } (\mu\text{UI/mL}) \times \text{glucose (mmol/L)}) / 22.5$ ¹⁶.

Triglycerides and cholesterol were determined with commercially available procedures (SPINREACT cholesterol-LQ and triglycerides-LQ; Spinreact S.A. Girona, Spain). HDL-cholesterol was measured by enzymatic procedures (Hitachi 902 analyzer; Hitachi LTD, Tokyo, Japan). Accuracy and precision of lipid measurements in our laboratory are under periodic surveillance by the Centers for Disease Control and Prevention (Atlanta, GA, USA).

Leptin and adiponectin were determined using specific ELISA kits for rat from MILLIPORE (EZRL-83K and EZRADP-62K Millipore Corporation, Missouri, USA). Leptin had a specificity of 100% and 0.08 ng/mL sensibility. The intra and inter-coefficients of variation were 2.13 and 2.95%, respectively. Adiponectin had a specificity of 100% and no reactivity with human or mouse; the sensibility was 0.4ng/mL. The intra and inter-coefficients of variation were 1.59 and 6.54%, respectively, with 4 duplicates per sample.

Ethics

All animals were lawfully acquired and their manipulation was carried out in accordance with The European Commission Environment (Declaration of Helsinki) EC

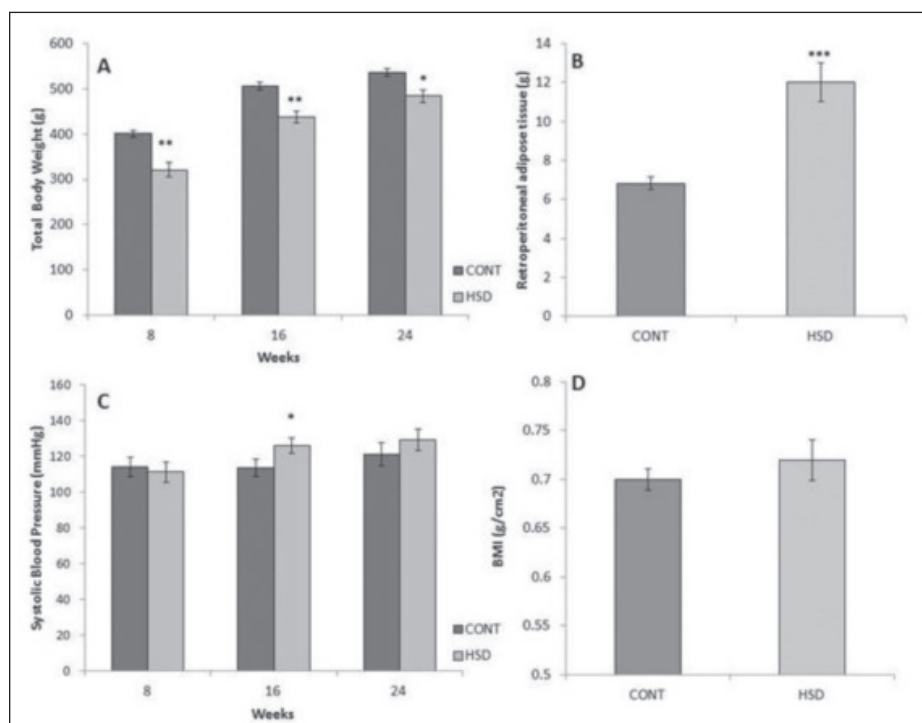


Fig. 1.—Body measurements. (A) Total body weight (g) throughout the treatment period; (B) Retroperitoneal adipose tissue (g) at sacrifice; (C) Systolic blood pressure (mmHg) throughout the treatment period and (D) BMI at the time of the BIA procedure (g/cm²). BMI: body mass index; CONT: control group; HSD: high sucrose diet. **P*<0.05; ***P*<0.01; ****P*<0.001.

Directive 86/609/EEC for animal experiments¹⁷. The protocol was reviewed and approved by Ethics Committee of the National Institute of Cardiology. Experimental work followed the guidelines from the Norma Oficial Mexicana guide for the use and care of laboratory animals (NOM-062-ZOO-1999) and for the disposal of biological residues (NOM-087-ECOL-1995).

All reagents used were of the highest grade available.

Statistical analysis

Statistical comparisons between experimental groups were conducted using Student's t-test (Sigma-Plot for Windows version 11.0 Germany), followed by Mann-Whitney post-hoc test. Data were tested for normality with the Shapiro-Wilk test (N-S-W test), and the abnormal variables were transformed to their natural logarithm. Values of *P*<0.05, *P*<0.01 and *P*<0.001 were considered as significant. Data are presented as standard error.

Results

External and macro-parameters

CONT and HSD began the study with no significant differences in body weight or age. At the end of the 24 weeks treatment period, HSD had a different appearance than CONT, since their hair was unevenly distributed along the whole body, and during the extraction of retroperitoneal adipose tissue, they presented more

fat pads around and inside the organs, as well as inside the thoracic cavity.

Progressive weight gain during treatment between groups is shown in figure 1A. HSD weighed 49.17 g less than CONT at sacrifice (*P*<0.01). Retroperitoneal adipose tissue was significantly more abundant in HSD (*P*<0.001) (Fig. 1B).

Blood pressure

There was a strong tendency of HSD to present higher systolic blood pressure. However, this parameter did not result in statistically significant differences between groups at the end of treatment (Fig. 1C).

Energy and macronutrient intake

Since the first month of treatment, HSD consumed significantly less pellets (*P*<0.001) and beverage (*P*<0.001) than CONT (Table I), even after adjusting by total weight (data not shown).

Energy consumption (Kcal) followed through the treatment period showed that HSD consumed less Kcal (*P*<0.01) (Table I). In relation to macronutrient ingestion, HSD consumed less protein (g) and lipids (g) than CONT (*P*<0.001). Interestingly, total HCO intake did not change between groups. CONT obtained HCO solely from pellet consumption, while HSD, although they consumed less pellets, compensated HCO consumption by drinking their sucrose rich water (Table I; Fig. 2).

Table I
Food, beverage, energy and macronutrient intake during 24 weeks

	8 WEEKS		16 WEEKS		24 WEEKS	
	CONT	HSD	CONT	HSD	CONT	HSD
Food intake (g/d)	29.5 ± 0.5	11.0 ± 0.4***	29.9 ± 0.5	11.2 ± 0.4***	29.7 ± 2.1	10.6 ± 1.0***
Beverage intake (mL/d)	58.6 ± 6.9	28.4 ± 4.3***	70.6 ± 3.9	38.4 ± 2.5***	68.6 ± 12.4	35.2 ± 6.2***
Total energy intake (Kcal/d)	89.4 ± 1.2	67.4 ± 3.2***	85.8 ± 4.9	76.2 ± 4.2***	94.6 ± 3.3	78.3 ± 3***
Lipid intake (g/d)	3.9 ± 0.05	1.4 ± 0.05***	3.6 ± 0.2	1.3 ± 0.0***	4.2 ± 0.1	1.5 ± 0.09***
Protein intake (g/d)	8.4 ± 0.1	3.1 ± 0.1***	7.7 ± 0.4	2.9 ± 0.1***	8.9 ± 0.3	3.1 ± 0.5***
Total HCO intake (g/d)	17.1 ± 0.2	14.9 ± 0.7**	15.7 ± 0.9	17.1 ± 0.9	18.1 ± 0.6	17.6 ± 0.8

Values are the result of the mean consumption per rat per day (d). **P<0.01; ***P<0.001. HCO: carbohydrates

Bioelectrical impedance analysis

Average weight of animals at the moment of the bioelectrical impedance analysis (BIA) was 519.58 ± 32.5 and 458.75 ± 48.4 g for CONT and HSD, respectively. Results of the procedure did not show significant differences between groups in relation to the measured components FFM, TBW, TBS and TBF after adjusting by total weight (Fig. 3). No significant differences were found in relation to BMI between groups (Fig. 1D).

Serum parameters

Blood glucose in both groups was normoglycemic. Triglycerides, adiponectin and leptin levels were higher (P<0.01, P<0.001 and P<0.01, respectively), while total cholesterol and HDL-cholesterol were lower (P<0.01 and P<0.001, respectively) in HSD compared to CONT. Serum insulin and HOMA index showed a strong tendency of being higher in HSD (data not significant). Values for each parameter are shown in table II.

Discussion

The present study demonstrates that chronic sucrose consumption starting from an early life stage plays a deleterious effect on serum parameters and significantly increases retroperitoneal adipose tissue. Despite having consumed more Kcal in the form of simple HCO (available from sucrose in their beverage (Fig. 2), HSD did not gain more weight than CONT. This diet-induced effect has been previously reported in a similar rat model¹⁸, where sweetened drinks were administered to animals and no weight difference was observed. Nonetheless, HSD presented significantly more retroperitoneal adipose tissue and a tendency of having more TBF, which could explain the higher serum levels of triglycerides and leptin, as well as the

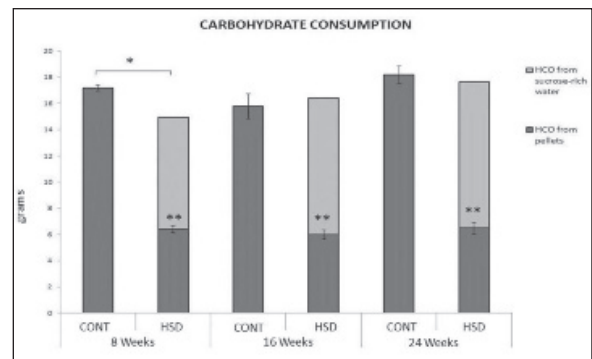


Fig. 2.—HCO consumption throughout the treatment period. HCO source (g) for CONT were pellets, whereas HSD obtained HCO from pellets and drinking water. HCO: carbohydrates. CONT: control group; HSD: high sucrose diet group. ***P<0.01; **P<0.001.

strong tendency of high blood pressure, which is consistent with previous studies¹⁸.

High sucrose diets do not necessarily induce an obese phenotype, but provoke severe endocrine and metabolic disturbances caused by abdominal adipose tissue accumulation, inducing hepatic synthesis of triglycerides from glucose and transports them to the bloodstream through very low density lipoproteins (VLDL) for storage in the adipose tissue¹⁹.

Leptin has pleiotropic effects on body weight, energy homeostasis, immune responses, inflammation, and angiogenesis²⁰. Circulating levels of leptin correlate with fat mass quantity. It travels from the adipose tissue to the hypothalamus, indicating the state of adipose tissue storage, and it exerts its action by inducing the expression of anorexigenic factors and reducing the hypothalamic production of orexigenic peptides²¹. High levels of leptin have been described in inflammatory states, making leptin resistance a key factor for the development of obesity²² together with hypertension²³. Our model presented high levels of leptin in HSD, and are in accordance with the presence of excess retroperitoneal fat.

Table II
Serum parameters

	CONT	HSD
Glucose (mg/dL)	90.5 ± 3.7	89.8 ± 4.06
Cholesterol (mg/dL)	69.2 ± 2.7	54.7 ± 3.2 **
HDL-Cholesterol (mg/dL)	47.4 ± 2.1	36.3 ± 1.8 ***
Triglycerides (mg/dL)	87.8 ± 4.9	136.6 ± 15.07 **
Insulin (μUI/mL)	3.7 ± 0.9	5.2 ± 0.7
Adiponectin (ng/mL)	14.2 ± 1.2	33.6 ± 3.6***
Leptin (ng/mL)	0.6 ± 0.06	1.4 ± 0.2**
HOMA	0.8 ± 0.2	1.1 ± 0.1

Values are expressed as means and standard error (±S.E.). HOMA: Homeostasis Model Assessment. **P< 0.01; ***P< 0.001. Insulin and leptin were transformed into the natural logarithm.

On the other hand, adiponectin controls systemic glucose and lipid homeostasis in the liver and skeletal muscle and is considered an anti-inflammatory adipokine^{24,25}. Adiponectin levels in plasma and adipose tissue are decreased in obese compared with lean individuals, and its production is inhibited by pro-inflammatory factors, such as tumor necrosis factor α (TNF-α) and interleukin-6 (IL-6), as well as by hypoxia and oxidative stress^{26,27}. However, it has also been reported that high levels of adiponectin are present during the pathogenesis of rheumatoid arthritis and osteoarthritis as a pro-inflammatory cytokine, inducing the expression of IL-6, IL-8, matrix metalloproteinase (MMP) -3 and MMP-9, via adenosin monophosphate-activated protein kinase, mitogen-activated protein kinases-38, inhibitor of κB kinase α-β and nuclear factor-κB^{28, 29}. At the time of sacrifice, adiponectin was elevated in our model. We hypothesize that it was exerting an inflammatory effect, due to the pro-in-

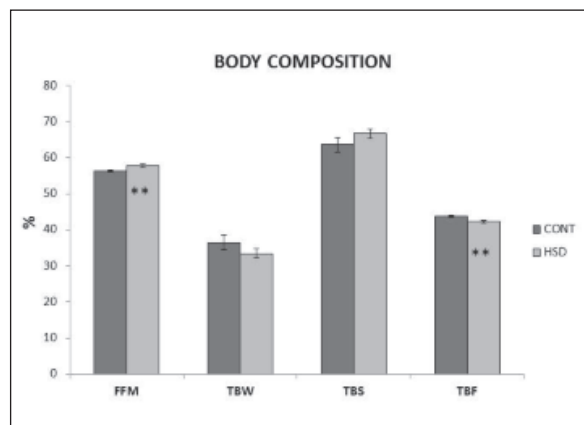


Fig. 3.—Body composition of both groups at 22 weeks of age. Values are expressed as percentage adjusted by total weight (g), representing body compartment distribution for CONT and HSD. FFM: fat free mass; TBW: total body water; TBS: total body solids; TBF: total body fat. **P<0.01.

flammatory microenvironment in the adipose tissue of HSD, emulating the behavior of inflammatory states, as in arthritis.

Sucrose rich diets do not necessarily promote obesity per se, but lead to adipose hypertrophy, causing major metabolic disturbances, such as glucose intolerance, hyperinsulinemia, hyperlipidemia and an increase in inflammation markers⁸. Furthermore, high sucrose diets induce hepatic synthesis of triglycerides from HCO, which are then transported to the blood through the VLDL and stored as adipose tissue³⁰. In our model, this is shown by the elevated storage of retroperitoneal adiposity and hypotriglyceridemia in HSD. In a study by Ruiz-Ramírez et al.³¹, elevated lipid levels in the liver by development of non-alcoholic fatty liver disease was confirmed in the same model.

There are many hypotheses that link these variables with inflammation. It is well known that pro-inflammatory cytokines produced by adipose tissue secrete TNF-α and IL-6, which reduce the expression of glucose transporters (GLUTs), such as GLUT4, that can result in lowering glucose uptake by the muscle, and can take part in the compensatory hyperinsulinemic state³², which is also reflected in the trend of elevated HOMA index seen in our model.

By performing BIA, no significant differences were observed between groups in body compartments after adjusting by total weight. However, HSD had significantly more retroperitoneal adipose tissue than CONT. This suggests that adiposity distribution varied widely between groups. This fact provides novel information on how a sucrose rich diet can lead to the rearrangement of fat depots towards the abdomen, contributing to the appearance of abdominal obesity and greatly increasing the risk of suffering from metabolic diseases as discussed by several authors³³. A limitation of this study was that BIA was only performed once in the animals, and the evolution of this redistribution could not be determined.

Abdominal adipose tissue storage has become a key factor in developing several metabolic risk factors. Such is this tendency that some authors have proposed that excessive fat depot would be one of the main features in insulin resistance³⁴. Others propose that the cause of insulin resistance is the excess storage of visceral adipose tissue³⁵. In our model, both excess of abdominal fat depots and insulin resistance were present in HSD when compared to CONT.

BIA allowed the comparison of body compartments in both groups, where the most interesting finding was that both groups had the same TBF after adjusting by total body weight, although HSD had significantly higher amounts of retroperitoneal fat.

These findings confirm that high sucrose diets play an important role in the development of dyslipidemia, and suggest that in this animal model, a clear rearrangement of adiposity takes place after a 24 week sucrose dietary intervention, rearranging most of the fat as abdominal adipose tissue and contribu-

ting to a higher risk of metabolic disturbances, such as cardiovascular diseases, dyslipidemias and type 2 diabetes. Future research should focus on elucidating the molecular mechanisms by which this rearrangement takes place.

Conclusions

A chronic sucrose rich diet induces high serum lipid and insulin levels, together with hypertension and excess abdominal adiposity. Studying macronutrient intake in animal models is relevant for unraveling the molecular and physiological disturbances of metabolic diseases. Adipose tissue rearrangement towards the abdominal cavity in HSD could be the cause of all metabolic disturbances, since abdominal obesity presents higher risk than when accumulated in other depots. Future work could be aimed on studying the mechanisms that contribute to the fat redistribution towards the abdominal cavity to understand the etiopathogenesis of different metabolic diseases.

Acknowledgements

The authors acknowledge financial support to A.K.C.J., who received a scholarship from the Coordinating Committee of National Institutes of Health and High Specialty Hospitals (PROBEI) and S.M.R.P., who received a PhD. scholarship from the National Council for Science and Technology (CONACYT # 230762).

References

- Lobstein T, Baur L, Uauy R: Obesity in children and young people: a crisis in public health. *Obesity reviews* 2004, 5 (Suppl. 1), 4-85.
- Tchkonina T, Thomou T, Zhu Y, Karagiannides I, Pothoulakis C, Jensen MD, Kirkland JL: Mechanisms and metabolic implications of regional differences among fat depots. *Cellular Metabolism* 2014, 17(5):644-656.
- Ochner CN, Tsai AG, Kushner RF, Wadden TA: Treating obesity seriously: when recommendations for lifestyle change confront biological adaptations. *Lancet Diabetes Endocrinol* 2015 [http://dx.doi.org/10.1016/S2213-8587\(15\)00009-1](http://dx.doi.org/10.1016/S2213-8587(15)00009-1).
- Fox CS, Massaro JM, Hoffmann U, Pou KM, Maurovich-Horvat P, Liu, CY, Vasan RS, Murabito JM, Meigs JB, Cupples LA, D'Agostino RB Sr., O'Donnell CJ: *Abdominal visceral and subcutaneous adipose tissue compartments: association with metabolic risk factors in the Framingham Heart Study. Circulation* 2007, 116:39-48.
- Lee M, Wu Y, Fried SK: Adipose Tissue Heterogeneity. Implication of depot differences in adipose tissue for Obesity Complications. *Molecular Aspects in Medicine* 2013, 34(1):1-11.
- Malik VS, Popkin BM, Bray GA, Despres JP, Hu FB: *Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. Circulation* 2010, 121:1356-1364.
- Kanazawa M, Xue CY, Kageyama H, Suzuki E, Ito R, Namba Y, Osaka T, Kimura S, Inoue, S: Effects of a high-sucrose diet on body weight, plasma triglycerides, and stress tolerance. *Nutrition Reviews* 2003, 61(5):S27-S33.
- Oliveira LS, Santos DA, Barbosa-da-Silva S, Mandarim-de-Lacerda CA, Aguilera MB: The inflammatory profile and liver damage of a sucrose-rich diet in mice. *Journal of Nutritional Biochemistry* 2014, 25(2):193-200.
- Carbó R, Guarner V: Insulin effect on glucose transport in thymocytes and splenocytes from rats with metabolic syndrome. *Diabetology & Metabolic Syndrome* 2010, 2:64.
- Pérez-Torres I, Roque P, El Hafidi M, Diaz-Diaz E, Baños G: Association of renal damage and oxidative stress in a rat model of metabolic syndrome. Influence of gender. *Free Radic Res* 2009 Aug, 43(8):761-771.
- Rubio-Ruiz ME, Pérez-Torres I, Diaz-Diaz E, Pavón N, Guarner-Lans V: Non-steroidal anti-inflammatory drugs attenuate the vascular responses in aging metabolic syndrome rats. *Acta Pharmacol Sin* 2014 Nov, 35(11):1364-74.
- Novelli EL, Diniz YS, Galhardi CM, Ebaid GM, Rodrigues HG, Mani F, Fernandes AA, Cicogna AC, Novelli Filho JL: *Anthropometrical parameters and markers of obesity in rats. Lab Animal* 2007, 41(1):111-119.
- Yokoi K, Lukaski HC, Uthus EO, Nielsen, FH: Use of bioimpedance spectroscopy to estimate body water distribution in rats fed high dietary sulfur aminoacids. *Journal of Nutrition* 2001, 131:1302-1308.
- Hall CB, Lukaski HC, Marchello MJ: Estimation of rat body composition using tetrapolar bioelectrical impedance analysis. *Nutrition Reports International* 1989, 39(3):627-633.
- Ilgan J, Bhutani V, Archer P, Lin PK, Jen KL: Estimation of body composition changes during weight cycling by bioelectrical impedance analysis in rats. *J Appl Physiol* 1993, 74(5):2092-2098.
- Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC: Homeostasis model assessment: insulin resistance and beta-cell function from fasting plasma glucose and insulin concentrations in man. *Diabetologia* 1985, 28(7):412-419.
- Council European Parliament. Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purpose. <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010D0011>.
- Sheludiakova A, Rooney K, Boakes RA: Metabolic and behavioral effects of sucrose and fructose/glucose drinks in the rat. *European Journal of Nutrition* 2012, 51(4):445-454.
- Dziedzic B, Szemraj J, Bartkowiak J, Walczewska A: Various dietary fats differentially change the gene expression of neuropeptides involved in body weight regulation in rats. *Journal of Neuroendocrinology* 2007, 19(5):364-373.
- Morton GJ, Schwartz MW: Leptin and the CNS control of glucose metabolism. *Physiology Reviews* 2011, 91(2):389-411.
- Krysiak R, Handzlik-Orlik G, Okopien B: The role of adipokines in connective tissue diseases. *European Journal of Nutrition* 2012, 51:513-552.
- Zhou Y, Rui L: Leptin signaling and leptin resistance. *Frontier Medicine* 2013, 7(2):207-222.
- Mark AL: Selective leptin resistance revisited. *American Journal of Physiology, Regulatory Integrative and Comparative Physiology* 2013, 15(6):R566-R581.
- Mandal P, Pritchard MT, Nagy LE: Anti-inflammatory pathways and alcoholic liver disease: Role of an adiponectin/interleukin-10/heme oxygenase-1 pathway. *World Journal of Gastroenterology* 2010, 16(11):1330-1336.
- Vu V, Liu Y, Sen S, Xu A, Sweeney G: Delivery of adiponectin gene to skeletal muscle using ultrasound targeted microbubbles improves insulin sensitivity and whole body glucose homeostasis. *American Journal of Physiology, Endocrinology and Metabolism* 2013, 304(2):E168-E175.
- Ouchi N, Parker JL, Lugus JJ, Walsh, K: Adiponectin as an anti-inflammatory factor. *Clinica Chimica Acta* 2007, 1(1-2):24-30.
- Hodson L: Adipose tissue oxygenation. Effects on metabolic function. *Adipocyte* 2014, 3(1):75-80.
- Kang EH, Lee YJ, Kim TK, Chang CB, Chung JH, Shin K, Lee EY, Lee EB, Song YW: Adiponectin is a potential catabolic mediator in osteoarthritis cartilage. *Art. Research & Therapy* 2010, 12:R231-R242.

29. Dessein PH, Norton GR, Badenhorst M, Woodiwiss AJ, Solomon A: Rheumatoid arthritis impacts on the independent relationships between circulating adiponectin concentrations and cardiovascular metabolic risk. *Mediators of Inflammation*, 2013, article ID 461849 9 pages. <http://dx.doi.org/10.1155/2013/461849>.
30. Amin KA, Kamel HH, Abd Eltawab MA: Protective effect of Garcinia against renal oxidative stress and biomarkers induced by high fat and sucrose diet. *Lipids Health Disease* 2011, 14(10):6-19.
31. Ruiz-Ramírez A, Chávez-Salgado M, Pineda-Flores JA, Zapata E, Masso F, El-Hafidi M: High-sucrose diet increases ROS generation, FFA accumulation, UCP2 level, and proton leak in liver mitochondria. *American Journal of Physiology, Endocrinology and Metabolism* 2011, 301:E1198-E1207.
32. Rotter V, Nagaev I, Smith U: Interleukin-6 (IL-6) induces insulin resistance in 3T3-L1 adipocytes and is, like IL-8 and tumor necrosis factor-alpha, overexpressed in human fat cells from insulin-resistant subjects. *Journal of Biological Chemistry* 2003, 14(46): 45777-45784.
33. Foster MT, Pagliassotti MJ: Metabolic alterations following visceral fat removal and expansion: Beyond anatomic location. *Adipocyte* 2012, 4:192-199.
34. Johnson RJ, Stenvinkel P, Martin SL, Jani A, Sanchez-Lozada LG, Hill JO, Lanaspa MA: Redefining metabolic syndrome as a fat storage condition based on studies of comparative physiology. *Obesity (Silver Spring)* 2013, 21(4):659-664.
35. Matsuzawa Y, Funahashi T, Nakamura T: The concept of metabolic syndrome: contribution of visceral fat accumulation and its molecular mechanism. *Journal of Atherosclerosis and Thrombosis* 2011, 18(8):629-639.



Original/*Ancianos*

Caracterización antropométrica, calidad y estilos de vida del anciano chileno octogenario

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Resumen

Introducción: en Chile ha habido un incremento de la población de adultos mayores (AM). Existe interés por el grupo de 80 años y más, debido a que se ha descrito que presentan características diferentes en relación al estado nutricional, hábitos y calidad de vida.

Objetivo: describir las características de los adultos mayores autónomos de 80 años y más desde diferentes aspectos, como son la antropometría y el estilo y calidad de vida.

Metodología: estudio de corte transversal en 271 AM autónomos de ambos sexos. El estado nutricional se evaluó mediante índice de masa corporal (IMC) y se utilizaron dos criterios para el diagnóstico nutricional: el del Ministerio de Salud de Chile (MINSAL) y el internacional (OMS). Posteriormente se aplicaron las encuestas de tendencia de consumo, sueño de Pittsburgh, somnolencia y percepción de calidad de vida.

Resultados: el IMC promedio fue similar en ambos sexos ($p=0,06$), sin embargo la ingesta alimentaria presentó diferencias para energía, macronutrientes y micronutrientes ($p<0,01$). Al comparar el criterio MINSAL vs. internacional, se encontró que el primero detecta casi veinte veces más proporción de AM con bajo peso y que para la condición de exceso de peso la OMS clasifica mayor frecuencia de casos ($p<0,01$). Por otra parte no se detectaron diferencias en horas de sueño, somnolencia y percepción de calidad de vida en los AM estudiados.

Conclusión: existe una prevalencia importante de exceso de peso en este grupo, independientemente del referente que se utilice, y aún persisten deficiencias de algunos micronutrientes esenciales para este grupo etario emergente.

(Nutr Hosp. 2015;31:2554-2560)

DOI:10.3305/nh.2015.31.6.8737

Palabras clave: Estado nutricional. Estilos de vida. Octogenario. Vitaminas. Micronutrientes. Sueño.

ANTHROPOMETRIC CHARACTERIZATION, QUALITY AND LIFESTYLES OF THE CHILEAN HIGHER OCTOGENARIAN OLD

Abstract

Introduction: in Chile there has been an increase in the elderly population (AM). There is an interest in the group aged in 80 and older, because it has been described that they have different characteristics in relation to nutritional status, habits and quality of life.

Objective: to describe the characteristics of autonomous -AM of 80 years and over considering different aspects such as anthropometry, styles and quality of life.

Methods: cross-sectional study, 271 AM of both genders, anthropometry was assessed by body mass index (BMI), two criteria for nutritional diagnosis were considered: one from the Ministry of Health of Chile (MINSAL) and the other from the World Health Organization (WHO). Subsequently surveys of food frequency, Pittsburgh Sleep, sleepiness and quality of life perception were applied.

Results: the mean BMI was similar in both sexes ($p = 0.06$). However the intake of energy, macronutrients and micronutrients was higher in men ($p < 0.01$). Considering both criterias MINSAL v/s International, it was found that nearly twenty times of the underweight AM proportion was detected by MINSAL criteria. Also, for the excess weight condition WHO classifies these cases with more frequency ($p < 0.01$). Moreover an excessive daytime sleepiness and moderate quality of life in the AM were perceived in the studied population.

Conclusion: there is a significant prevalence of overweight in this age group, independently of criteria used. Although there are still some critical micronutrient deficiencies for this emerging age group.

(Nutr Hosp. 2015;31:2554-2560)

DOI:10.3305/nh.2015.31.6.8737

Key words: Nutritional status. Lifestyle. Octogenarian. Vitamins. Micronutrients. Sleep.

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Recibido: 6-II-2015.
Aceptado: 3-III-2015.

Introducción

En Chile, el 11,4% de la población es Adulto Mayores (AM) lo que equivale a 1.171.478 habitantes¹. Durante el envejecimiento se produce un deterioro biológico resultante de la interacción de factores genéticos y ambientales como los estilos de vida, hábitos alimentarios, actividad física y presencia de enfermedades². Para el 2020 se proyecta que la cantidad del AM de 80 años y más sea el doble que inicio de la década (469.536), situación que preocupa en términos sanitarios, debido a que existe una escasa información en relación a la condición nutricional, de salud y estilos de vida que tienen los AM que están insertos en la comunidad³.

En relación a la situación nutricional del AM controlados en centros de salud del país, casi 50% de los AM de 65 a 79 años presentan malnutrición por exceso y que menos del 10% presentaría déficit, sin embargo en el caso de los AM de 80 años y más esta situación cambia, disminuyendo en 10% la condición de exceso de peso e incrementando la situación de bajo peso (15,2%)³. Con respecto a la ingesta alimentaria en el AM se ha descrito que es menor a los requerimientos establecidos para este grupo, esta situación afecta a un 30% de los AM entre 70 y 80 años y que viven solos, sumado a lo anterior los AM desnutridos presentan mayor riesgo de morbilidad y mortalidad⁴. Los AM octogenarios (>80 años) son un grupo demográficamente emergente, la proyección de crecimiento poblacional publicado por el Instituto Nacional de Estadísticas (INE) en base al censo de 2002 sitúa a este grupo como el de mayor crecimiento proporcional, con lo que llegaría el 2050 a representar un 6,87% de la población chilena (1.388.136 personas)⁵.

Los AM presentan cambios en el sueño y son considerados como trastornos característicos de esta población⁶. Casi el 70% de ellos reportan problemas con el sueño^{7,8}. Se puede destacar una mayor latencia al sueño, dificultad en el mantenimiento ininterrumpido del sueño, disminución cuantitativa de fases de sueño profundo, disminución del umbral para la excitación debido al ruido, aumento de siestas durante el día y trastornos de sueño^{9,10}.

La somnolencia diurna excesiva, puede afectar entre un 10 a un 33% de las personas y se ha asociado en AM con el aumento de la incidencia de deterioro funcional, mayor riesgo a caídas, déficits cognitivos, disminución de la calidad de vida y mortalidad^{11,12}. En este ámbito se ha descrito que la edad es un factor importante, sin embargo se debe considerar también, el consumo de fármacos, la inactividad durante el día, consumo de alimentos estimulantes y fumar¹³.

La evaluación de la calidad de vida del AM es actualmente una preocupación dado al aumento de la expectativa de vida que ha presentado el país, esta condición se ha relacionado principalmente con factores socioeconómicos y condición de salud¹⁴⁻¹⁶.

El objetivo de este trabajo es describir las características de adultos mayores autónomos de 80 o más años desde diferentes aspectos como lo son la antropometría, estilos y calidad de vida.

Metodología

Estudio de corte transversal, se entrevistó a 271 AM voluntarios de las Ciudades de Santiago y Viña del Mar, de 80 años o más de edad, reclutados en centros de AM y que pertenecen al mismo nivel socioeconómico. Se consideró autónomo a la persona que tenía un puntaje ≥ 43 puntos, para lo cual se utilizó el diagnóstico de funcionalidad del AM (EFAM-Chile)¹⁷. El protocolo fue revisado y aprobado por el Comité de Ética de ambas universidades, cada participante firmó un consentimiento informado.

Mediciones

Antropometría

Para la evaluación nutricional se efectuó una evaluación antropométrica de peso y talla. La determinación del peso se realizó con un mínimo de ropa, utilizando una balanza mecánica (SECA, capacidad máxima de 220 kg y precisión de 50 g). La estatura se midió con un tallímetro con precisión de 1 mm. El estado nutricional fue determinado con el índice de masa corporal (IMC). Posteriormente y se clasificó de acuerdo a lo recomendado por el Ministerio de Salud de Chile (MINSAL) para la clasificación del AM: ≤ 23 delgadez o enflaquecido (EF); >23 a <28 normal; ≥ 28 a <32 sobrepeso (SP) y ≥ 32 obesidad¹⁸ y de acuerdo a los criterios OMS en bajo peso ($<18,5$), normal (18,5-24,9), sobrepeso (25,0-29,9), obesidad ($\geq 30,0$)¹⁹.

Encuesta Alimentaria

La ingesta alimentaria se evaluó a través de una encuesta de tendencia de consumo de alimentos semanal incluyó 31 tipos de alimentos (frutas, verduras, cereales, pan, carnes, pescados, lácteos, papas, aceites y grasas, bebidas, azúcares, etc.), la cual entregó información detallada sobre el consumo de alimentos de cada uno de los encuestados. Las porciones fueron descritas como utensilios típicos de uso en el hogar (vaso, taza, cuchara, cucharadita, plato, etc.). Esta información fue utilizada para calcular la ingesta usual estimada de vitaminas y minerales la cual fue comparada la Dosis Diaria Recomendada (RDA)²⁰. Las mediciones descritas fueron realizadas mediante la estandarización de profesionales nutricionistas (utilizando técnicas internacionales)²¹.

A los participantes se les aplicó la encuesta “Estilo de Vida y Promotor de Salud” (EVPS)²². Esta consiste en 48 aseveraciones sobre estilo de vida o hábitos personales, con 4 posibilidades de respuesta en escala de tipo Likert (nunca, a veces, frecuentemente y siempre)²³.

Encuesta de sueño de Pittsburg

Este cuestionario mide la calidad de Sueño al que se le agregó información sobre uso de medicamentos para dormir, consumo tabaco y alcohol, y horario de la cena o última comida²⁴.

Escala de Somnolencia de Epworth (ESE)

Se utilizó esta encuesta para detectar somnolencia diurna excesiva, una puntuación de ESE > 10 se considera somnoliento y >15 Somnolencia excesiva es un cuestionario sencillo y validado para la evaluación de la somnolencia subjetiva diurna en el contexto de los trastornos del sueño²⁷.

Análisis de datos

Los datos fueron procesados en planilla Excel y en SPSS 22.0. Para evaluar la normalidad de las variables continuas (edad, peso, talla, IMC, ingesta de nutrientes) se utilizó la prueba de kolmogorov-Smirnov; para el análisis de datos se utilizó el promedio y DE en las variables continuas y de distribución de frecuencia en las categóricas. Para la comparación entre 2 grupos con variables normales se utilizó la prueba T de Student y para las no normales la prueba de Mann-Whitney U. Para las variables categóricas de utilizó la prueba de Chi-cuadrado. En todos los casos se consideró significativo un valor $p < 0,05$.

Resultados

En la muestra estudiada hubo en predominio de mujeres (58,8%), las medianas de edad y escolaridad fueron similares en ambos sexos. Con respecto al IMC, se encontraron valores dentro de los parámetros normales para esta población. En la ingesta alimentaria se detectó que los hombres presentan una mayor ingesta de energía, hidratos de carbono, proteínas lípidos, fibra dietética, hierro, zinc, calcio, magnesio, folato y vitamina B12. En relación a las horas de sueño en la semana y fin de semana no se detectaron diferencia por sexo. Con respecto a la somnolencia diurna se observó una prevalencia general del cercana 33%. Al evaluar algunos componentes de los estilos de vida, se encontró que el consumo de tabaco y alcohol es casi dos veces más frecuentes en hombres que en mujeres. En el caso del uso de medicamentos, el mayor consumo se observó en ellas (tabla I).

Al utilizar los diferentes puntos cortes sugeridos para determinar el estado nutricional en los adultos mayores (MINSAL v/s OMS), se encontró que el criterio nacional pesquisa casi 20 veces más déficit que el criterio internacional y que en el caso del exceso de peso es el criterio internacional que clasifica casi a la mitad de adultos mayores en esta condición ($\chi^2 < 0,001$) (figura 1).

La evaluación dietética (figura 2) mostró en mujeres que el promedio de ingesta de ácido pantoténico, vitamina A, B12, Calcio y Hierro están bajo la RDA, en los hombres son las vitaminas E, C, ácido pantoténico, A y B12, y Calcio.

Discusión

El presente estudio mostró una elevada prevalencia de malnutrición por exceso, independiente del referente utilizado. Se detectó una ingesta insuficiente de vitaminas y minerales especialmente en mujeres, a su vez una elevada prevalencia de somnolencia diurna y una percepción moderada con respecto a la calidad de vida en este grupo. En relación a las características de estilo de vidas evaluadas se observa un mayor consumo del alcohol y tabaco en hombres y en el caso de las mujeres un predominio en el consumo de fármacos.

En este trabajo hubo una elevada prevalencia de sobrepeso, recientemente se ha publicado que esta condición podría ser un factor protector en este grupo etario. Un estudio realizado en adultos y AM taiwaneses, quienes presentaban un IMC entre 27-28kg/m² mostraron una razón de riesgo ajustada significativamente más baja que los normales para HTA 0,5 (IC95% 0,30-0,81) y para diabetes 0,41 (IC95% 0,18-0,89)²⁵. Otro estudio en AM españoles muestra que presentar un mayor IMC es un factor protector al riesgo de presentar malnutrición déficit OR=0,85 (IC95% 0,79-0,91)²⁶.

Un estudio realizado por Jiménez-Redondo²⁷ que evaluó a octogenarios y nonagenarios mostró que el 40% de ellos presentaba riesgo de malnutrición, detectándose deficiencias de micronutrientes como zinc, magnesio, potasio, ácido fólico, vitamina D y E, en cambio en nuestro estudio las posibles deficiencias que afectaron a todo el grupo de AM fue para zinc, calcio, vitamina A, B12, ac. Pantoténico. Solo se detectaron diferencias en Hierro en mujeres y vitamina C en hombres. Otro estudio realizado en AM chilenos mostro una elevada prevalencia de deficiencia de zinc sérico (66,8%). La disminución de la ingesta es la principal causa de la deficiencia de este mineral^{28, 29}, en nuestro estudio la adecuación de zinc fue baja en ambos sexos. Se estima que su deficiencia es un problema prevalente en los países en desarrollo y que su magnitud no sería muy distinta de la deficiencia de hierro³⁰.

Entre las vitaminas que presento una importante deficiencia en la ingesta podemos nombrar a la vitamina-A (retinol), quien juega un papel esencial en el sistema inmunológico tanto innato como adaptativo,

Tabla I
Características generales de octogenarios de las Comunas de Viña del Mar y Santiago

<i>Características</i>	<i>Mujer</i>	<i>Hombre</i>	<i>P – value</i>
Edad (EIC)	84 (81 - 87)	83 (81 - 86)	0,36*
Escolaridad (EIC)	6 (3 – 12)	7 (4 – 12)	0,72*
Estado nutricional			
IMC kg /mt2	25,5 (22,6 – 29,2)	25,8 (23,6 – 28,5)	0,06*
Ingesta alimentaria (EIC)			
Energía (kcal)	1699,2 (1473,9 – 2084,2)	1994,5 (1652,0 – 2356,4)	0,00*
Hidratos de Carbono (gr)	235,0 (201,1 - 299,1)	284,5 (232,5 - 338,4)	0,00*
Proteínas (gr)	68,0 (51,5 - 83,3)	77,4 (61,7 – 91,3)	0,00*
Lípidos (gr)	50,3(37,7 – 60,4)	53,6 (41,5 - 72,7)	0,01*
Fibra (gr)	19,7(14,8 – 25,3)	20,6 (16,3 – 27, 4)	0,03*
Hierro (mg)	11,6 (9,4 – 15,5)	13,5 (10,7 – 16, 4)	0,00*
Zinc (mg)	6,3 (4,5 – 8,1)	7,4 (5,4 – 9,4)	0,01*
Calcio (mg)	670,3 (518,7- 891,3)	753,5 (502,5 – 988,0)	0,02*
Magnesio (mg)	136,3(101,3 – 209,1)	161,1 (118,6 – 246,8)	0,04*
Folato (ug)	524,5 (383,7- 640,6)	587,2 (448,9 – 706,2)	0,00*
B 12 (ug)	1,1 (0,7 – 1,7)	1,2 (0,8 - 1,8)	0,02*
Sueño (EIC)			
Horas de sueño en la semana	9,0 (7,5 – 10,0)	9,0 (7,7 – 10,0)	0,69*
Horas de sueño fin de semana	9,0 (7,5 – 10,0)	9,0 (7,5 – 10,5)	0,72*
Somnolencia diurna (%)			
Sin somnolencia	70,8 (63,5 -78,0)	62,4(53,5 – 71,3)	0,14**
Somnolencia leve	24,0(17,2 – 30,8)	29,9(21,4 – 38,3)	0,27**
Somnolencia severa	5,2(1,6 – 8,7)	7,7(2,7 – 12,5)	0,40**
Estilo de Vida			
Actividad física (%)	11,0 (6 ,0 – 16,0)	19,7% (13,0 -27,9)	0,00**
Habito tabáquico (%)	7,1 (3,0 – 11,2)	17,1(10,1 – 24,0)	0,00**
Consumo de alcohol (%)	4,5 (1,2 – 7,8)	8,5 (3,4 – 13,6)	0,00**
Uso Medicamentos (%)	38,3 (30,5 – 46,0)	25,6 (17,6 – 33,6)	0,00**
Siesta (%)	55,2(47,2 – 63,1)	53,8 (44,6 – 63,0)	0,82**
Percepción de calidad de vida (1-4) (EI)	2,5 (2,2-2,9)	2,4 (2,1 – 2,8)	0,18**

Med = Mediana EIC= Espacio intercuartílico

*Test Mann-Whitney

** Chi cuadrado

la deficiencia de esta vitamina se asocia a una exacerbación de la inmunodeficiencia³¹ un reducido y/o desbalance del conteo de linfocitos³² y una desregulación en la producción de anticuerpos³³.

En el caso de vitamina-B12 se encontró una adecuación cercana al 60% con la RDA. La deficiencia de esta vitamina se traduce en enfermedades neurológicas/psiquiátricas tales como depresión, deterioro cognitivo o demencia, las cuales se incrementan en la medida que aumenta la edad y la deficiencia de esta

vitamina^{34, 35}. Un estudio realizado por Sánchez y cols. Mostró que AM chilenos las mujeres presentaron un 16,7% de déficit marginal, en cambio en hombres, el 8,3% presentaba déficit y el 25% déficit marginal de la vitamina B-12³⁶.

Se postula que la cantidad promedio de sueño disminuye con la edad avanzada³⁷. Sin embargo estudios en AM han mostrado una cantidad promedio de sueño de 7,6 horas³⁸, resultado similar al estudio transversal de Mesas y cols³⁹, pero inferiores a lo reportado en

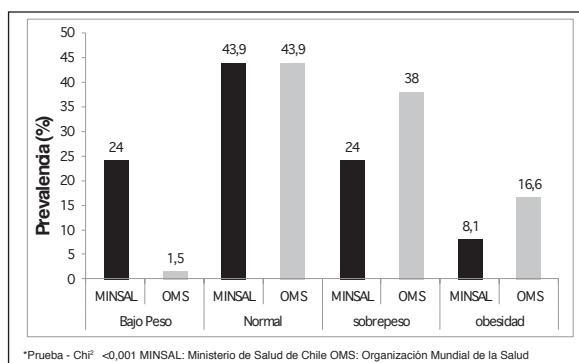


Fig. 1.—Estado nutricional según criterios nacional e internacional.

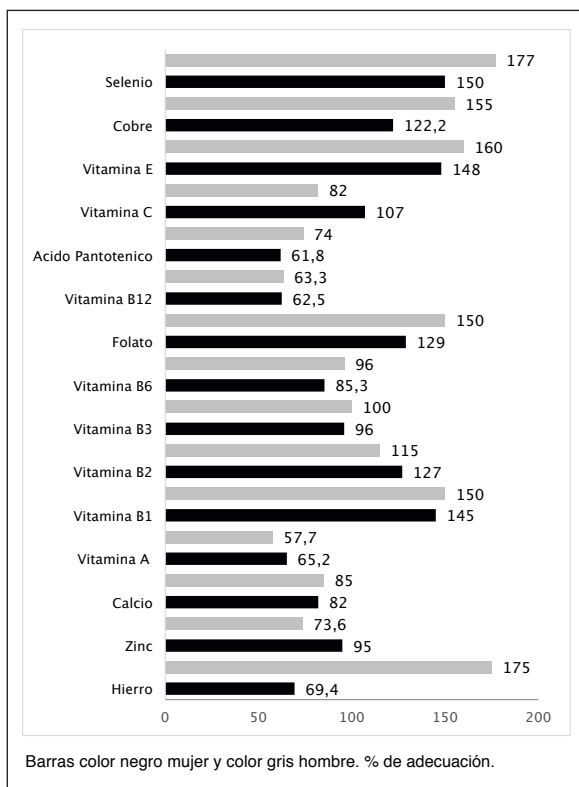


Fig. 2.—Contribución de la ingesta promedio de vitaminas y minerales en adultos mayores comparados con la RDA.

nuestro estudio que fue de 9 horas en ambos sexos. En relación a la somnolencia diurna se presentó en 1/3 de los AM evaluados. Esta condición se asocia con una reducción en la conectividad funcional de las redes de reposo (DMN) implicadas en la cognición⁴⁰. La pérdida de sueño, el sueño fragmentado afectan negativamente el rendimiento neurocognitivo^{41,42}. La privación de sueño se asocia con efectos adversos sobre la memoria, cognición y salud⁴³.

Un estudio de calidad de vida utilizando el cuestionario SF-36 en AM españoles⁴⁴ mostró un mejor estado de salud y calidad de vida que un estudio anterior español⁴⁵, en el estudio de García-Villanueva y cols.

las mujeres presentaron una menor calidad de vida que los hombres, resultado similar a otro estudio⁴⁶, a pesar que en nuestro trabajo no encontramos diferencias por sexo, es importante considerar este factor debido a que se relaciona con hábitos alimentarios y horas de sueño^{47,48}.

Entre los factores de estilos de vida que es importante considerar en este grupo sin duda es el mayor consumo de alcohol y tabaco principalmente en hombres, estos antecedentes deben ser considerados para monitoreo del estado de salud en este grupo, a su vez la baja actividad física reportada se ha asociado también en los AM al hábito tabáquico⁴⁹⁻⁵¹.

Entre las limitaciones del estudio pudo haber un sesgo de selección y memoria al trabajar con AM voluntarios, tal vez este grupo tiene características diferentes a los que no quisieron participar, sin embargo al pertenecer todos de segmentos sociales similares es posible que este factor no influya en los resultados presentados. Entre las fortalezas del estudio están el número de sujetos estudiados, los procesos de estandarización y control de calidad de los datos, lo cual favorece a la validez interna del trabajo.

Los AM octogenarios son una población poco estudiada, este trabajo muestra la necesidad de seguir evaluando las características antropométricas y alimentarias debido a que existe discusión en relación a que parámetros a utilizar para diagnosticar el estado nutricional y cuáles son los micronutrientes que deben ser intervenidos a nivel poblacional. Finalmente las características presentadas de estilos de vida, muestran la importancia de generar estrategias focalizadas a la prevención en este grupo etario emergente en la población chilena.

Agradecimientos:

A todos los colegas que participaron en el proyecto.

Referencias

1. Instituto Nacional de Estadísticas de Chile (INE); Available from: http://www.ine.cl/canales/chile_estadistico/estadisticas_sociales_culturales/adultos_mayores/adultos_mayores.php.
2. Blumberg J. Nutrient requirements of the healthy elderly--should there be specific RDAs? *Nutr Rev*. 1994;52(8 Pt 2):S15-8.
3. Diagnóstico del estado nutricional de menores de 6 años, gestantes, nodrizas y adultos mayores, bajo control en el sistema público de salud. http://web.minsal.cl/sites/default/files/DIAGNOSTICO_ESTADO_NUTRICIONAL_DICIEMBRE_2013.pdf.
4. van Staveren WA, de Groot LC, Burema J, de Graaf C. Energy balance and health in SENECA participants. Survey in Europe on Nutrition and the Elderly, a Concerted Action. *Proc Nutr Soc*. 1995;54(3):617-29.
5. Instituto Nacional de Estadísticas (INE). Estadísticas vitales proyección 2005-2050.; Available from: http://www.ine.cl/canales/chile_estadistico/demografia_y_vitales/proyecciones/Informes/MicrosoftWordInforP_T.pdf.

6. Ohayon MM, Carskadon MA, Guilleminault C, Vitiello MV. Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: developing normative sleep values across the human lifespan. *Sleep*. 2004;27(7):1255-73.
7. Reid KJ, Martinovich Z, Finkel S, Statsinger J, Golden R, Harter K, et al. Sleep: a marker of physical and mental health in the elderly. *Am J Geriatr Psychiatry*. 2006;14(10):860-6.
8. Suzuki E, Yorifuji T, Ueshima K, Takao S, Sugiyama M, Ohta T, et al. Sleep duration, sleep quality and cardiovascular disease mortality among the elderly: a population-based cohort study. *Prev Med*. 2009;49(2-3):135-41.
9. Neikrug AB, Ancoli-Israel S. Sleep disorders in the older adult - a mini-review. *Gerontology*. 2010;56(2):181-9.
10. Costa SV, Ceolim MF, Neri AL. Sleep problems and social support: Frailty in a Brazilian Elderly Multicenter study. *Rev Lat Am Enfermagem*. 2011;19(4):920-7.
11. Moraes W, Piovezan R, Poyares D, Bittencourt LR, Santos-Silva R, Tufik S. Effects of aging on sleep structure throughout adulthood: a population-based study. *Sleep Med*. 2014;15(4):401-9.
12. Gooneratne NS, Richards KC, Joffe M, Lam RW, Pack F, Staley B, et al. Sleep disordered breathing with excessive daytime sleepiness is a risk factor for mortality in older adults. *Sleep*. 2011;34(4):435-42.
13. Bloom HG, Ahmed I, Alessi CA, Ancoli-Israel S, Buysse DJ, Kryger MH, et al. Evidence-based recommendations for the assessment and management of sleep disorders in older persons. *J Am Geriatr Soc*. 2009;57(5):761-89.
14. A. V. Investigación en salud y calidad de vida. 1ra Ed. Bogotá: Universidad Nacional de Colombia; . 1994. p. 300.
15. L. G. Calidad de vida, estrés y bienestar. San Juan, Puerto Rico: Editorial Psicoeducativa 1991.
16. González A. L. (s.f.). Instituto Nacional de geriatría M.
17. Manual de Aplicación del Examen de Medicina Preventiva del Adulto Mayor. (Chile) Available from: <http://web.minsal.cl/portal/url/item/ab1f81f43ef0c2a6e04001011e011907.pdf>.
18. Feng W, Chumley P, Allon M, George J, Scott DW, Patel RP, et al. The transcription factor E26 transformation-specific sequence-1 mediates neointima formation in arteriovenous fistula. *J Am Soc Nephrol*. 2014;25(3):475-87.
19. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO Consultation. Geneva: World Health Organization; 2000.
20. García A. Ingesta de Nutrientes: Conceptos y Recomendaciones internacionales (1ª Parte). *Nutr Hosp*. 2006;21(4):291-9.
21. de Onis M, Onyango AW, Van den Broeck J, Chumlea WC, Martorell R. Measurement and standardization protocols for anthropometry used in the construction of a new international growth reference. *Food Nutr Bull*. 2004;25(1 Suppl):S27-36.
22. Walker SN, Kerr MJ, Pender NJ, Sechrist KR. A Spanish language version of the Health-Promoting Lifestyle Profile. *Nurs Res*. 1990;39(5):268-73.
23. Cid PM, Merino EJM, Stiepovich BJ. Biological and psychosocial factors that predict health promoting lifestyles. *Rev Med Chile*. 2006;134(12):1491-9.
24. Buysse DJ, Reynolds CF, 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res*. 1989;28(2):193-213.
25. Chung WS, Ho FM, Cheng NC, Lee MC, Yeh CJ. BMI and all-cause mortality among middle-aged and older adults in Taiwan: a population-based cohort study. *Public Health Nutr*. 2014;1-8.
26. Montejano Lozoya AR, Ferrer Diego RM, Clemente Marin G, Martinez-Alzamora N, Sanjuan Quiles A, Ferrer Ferrandiz E. Nutrition-related risk factors in autonomous non-institutionalized adult elderly people. *Nutr Hosp*. 2014;30(4):858-69.
27. Jimenez-Redondo S, Beltran de Miguel B, Gomez-Pavon J, Cuadrado Vives C. Non-Institutionalized Nonagenarians Health-Related Quality of Life and Nutritional Status: Is There a Link between Them?. *Nutr Hosp*. 2014;30(n03):602-8.
28. Sharkey JR, Branch LG, Zohoori N, Giuliani C, Busby-Whitehead J, Haines PS. Inadequate nutrient intakes among homebound elderly and their correlation with individual characteristics and health-related factors. *Am J Clin Nutr*. 2002;76(6):1435-45.
29. Olivares M, Lera L, Albala C, Pizarro F, Araya M. Prevalence of zinc and copper deficiencies in older subjects living in Metropolitan Santiago. *Rev Med Chile*. 2011;139(3):283-9.
30. International Zinc Nutrition Consultative Group (IZINCG). Technical document #1. Assessment of the risk of zinc deficiency in populations and options for its control. *Food Nutr Bull* 2004; 25: S91-204.
31. Hanley TM, Kiefer HL, Schnitzler AC, Marcello JE, Viglianti GA. Retinoid-dependent restriction of human immunodeficiency virus type 1 replication in monocytes/macrophages. *J Virol*. 2004;78(6):2819-30.
32. Bjersing JL, Telemo E, Dahlgren U, Hanson LA. Loss of ileal IgA+ plasma cells and of CD4+ lymphocytes in ileal Peyer's patches of vitamin A deficient rats. *Clin Exp Immunol*. 2002;130(3):404-8.
33. Stephensen CB, Jiang X, Freytag T. Vitamin A deficiency increases the in vivo development of IL-10-positive Th2 cells and decreases development of Th1 cells in mice. *J Nutr*. 2004;134(10):2660-6.
34. Eussen SJ, de Groot LC, Joosten LW, Bloo RJ, Clarke R, Ueland PM, et al. Effect of oral vitamin B-12 with or without folic acid on cognitive function in older people with mild vitamin B-12 deficiency: a randomized, placebo-controlled trial. *Am J Clin Nutr*. 2006;84(2):361-70.
35. Clarke R, Grimley Evans J, Schneede J, Nexø E, Bates C, Fletcher A, et al. Vitamin B12 and folate deficiency in later life. *Age Ageing*. 2004;33(1):34-41.
36. Sanchez H, Albala C, Lera L, Dangour AD, Uauy R. Effectiveness of the National Program of Complementary Feeding for older adults in Chile on vitamin B12 status in older adults; secondary outcome analysis from the CENEX Study (ISRCTN48153354). *Nutr J*. 2013;12:124.
37. Ancoli-Israel S, Ayalon L, Salzman C. Sleep in the elderly: normal variations and common sleep disorders. *Harv Rev Psychiatry*. 2008;16(5):279-86.
38. Helbig AK, Doring A, Heier M, Emeny RT, Zimmermann AK, Autenrieth CS, et al. Association between sleep disturbances and falls among the elderly: results from the German Cooperative Health Research in the Region of Augsburg-Age study. *Sleep Med*. 2013;14(12):1356-63.
39. Mesas AE, Lopez-Garcia E, Rodriguez-Artalejo F. Self-reported sleep duration and falls in older adults. *J Sleep Res*. 2011;20(1 Pt 1):21-7.
40. Buckner RL, Andrews-Hanna JR, Schacter DL. The brain's default network: anatomy, function, and relevance to disease. *Ann N Y Acad Sci*. 2008;1124:1-38.
41. Goel N, Rao H, Durmer JS, Dinges DF. Neurocognitive consequences of sleep deprivation. *Semin Neurol*. 2009;29(4):320-39.
42. Durmer JS, Dinges DF. Neurocognitive consequences of sleep deprivation. *Semin Neurol*. 2005;25(1):117-29.
43. Belenky G, Wesensten NJ, Thorne DR, Thomas ML, Sing HC, Redmond DP, et al. Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study. *J Sleep Res*. 2003;12(1):1-12.
44. Garcia Villanueva MZ, Uterga Valiente JM, Rodriguez-Antiguedad Zarranz A. Quality of Life in an Adult Population of More than 60 Years of Age without Cognitive Impairment. *Dement Geriatr Cogn Dis Extra*. 2014;4(3):355-63.
45. Lopez-Garcia E, Banegas JR, Graciani Perez-Regadera A, Gutierrez-Fisac JL, Alonso J, Rodriguez-Artalejo F. Population-based reference values for the Spanish version of the SF-36 Health Survey in the elderly. *Med Clin (Barc)*. 2003;120(15):568-73.
46. Azpiazu Garrido M, Cruz Jentoft A, Villagrasa Ferrer JR, Abanades Herranz JC, Garcia Marin N, Alvarez De Mon Rego C. Quality of life in noninstitutionalized persons older than 65 years in two health care districts in Madrid. *Aten Primaria*. 2003;31(5):285-92; discussion 93-4.

47. Garcia Milla P, Candia Johns P, Duran Aguero S. Association between breakfast intake and quality of life among self-sufficient chilean elderly. *Nutr Hosp.* 2014;30(4):845-50.
48. Durán S, Mattar P, Bravo N, Moreno C, Reyes, S. Asociación entre calidad de vida y cantidad de sueño en adultos mayores de la Región Metropolitana y Región de Valparaíso, Chile. *Rev Med Chile.* 2014;142:1371-6.
49. Wyatt LC, Trinh-Shevrin C, Islam NS, Kwon SC. Health-related quality of life and health behaviors in a population-based sample of older, foreign-born, Chinese American adults living in New York City. *Health Educ Behav.* 2014;41(1 Suppl):98S-107S.
50. Chile. OtpladsdlpameapMdSGd. Available from: http://web.minsal.cl/sites/default/files/files/ot_a_MAYOR.pdf.
51. Mesquita R, Goncalves CG, Hayashi D, Costa VD, Teixeira DD, de Freitas ER, et al. Smoking status and its relationship with exercise capacity, physical activity in daily life and quality of life in physically independent, elderly individuals. *Physiotherapy.* 2014. [Epub ahead of print].



Original/Ancianos

Impact of the consumption of a rich diet in butter and its replacement for a rich diet in extra virgin olive oil on anthropometric, metabolic and lipid profile in postmenopausal women

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Abstract

Objective: to analyze the impact of the substitution of a rich diet in saturated fats with a rich diet in monounsaturated fats on anthropometric, metabolic and lipid profile in postmenopausal women.

Material and methods: a prospective, longitudinal and comparative study where 18 postmenopausal women participated in two periods of dietary intervention of 28 days each one: 1) (SAT diet) consumed butter. Caloric formula (CF) = 15% protein, 38% fat. [20% saturated fat (SFA), 12% monounsaturated fat (MUFA) and 47% carbohydrates and 6% polyunsaturated (PUFA)]. b) Period MONO: with extra virgin olive oil (EVOO). CF = 15% protein, 38% fat (<10% SFA, 22% PUFA and 6% MUFA) and 47% carbohydrates. Size and body composition, glucose, insulin, HOMA, TC, HDL-C, LDL-C, VLDL-C, TG, TC/HDL-C, LDL-C/HDL-C, TG/HDL-C and non-HDL-C/HDL-C were measured; dietary Anamnesis/24 hours, daily food record. ANOVA and Bonferroni statistical analysis (SPSS 20) was applied.

Results: the age was 56 ± 5 years, BMI 29.8 ± 3.1 kg/m², waist circumference: 93.2 ± 10.1 cm, waist/hip ratio: 0.86 ± 0.14 , waist/height: 0.59 ± 0.06 and $38.6 \pm 4\%$ body fat (NS). Lipid profile: SAT diet increased TC ($p < 0.001$), LDL-C ($p < 0.002$) and non HDL-Cholesterol ($p < 0.000$), HDL-C increased in MONO diet ($p < 0.000$). SAT diet: TC/HDL-c ratio, Non col HDL-c/HDL-c, LDL-c/HDL-c ($p < 0.000$) and TG/HDL-c ($p < 0.000$). In MONO diet decreased TC/HDL-c ($p < 0.015$) and TG/HDL-c ($p < 0.016$).

IMPACTO DEL CONSUMO DE UNA DIETA RICA EN MANTEQUILLA Y SU REEMPLAZO POR UNA DIETA RICA EN ACEITE DE OLIVA VIRGEN EXTRA SOBRE EL PERFIL ANTROPOMÉTRICO, METABÓLICO Y LIPÍDICO EN MUJERES POSTMENOPÁUSICAS

Resumen

Objetivo: analizar el impacto de la sustitución de una dieta rica en grasas saturadas por una dieta rica en grasas monoinsaturadas sobre el perfil antropométrico, metabólico y lipídico en mujeres postmenopáusicas.

Material y método: estudio prospectivo, longitudinal y comparativo en el que 18 mujeres postmenopáusicas participaron en dos períodos de intervención dietética de 28 días cada uno: 1) (dieta SAT) consumieron mantequilla. Fórmula calórica (FC) = 15% de proteínas, 38% grasas. [20% grasas saturadas (AGS), 12% grasas monoinsaturadas (AGM) y 47% carbohidratos y 6% poliinsaturadas (AGPI)]. 2) Período MONO: con aceite de oliva virgen extra (AOVE). Fórmula calórica = 15% de proteínas, 38% grasas (<10% AGS, 22% AGM y 6% AGPI) y 47% carbohidratos. Se midieron dimensión y composición corporal, glicemia, insulina, HOMA, CT, HDL-C, LDL-C, VLDL-C, TG, CT/HDL-C, LDL-C/HDL-C/ TG/HDL-C y CT no HDL-C/HDL-C. Anamnesis dietética/24 horas, registro diario de alimentos. Para el análisis estadístico se aplicó ANOVA y BONFERRONI (SPSS 20).

Resultados: la edad fue de 56 ± 5 años, IMC: $29,8 \pm 3,1$ kg/m², circunferencia de cintura (CCI): $93,2 \pm 10,1$ cm, circunferencia cintura/cadera (IC/C): $0,86 \pm 0,14$, relación cintura/estatura (ICE): $0,59 \pm 0,06$ y $38,6 \pm 4\%$ de grasa corporal (%GC) (NS). CCI, Dieta SAT al Inicio: $55,6\%$ = RCV, final = $66,7\%$, dieta MONO = $55,6\%$. Perfil lipídico: dieta SAT aumentaron CT ($p < 0,001$), LDL-C ($p < 0,002$) y colesterol NO HDL-c ($p < 0,000$), HDL-C aumentó en dieta MONO ($p < 0,000$). Dieta SAT: Rel. CT/HDL-c, Col No HDL-c/HDL-c, LDL-c/HDL-c ($p < 0,000$) y TG/HDL-c ($p < 0,000$). En dieta MONO disminuyeron CT/HDL-c ($p < 0,015$) y TG/HDL-c ($p < 0,016$).

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Recibido: 28-I-15.

1.ª Revisión: 3-III-15.

Aceptado: 7-III-2015.

Conclusions: the SAT diet increased cardiovascular risk, while the MONO diet decreased the risk to develop the metabolic syndrome components and coronary heart disease.

(Nutr Hosp. 2015;31:2561-2570)

DOI:10.3305/nh.2015.31.6.8732

Keywords: *Postmenopause. Cholesterol dietary. Olive oil. Butter. Diet therapy.*

Abbreviations:

SFA: Saturated fatty acids.
MUFA: Monounsaturated fatty acids.
PUFA: polyunsaturated fatty acids.
EVOO: extra virgin olive oil.
WC: Waist circumference.
TC: Total cholesterol.
TC/HDL-C: Total cholesterol/HDL-C ratio.
Col No HDL: Colesterol no HDL.
DIET SAT: Diet with butter.
DIET MONO: Extra virgin olive oil diet.
CVD: Cardiovascular Diseases.
CVR: Cardiovascular risk factor.
HDL-C: High density lipoproteins.
BMI: Body Mass Index.
W/Hip I: Waist Hip Index.
W/Height I: Waist Height index.
LDL-C/HDL-C: LDL-C/HDL-C ratio.
LDL-C: Low Density Lipoproteins.
PMW: Postmenopausal Women.
No HDL-C/HDL-C: no HDL-C/HDL-C Ratio.
TG: Triglycerides.
TG/HDL-C: Triglycerides/HDL-C Ratio.
VLDL-C: Very Low Density level Lipoproteins.

Introduction

Menopause is the permanent suspension of menstrual function caused by reduced estrogen secretion, due to the loss of follicular function¹ which brings the end of the reproductive life of women, so bodily changes and biochemical characteristics occur that bring on a number of risk factors associated with obesity abdominal and insulina resistance²; which includes hypertension, diabetes and dyslipidemia that increase cardiovascular disease favoring higher mortality in this cycle of life³. Early, natural or surgical menopause is associated with endothelial dysfunction and increases 3 times the risk of coronaria artery disease⁴.

In this period of life, decreased circulating levels of estrogen brings about changes in the size and body composition, favoring weight gain of adipose tissue and increased fat distribution in the abdominal area². Currently there are various models, methods and techniques for anthropometric assessment, where it is

Conclusiones: la dieta SAT aumentó el riesgo cardiovascular, mientras que la dieta MONO disminuyó el riesgo de desarrollar los componentes del síndrome metabólico y enfermedades coronarias.

(Nutr Hosp. 2015;31:2561-2570)

DOI:10.3305/nh.2015.31.6.8732

Palabras clave: *Menopausia. Perfil lipídico. Aceite de oliva. Mantequilla. Intervención dietética.*

important to obtain information in determining the nutritional status as well as their influence on the cardiometabolic risk⁵.

On the one hand, another important aspect is the lipid profile⁶⁻⁸. Postmenopausal women have a lipid profile characterized by high concentrations of total cholesterol, LDL-C and TG and low HDL-C called dyslipidemia atherogenic⁸. It is considered that the Castelli atherogenic index and LDL-C / HDL-C ratio are good predictors of the clinical benefit degree on lipids intervention, although studies have been conducted mainly in pharmacological therapies⁹. Acevedo M et al showed in their study that the TC / HDL-C ratio and cholesterol no-HDL-C were the best associated, among different lipoprotein markers, to subclinical atherosclerosis. The HDL cholesterol proved to be the best protector of carotid thickness¹⁰.

In Venezuela women over 45 years accounted for 17.05% of the total female population for 1995 and projection for 2035 is 35.76%, with a life expectancy of 74.73 years old. The age for menopause comprises between 48.7 ± 4.6 years, this indicates that consequent alterations of endocrinological, biological and clinical processes of this gonadal cessation, will accompany them for a third of their lives¹¹. This aspect reflects the great importance of the study and management of environmental factors that influence their lifestyle, specifically food. However, few studies of dietary intervention on lipids in this cycle of life is conducted in the region.

From the nutrition point of view, epidemiological studies have highlighted the role of vegetable fats in the cardiovascular disease (CVD), neurodegenerative and cancer prevention^{12,13}. Lopez et al¹⁴ analyzed the association between dietary patterns and the presence of cardiovascular risk factors (CVR) in the National Health and Nutrition Examination Survey (NHANES) 2001-2002, These authors evaluated 1,313 women, and founded a significant association between dietary patterns and increased CVR. Cardiovascular protection decreases with age after menopause¹⁵, so it is possible that dietary intervention of monounsaturated fatty acids instead of saturated fatty acids in healthy diet, can induce different effects on metabolic risk factors in postmenopausal women¹⁶.

When it comes to foods rich in saturated fatty acids (SFA) and its effect on CVR factors, it is butter where

palmitic and stearic fatty acids predominate. These two SFA have the greatest potential impact on LDL-C¹⁷. The Health of Nurses, after tracking 80,082 women for 14 years, has estimated that an increase of 2% of caloric intake of SFA produces a 28% increased risk of coronary heart disease^{18,19}.

On the other hand, aliments rich in monounsaturated fats (MFA), the main representative being extra virgin olive oil (EVOO), which has a higher anti-atherogenic capacity, improves metabolic syndrome, facilitates glucose control, blood pressure and has beneficial effects on platelet function, thrombogenesis and fibrinolysis²⁰.

According to the above stated, the present research aimed to determine the impact of two dietary interventions in order to measure effects on anthropometric, metabolic and lipid profile before and after consumption of a diet high in saturated fat (diet SAT), compared to its replacement on a diet rich in monounsaturated fatty acids (diet MONO) supplied to a group of postmenopausal women, to generate dietary interventions aimed at improving the quality of life of women during this cycle of life.

Materials and methods

Study design

It is a prospective, longitudinal, experimental and comparative research. It consisted of 18 postmenopausal women (PMW) selected according to the inclusion criteria and subjected to two dietary interventions. Menopause was defined according to published criteria^{1,6}. In the pre and post intervention periods, a menu was provided with a similar fat composition to be consumed in each diet. The Shaw et al²¹ criteria for dietary intervention protocol was used.

Study population

From a universe of 100 PMW attending the Out-patient Nutrition Clinic, from March 2011 to March 2012; after explanation of the protocol, 18 patients who met the following criteria were selected: a) Between 50 and 65 years old. b) Being postmenopausal. c) Not having evidence of chronic disease, including liver, kidney, thyroid or heart dysfunction. d) Not following a low calorie diet. e) Not receiving drugs that could affect lipid metabolism. f) Has not received hormone replacement therapy; and g) Agreeing in writing to participate in the study. This research was approved by the Ethics Committee of the Laboratory for Research and Development in Nutrition, School of Nutrition and Dietetics, Faculty of Medicine, University of Zulia.

Methodology

Anthropometric Assessment

The measurements were performed by a specialist in Clinical Nutrition, previously trained and standardized in anthropometry. Women were assessed only with the minimum of clothes, no shoes or accessories. The technical error of measurement was within the range of values considered adequate: weight: 0.00 g, size: 0.01cm and triceps skinfold (PT_r) 0.1 mm. Skinfolds were measured with a Lange[®] grease caliper (Cambridge Scientific Instruments, Cambridge, MD) with a measuring range of 0-60 mm, graduation 0.3 mm and a constant pressure of 10 g/mm². Scales INNER-Scan Body Composition Monitor by Tanita, Ironman TM-BC554-3901 was used to determine body composition. For perimeters a 150 cm long anthropometric measuring tape was used. The measures of size and body composition²² were taken according to the criteria of the WHO²³.

Biochemical Evaluation

The sampling was performed at the Laboratory for Research and Development in Nutrition, after an overnight fast of 12 hours in a conditioned room where patients remained seated and relaxed. Then it was proceeded to attain the right antecubital vein, collecting 5 ml of blood in dry tube, samples were taken at baseline and 28 days after that at the end of each period; then it was proceeded to determine the levels of glucose, insulin, TG, TC, HDL-C, LDL-C, VLDL-C.

Insulin was determined by ELISA (DRG Instruments GmbH, Germany, Division of DRG International, Inc.) and blood glucose by the enzymatic colorimetric method of Glucose Oxidase (Human Gesellschaft für Biochemica und Diagnostica mbh). With both data it was proceeded to calculate HOMA-IR (Homeostasis Model Assessment) index, using the parameters of insulin and basal glucose following formula: IR (HOMA-IR) = Insulin fasting (uU / mL) × fasting glucose (mmol /L)/22.5²⁴.

Different concentrations of lipids were analyzed using commercial colorimetric methods (Human Gesellschaft für Biochemica und Diagnostica mbh). LDL-C cholesterol was calculated using the Friedewald formula: LDL-C=CT (HDL-C + TG/5)²⁴. It was used as a reference for the lipid profile ATP III²⁵ criteria. Regarding lipoprotein⁹ ratios were determined as follows:

- For the atherogenic index Castelli²⁶ equals relation to TC/HDL-C, the following were taken as cutoff points: <4.5 lower risk, from 4.5 to 7 moderate risk and >7 high risk.

- For the LDL-C/HDL-C index <3 was taken as the cutoff point.
- For the relation CHOLESTEROL No HDL/HDL-c, <4.5 was taken as the cutoff.
- For the TG/HDL-C ratio, ≥ 3.0 was used as the cutoff.

Dietary Assessment

During the initial dietary assessment²⁷ was performed by applying the 24-hour recall²⁸ in a standardized manner to identify the habits and preferences of the participants taking into account two nonconsecutive days (usual day and not usual), emphasis was placed on the amounts and types of food as well as specials preparations, recording measurements and ingredients used. During the execution of the study to assess diets compliance, their homes were visited and 3 phone calls were made weekly. To calculate the contribution of energy and nutrients a computer program with data from the Table of Food Composition of Venezuela²⁹ was used.

Dietary intervention

All volunteers participated in two dietary intervention periods of 28 days each one, isocaloric in relation to their usual previous consumption in order to keep their weight stable. There was no washout period. At the beginning and end of each dietary intervention period the respective biochemical tests were performed. PMW consumed the SAT diet which comprises 15% protein, 47% carbohydrate (CHO) and 38% fat (20% SFA, 12% MUFA, and PUFA 6%) and the MONO diet which comprised 15% protein, 47% CHO, 38% fats ($<10\%$ SFA, 22% MUFA and PUFA 6%). Cholesterol intake was less than 300 mg/day for the two periods of dietary intervention. With the results of dietary assessment it was proceeded to calculate the average caloric formula and the drafting of the regimes used in different periods according to the type of fat used.

The diet was made based on 7 rotating menus previously established with an isocaloric formula which providing for the SAT DIET 1926 kcal, 80.7 g fat; while where provided for the MONO diet 1951 kcal and 82.7 g of fat. Both regimens provided 79 g protein and 222 g carbohydrate. These diets were consumed by patients at home. The participants in the first stage received the SAT diet where they consumed 50 g of butter a day as a source of saturated fat, which they smeared on white bread or corn products; subsequently, they received the OLIVA diet, which included 50 cc of EVOO, which was consumed in soup (added raw) or tablespoons.

Statistical analysis

For the statistical treatment of the data, the statistical program package SPSS (Statistical Package for Social Sciences) version 17.0²⁹ was used. Descriptive Statistics were used to represent the results as mean $\pm$ standard deviation and change percentages for the control diet in tables. The Kolmogorov – Smirnov test was used to compare the normal distribution of the variables. The Levene test was used in the contrast of the homogeneity test. To determine the effect of the different diets on the studied variables, the analysis of variance (ANOVA) was used in comparing arithmetic means and post hoc, Bonferroni was applied. $p < 0.05$ was considered as the significant statistical value.

Results

Women studied were of 56 ± 5 years old, with a range between 50 and 64. Table 1 shows the anthropometric variables of body dimension, it appears that at the beginning of the SAT diet, BMI was 29.8 ± 3.1 kg/m², waist circumference (WC), 93.2 ± 10.1 cm, waist/hip circumference (W/HC) of 0.86 ± 0.14 and waist/height relationship (W/HR) of 0.59 ± 0.06 . Also, regarding the body composition, the subjects presented a body fat percentage of $38.6 \pm 4\%$. There were no significant differences in anthropometric measurements between the two diets. However, while analyzing the effects of the anthropometric indicators of cardiovascular disease risk, it was found that the cardiovascular disease risk had increased during the consumption of the SAT diet for all indicators; which then decreased during the period of the MONO diet consumption.

In table 3 a metabolic and lipidic profile is presented for both periods. Regarding the metabolic profile, glycemia and the HOMA-IR index significantly increased during the SAT diet, while not presenting any modifications at the end of the MONO period. Regarding the lipidic profile, it was observed that during the SAT diet there was a significant increase in TC ($p < 0.001$), LDL-C ($p < 0.002$) and observed the no cholesterol HDL-c ($p < 0.000$). Additionally, no significant changes were observed in the VLDL-C, nor TG on any of the dietary interventions. Nevertheless, while percentage comparing it was found that during the MONO period the TG and VLDL-C decreased by 7.4% and 7.2%, respectively.

When it comes to the HDL-C, it was observed that in the MONO diet the response was significant ($p < 0.000$). Another aspect evaluated in table 3 were the lipoproteics indicators where it is evident that the relation CT/HDL-C and the relation Col No HDL-C/HDL-C increased the cardiovascular disease risk in the SAT diet ($p < 0.000$); the same aspect decreased in the MONO diet ($p < 0.015$ and $p < 0.016$ respectively). The relation LDL-C/HDL-C increased during the SAT diet ($p < 0.000$).

Table I
Comparison of anthropometric variables of participants body size and composition
in the two periods of dietary intervention.

Antropometric Variable	Dietary Intervention Type		
	Diet SAT		Diet MONO
	BEGINNING (n=18)	ENDING (n=18)	(n=18)
Body size			
Body weight (kg)	72.4±10.3	72.2±10.0	71.9±10.2
BMI (kg/m ²)	29.8±3.1	29.7±2.9	29.7±2.9
Torax (cm)	103.1±8.9	102.8±9.5	101.7±9.0
Waist circumference (cm)	93.2±10.1	93.3±9.5	93.2±10.1
Hip circumference (cm)	108.0±7.2	107.7±6.3	106.0±6.7
Waist/Hip Circumference	0.86±0.14	0.86±0.15	0.87±0.15
Waist/Height ratio	0.59±0.06	0.59±0.06	0.58±0.05
Thigh circumference (cm)	106.6±5.2	106.6±5.4	106.7±4.9
Media right arm/ Circunferemce (cm)	32.6±3.1	32.6±2.8	32.2±2.8
Right wrist (cm)	16.7±1.3	16.7±1.1	16.5±1.0
Body built	9.2±0.54	9.1±0.46	9.23±0.42
Right thigh circumference (cm)	63.1±3.6	63.7±3.5	62.1±2.5
Right calf circumference (cm)	37.9±2.1	37.8±2.2	37.2±2.4
Body composition			
Biceps skinfold (mm)	11.8±3.2	11.3±2.7	11.2±2.6
Triceps skinfold (mm)	17.1±4.6	19.0±3.0	18.9±3.1
Subscapular skinfold (mm)	22.0±5.2	20.3±4.6	20.3±3.3
Suprailiac skinfold (mm)	26.7±6.4	27.1±3.2	25.4±3.2
Abdominal skinfold (mm)	27.3±5.5	27.0±4.6	25.4±4.3
Total body water (%)	42.7±2.4	42.3±2.3	41.4±2.0
Fat free area (kg)	41.8±3.8	41.2±3.7	40.6±3.8
Bone tissue (kg)	2.2±0.1	2.2±0.2	2.1±0.2
Body fat (%)	38.6±4.0	39.2±4.0	40.4±3.5
Body fat (kg)	28.2±6.4	28.5±6.2	29.5±5.8
Visceral fat (%)	9.3±1.9	9.5±1.9	9.8±1.8
Visceral fat (kg)	6.8±2.1	6.9±2.1	7.1±2.1

Values represent the mean ± D. Diet SAT: Butter diet. Diet MONO: Extra virgin olive oil diet.

Table IV represents percentage ratio comparison in regards of the lipid profile of both types of diets. Regarding the cholesterol, it was observed that after the ingestion of butter the cardiovascular disease risk increased in 77.8% of the patients, said risk decreased after the consumption of olive oil in 61.1% of the patients. Table 4 also shows that the levels of LDL-C, after the consumption of butter, increased in all of the patients, while decreasing during the consumption of EVOO, and optimal values were observed in 11.1% of the patients.

For a more specific analysis the percentage evaluation of the lipoprotein ratios of cardiovascular disease risk in every patient was considered. In that sense, table 4 showing the CT/HDL-C relation, it is observed that during the dietary intervention with butter, the risk of cardiovascular disease increased in all patients; while decreasing during the extra virgin olive oil intervention, in such a way that 33.3% presented low risk. In the same order of ideas, table 4 shows similar results for the LDL-C/HDL-C relation and the TG/HDL-C. Furthermore, it is shown that in the NO cholesterol

Table II
Comparison of anthropometric indicators of cardiovascular risk
in the two periods of dietary intervention.

Anthropometric Indicator	Diet SAT		Diet MONO
	BEGINNING (n=18)	ENDING (n=18)	(n=18)
Body Mass Index			
Normal	5 (27.8%)	4 (22.2%)	4 (22.2%)
Overweight	3 (16.7%)	5 (27.8%)	5 (27.8%)
Obesity	10 (55.6%)	9 (50.0%)	9 (50.0%)
Waist Circumference			
Without risk	8(44.4%)	6 (33.3%)	8(44.4%)
With risk	10 (55.6%)	12 (66.7%)	10 (55.6%)
Waist/Hip Index			
Low risk	2 (11.1%)	1 (5.6%)	2 (11.1%)
Moderated risk	8(44.4%)	10 (55.6%)	8(44.4%)
High risk	8(44.4%)	7 (38.9%)	8(44.4%)
Waist/Height Index			
Without risk	2 (11.1%)	0 (0.0%)	1 (5.6%)
With risk	16 (88.9%)	18 (100.0%)	17 (94.4%)

Diet SAT= butter diet

Diet MONO= extra virgin olive oil diet

HDL-C/HDL-C relation, during the SAT period, the cardiovascular disease risk increased for 83.3% of the patients to high risk; however, these values improved in the MONO diet for 66.7% of the subjects.

Discussion

Despite major advances in the pharmacological management of dyslipidemia in recent decades, nutrition continues to play a key role in primary and secondary prevention of CVD. The main objective of this study was to determine the effect of a dietary intervention that included the replacement of saturated fatty acids represented by butter, as base grease of the typical Western diet based on monounsaturated fatty acids using extra virgin olive oil, as fat source of the Mediterranean diet, over atherogenic dyslipidemia of PMW; obtaining as a result that the SAT diet severely increased cardiovascular disease risk, which improved by receiving the MONO diet.

During menopause, cardiovascular risk factors are of greater impact due to hormonal changes, age, weight gain, inactivity and altered lipidic profile³. Women in this study were overweight and fat distribution of android type, with high cardiovascular metabolic risk according to the WC, W/Hip and W/Height index, which can foster the development of insulin resistance

and its clinical consequences: carbohydrate intolerance and type 2 diabetes, hypertension, dyslipidemia and coronary disease^{1,2}.

This investigation the studied patients were overweight with abdominal fat distribution. Similar results were reported by Meertens et al.³⁰ who evaluated 129 PMW aged 52.52±5.48 years old, they found a BMI of 28.07±5.78 kg/m², and WC of 89.16±11.13 cm with similar cardiometabolic risk; either than Rosety-Rodriguez et al³¹ were aimed at clarifying whether central obesity measurements assessed by dual X-ray absorptiometry may predict metabolic syndrome in 1326 Spanish postmenopausal women aged > 45 years old, during the observation period 537 women, representing 40.5% of the total studied, met the diagnostic criteria for metabolic syndrome. Also differs from those values reported by Miguel-Soca et al.⁸ who studied 298 menopausal women aged 59.5±9.7 years finding a BMI of 30.46±5.23 kg/m², and WC of 102.16±11.58 cm. Menopause brings with it increased fat due to age decreases of the basal metabolic rate associated with a progressive reduction in physical activity, decreased estrogen controlling leptin and possibly regulating appetite, inadequate food habits, socioeconomic conditions and genetic⁸.

The high cardiovascular risk observed in these women justifies the need for studies on the lipid profile diet effects, that being the main objective of this re-

Table III
Comparison of metabolic and lipid profile of the participants
in the two periods of dietary intervention.

Biochemicals	Dietary Intervention Type				
	Diet SAT		Bonferroni	Diet MONO	Bonferroni
	Beginning (n=18)	Ending (n=18)	p<0,005	(n=18)	p<0,005
Glycemia (RV: 70-100 mg/dl)	85.0±6.1	95.4±11.9 (↑11.7%)	0,008	94.0±10.8 (↓1.5%)	NS
Basal Insulin (RV:< 25 UI/l)	9.5±2.6	11.1±2.3 (16.8%)	NS	10.2±1.8 (↓8.9%)	NS
HOMA (RV: <2,5)	1.99±0.66	2.62±0.77 (↑31.6%)	0,029	2.36±0.67 (↓10%)	NS
Total Cholesterol (RV:<200 mg/dl)	182.7±16.2	223.2±30 (↑22.1%)	0,001	211.7±39.8 (↓5.1%)	NS
HDL-C (RV: <45 mg/dl)	39.3±2.7	40.0±1.9 (↑1.7%)	NS	43.4±1.6 (↑8.5%)	0,000
LDL-C (RV: 100-140mg/dl)	110.1±12.6	149.0±30 (↑35.3%)	0,002	140.9±43.3 (↓5.5%)	NS
VLDL-C (<25 mg/dl)	33.1±1.7	33.6±4.6 (↑1.5%)	NS	31.2±4.2 (↓7.2%)	NS
No HDL-C Cholesterol (< 140 mg/dl)	143.3±13.7	183.1±13.7 (↑27.7%)	0,000	169.7±37.3 (↓7.4%)	NS
Triglycerides (<150 mg/dl)	164.9±6.4	168.1±23.0 (↑1.9%)	NS	155.8±21.7 (↓7.4%)	NS
CT/HDL-C Rel (RV: 00-4,5)	4.61±0.25	5.5±0.7 (↑19.3%)	0,000	4.8±0.9 (↓12.7%)	0,015
LDL-C/HDL-C Rel (RV: 0,0-3)	2.83±0.22	3.8±0.7 (↑34.2%)	0,000	3.5±0.9 (↓7.8%)	NS
TG/HDL-C Rel (RV:0,0-3)	4.22±0.30	4.20±0.68 (↓0.47%)	NS	3.90±0.87 (↓7.1%)	0,003
Col No HDL-C/HDL-C Rel (RV: 00-4,5)	3.63±0.20	4.47±0.58 (↑23.1%)	0,000	3.63±0.20 (↓18.7%)	0,016

Values represent the mean ± DE

Diet SAT: Butter diet. Diet MONO: Extra virgin olive oil diet.

HDL-C: High density lipoproteins. LDL-C: Low density lipoproteins, VLDL-C: Very low density lipoproteins, Col HDL-C: cholesterol no HDL-C, TG: Triglycerides, Rel: Relación.

search. In terms of diet in different population groups, it has been reported that it is especially important in the prevention of mentioned diseases^{12,32} Hu et al.³² conducted a study of 80,082 women between 34 and 59 years old, which showed that the replacement of saturated fat and unsaturated fatty acids trans for monounsaturated or polyunsaturated fatty acids prevents the development of coronary heart disease, more significantly compared with only reduce consumption of saturated fat.

The present study at the end of the SAT period, an increase in TC at the expense of LDL-C was observed. It has been demonstrated that LDL-C is one of the key factors in the development of atherosclerosis,

since they are more susceptible to oxidation because they are better able to enter the macrophage monocyte arterial wall system; the opposite effect occurred when the extra virgin olive oil was consumed as monounsaturated fatty acids present in this oil are incorporated to the lipoproteic particle¹⁵. Concerning HDL-C was observed, that EVOO diet significantly improved HDL-C by 8.5% compared with the diet butter. It has been reported that the concentration of HDL-C is the best predictor of coronary heart disease risk in women, and their risk decreases by 3% for every 1 mg/dl increasing HDL-C in plasma³².

In this study, cardiovascular disease predictive index in the 2 periods of dietary intervention for com-

Table IV
Comparison of lipoproteins ratio and cardiovascular risk of the participants in the two periods of dietary intervention.

Indicator	Dietary Intervention Type		
	Diet SAT		Diet MONO
	BEGINNING (n=18)	ENDING (n=18)	(n=18)
Total Cholesterol			
Desirable	17 (94.4%)	4 (22.2%)	7 (38.9%)
High	1 (5.6%)	7 (38.9%)	7 (38.9%)
Very high	0 (0.0%)	7 (38.9%)	4 (22.2%)
Low density lipoproteins			
Optimum	4 (22.2%)	0 (0.0%)	2 (11.1%)
Intermediate	14 (77.8%)	6 (33.3%)	7 (38.9%)
High limit	0 (0.0%)	6 (33.3%)	4 (22.2%)
High	0 (0.0%)	5 (27.8%)	1 (5.6%)
Very high	0 (0.0%)	1 (5.6%)	4 (22.2%)
Cholesterol total/HDL-C Relationship			
Low risk	3 (16.7%)	0 (0.0%)	6 (33.3%)
Moderate risk	15 (83.3%)	17 (94.4%)	12 (66.7%)
High risk	0 (0.0%)	1 (5.6%)	0 (0.0%)
LDL-C/HDL-C Relationship			
Low risk	2 (11.1%)	0 (0.0%)	3 (16.7%)
Moderate risk	16 (88.9%)	5 (27.8%)	7 (38.9%)
High risk	0 (0.0%)	13 (72.2%)	8 (44.4%)
Triglycerides/HDL-C Relationship			
Low risk	0 (0.0%)	0 (0.0%)	1 (5.6%)
High risk	18 (100.0%)	18 (100.0%)	17 (94.4%)
Cholesterol NO HDL-C/HDL-C Relation			
Low risk	18 (100.0%)	3 (16.7%)	12 (66.7%)
High risk	0 (0.0%)	15 (83.3%)	6 (33.3%)

Values represent the mean $\pm$ DE

Diet SAT: Butter diet. Diet MONO: Extra virgin olive oil diet.

HDL-C: High density lipoproteins. LDL-C: Low density lipoproteins, VLDL-C: Very low density lipoproteins, Col HDL-C: cholesterol no HDL-C, TG: Triglycerides, Rel: Relationship.

paring the use impact of diet high in SFA and its replacement by a diet rich in MUFA were calculated; in this sense the Castell index and LDL-C/HDL-C ratio reflect increased atherogenic lipoproteins (LDL-C), and the decrease in HDL-C correlating with cardiovascular risk factors such as the components of metabolic syndrome (MS). Moreover, it has been shown that the predictive value of TG/HDL-C ratio is high for heart disease, and there is a direct relationship with hypertension and MS⁹.

In this line of thought, the results of this work at the beginning there was no PMW with high CV risk;

which is why they differ from E Chavez Gonzalez et al.³³ who evaluated the rate of Castell in 112 menopausal study reporting that 9.3% had low risk, 68.6% moderate risk and 22% high cardiovascular risk. Similarly, regarding the dietary intervention periods, the lipoprotein indicators showed high atherogenic and MS risk in patients following consumption of a diet rich in butter; as well as the beneficial effect of consuming a diet rich in EVOO.

The consumption of olive oil has been widely studied^{13,15,21}. The PREDIMED study with 7,216 subjects between 55 and 80 years old, including both genders,

with high cardiovascular risk, concluded that consumption of olive oil, especially extra-virgin variety was associated with a significantly reduced risk of cardiovascular events and cardiovascular mortality. It is important to consider that for every 10 g per day increase in total consumption of olive oil is associated with a 16% reduction in cardiovascular mortality, based on the findings in the EPIC-España³⁴ study. No literature that would allow comparison of lipid profile dietary intervention periods applying the aforementioned ratios is found.

This study has some limitations. The most important one was the small sample size, due to the high cost of chemical reagents, its scarcity and high inflation in the country where the study took place. As well as consumer acceptance of extra virgin olive oil because it is not part of the food patterns within the Western diet.

Conclusion

The results of this study indicates that replacing saturated fat butter and extra virgin olive oil improved atherogenic dyslipidemia, but did not influence the metabolic profile in these postmenopausal women.

Conflicts of interest

No conflicts of interest.

References

1. Zárate A, Saucedo R, Basurto L, Martínez C. La enfermedad cardiovascular como amenaza actual para la mujer adulta mayor. *Ginecol Obstet Mex*. 2007; 75: 286-92.
2. Rojas J S, Lopera V J S, Cardona V J, Vargas G N, Hormaza A M P. Síndrome metabólico en la menopausia, conceptos clave. *Rev. chil. obstet. ginecol*. 2014; 79(2): 121-128.
3. Pinto López E, Rice C and Weddle D O. The relationship among cardiovascular risk factors, diet patterns, alcohol consumption, and ethnicity among women aged 50 years and older. *J. Am Diet Assoc*. 2008; 108(2): 248-256.
4. Velázquez-Maldonado Elsy M. Prevención cardiovascular en la mujer postmenopáusica. *Rev. Venez. Endocrinol. Metab*. 2009 Jun; 7(2): 3-16.
5. Rosales Ricardo Y. Antropometría en el diagnóstico de pacientes obesos: una revisión. *Nutr. Hosp*. 2012 Dic; 27(6): 1803-1809.
6. Arca M, Lena-Vega G, Grundy S. Hypercholesterolemia in post-menopausal women. *JAMA*. 1994; 27: 453-459.
7. Villasmil E R, Guerra V M, Torres M M, Reyna N, Mejía M J. Perfil lipídico en mujeres pre menopáusicas y posmenopáusicas. *Rev Obstet Ginecol Venez*. 2007; 67(2): 107-114.
8. Miguel-Soca PE, Rivas-Estévez M, Sarmiento-Teruel Y, Mariño-Soler AL, Marrero-Hidalgo M, Mosqueda-Batista L. Factores de riesgo de enfermedad cardiovascular en mujeres con menopausia. *Rev Fed Arg Cardiol*. 2014; 43(2): 90-96.
9. Millán J, Pintó X, Muñoz A, Zúñiga M, Rubiés-Prat J, Pallardo L F et al. Cocientes Lipoproteicos: significado fisiológico y utilidad de los índices aterogénicos en prevención cardiovascular. *Clin Invest Arterioscl*. 2010; 22(1): 25-32.
10. Acevedo M, Krämer V, Tagle R, Corbalán R, Arnaiz P, Berríos X, Navarrete C. Relación colesterol total a HDL y colesterol no HDL: los mejores indicadores lipídicos de aumento de grosor de la íntima media carotídea. *Rev Med Chile* 2012; 140: 969-976.
11. CEPAL América Latina y el Caribe: el envejecimiento de la población. 1950-2050. Santiago de Chile: Boletín Demográfico. Centro Latinoamericano y Caribeño de Demografía (CELADE); 2003.
12. Carrillo Fernández L, Dalmau Serra J, Martínez Álvarez JR, Solà Alberich R, Pérez-Jiménez F. Grasas de la dieta y salud cardiovascular. *Nutr. clín. diet. Hosp*. 2001; 31(2): 6-25.
13. Pérez-Martínez P, Moreno-Conde M, Cruz-Teno C, Ruano J, Fuentes F, Delgado-Lista J, García-Ríos A et al. Dietary fat differentially influences regulatory endothelial function during the postprandial state in patients with metabolic syndrome: from the LIPGENE study. *Atherosclerosis*. 2010; 209(2): 533-8.
14. López EP, Rice C, Weddle DO, Rahill GJ. The relationship among cardiovascular risk factors, diet patterns, alcohol consumption, and ethnicity among women aged 50 years and older. *J Am Diet Assoc*. 2008 Feb; 108(2): 248-56. doi: 10.1016/j.jada.2007.10.043.
15. Rodenas S, Rodríguez-Gil S, Cruz Merinero M, Sánchez-Muniz FJ. Dietary Exchange of an Olive Oil and Sunflower Oil Blend for Extra Virgin Olive Oil Decreases the Estimate Cardiovascular Risk and LDL and Apolipoprote in All Concentrations in Postmenopausal Women. *Rev. Journal of the American College of Nutrition*. 2005; 24(5): 361-369.
16. Tardivo AP, Nahas-Neto J, Nahas EA, Maesta N, Rodrigues MA, Orsatti FL. Associations between healthy eating patterns and indicators of metabolic risk in postmenopausal women. *Nutr J*. 2010 Dec 8; 9:64. doi: 10.1186/1475-2891-9-64.
17. Cicerali S, Conlan XA, Sinclair AJ, and Keast RSJ. Chemistry and Health of Olive Oil Phenolics. *Critical Reviews in Food Science and Nutrition*. 2009; 49: 218-236.
18. Sun J, Buys NJ, Hills AP. Dietary pattern and its association with the prevalence of obesity, hypertension and other cardiovascular risk factors among Chinese older adults. *Int J Environ Res Public Health*. 2014 Apr 10; 11(4): 3956-71. doi: 10.3390/ijerph110403956.
19. Vilela AA, Sichieri R, Pereira RA, Cunha DB, Rodrigues PR, Gonçalves-Silva RM, Ferreira MG. Dietary patterns associated with anthropometric indicators of abdominal fat in adults. *Cad Saude Publica*. 2014 Mar; 30(3): 502-10.
20. Pérez- Martínez P, López- Miranda J, Delgado-Lista J, López-Segura F y Pérez - Jiménez F. Aceite de oliva y prevención cardiovascular: más que una grasa. *Clin Invest Arterioscl*. 2006; 18(5): 195-205.
21. Shaw, D.I., Tierney A.C., McCarthy S., Upritchard J., Vermunt S., Gulseth H.L. et al. J.A. LIPGENE food-exchange model for alteration of dietary fat quantity and quality in free-living participants from eight European countries. *British Journal of Nutrition*. 2009; 101(5): 750-759. ISSN 0007-1145.
22. Onis M, Habicht P. Anthropometric reference data for international use: recommendations from a World Health Organization Expert Committee. 1996.
23. ISAK. International Standards For Anthropometric Assessment. International Society for the Advancement of Kinanthropometry. *National Library of Australia*. 2001: 1-123.
24. Díaz Portillo J, Staff V.V., Fernández del Barrio M.T., Paredes Salido F. Determinaciones bioquímicas: Utilidad y valoración clínica Editorial Elsevier, España, 2004. ISBN 8445813684, 9788445813683. 524 pp.
25. Castelli WP. Epidemiology of coronary heart disease: The Framingham Study. *Am J Med*, 1984; 76: 4-9.
26. ATP III Guidelines At-A-Glance Quick Desk Reference. Third Report of the Expert Panel on. National Cholesterol Education Program. National. institutes of Health. National Heart, Lung, and Blood Institute. *NIH Publication*. 2001; No. 01-3305:1-6.
27. Palma SG, Puchal A, Vilà M C, Miserachs M, Illan M. Entrevista dietética: Herramientas útiles para la recogida de datos. *Rev Med Univ Navarra*. 2006; 50(4): 46-55.

28. Instituto Nacional de Nutrición. Tabla de Composición de Alimentos para uso práctico. Publicación N° 52. Caracas (Venezuela). *Serie Cuadernos Azules*. 2001: 15-77.
29. Manual del Usuario de SPSS (2010) IBM_SPSS_Statistics_Base_20.148151002 SPSS Inc., an IBM Company Headquarters, 233 S. Wacker Drive, 11th floor. Chicago, Illinois 60606.
30. Pavón de Paz I., Alameda Hernando C y Olivar Roldán J. Obesidad y Menopausia. *Nutr. Hosp.* 2006; 21(6): 633-637.
31. Meertens L, Díaz N, Fraile C, Riera M, Rodríguez A, Rodríguez L y cols. Estado nutricional, indicadores antropométricos y homocisteína sérica en mujeres posmenopáusicas venezolanas. *Rev. chil. nutr.* 2011 Sep; 38(3): 278-284.
32. Hu FB, Stampfer MJ, Manson JE, Rimm E, Colditz GA, Rosner BA et al. Dietary fat intake and the risk of coronary heart disease in women. *N Engl J Med.* 1997; 337: 1491-1499.
33. Chávez González E, Romero Romero N, Pardo Morales RV. Índice aterogénico en pacientes Perimenopáusicas. *Archivos de Investigación Materno Infantil*. 2011 mayo-agosto; III (2): 73-76. URL: www.medigraphic.org.mx.
34. Guasch-Ferré M, Hu FB, Martínez-González MA, Fitó M, Bulló M, Estruch R et al. Olive oil intake and risk of cardiovascular disease and mortality in the PREDIMED Study. *BMC Med.* 2014 May 13;12:78. doi: 10.1186/1741-7015-12-78.



Original/*Ancianos*

Calidad de la dieta de la población española mayor de 80 años no institucionalizada

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Resumen

Introducción: los adultos mayores no institucionalizados son un colectivo que suele presentar alto riesgo de malnutrición. Detectar problemas nutricionales mediante indicadores de la calidad global de la dieta, es un reto para los profesionales de la salud, de utilidad para la planificación de políticas nutricionales.

Objetivo: determinar la calidad global de la dieta de la población española mayor de 80 años no institucionalizada, para promover y fomentar la calidad de vida del anciano.

Metodología: se seleccionaron las personas mayores de 80 años del *Estudio Longitudinal Envejecer en España* 2011-2013 (n = 159), residentes en diversas zonas españolas. Para valorar la calidad de la dieta se utilizó el índice de alimentación saludable (IAS), la frecuencia de consumo de alimentos y el grado de adhesión al patrón de dieta Mediterránea (ADM).

Resultados: la población presentó valores de IAS cercanos a los correspondientes a una dieta saludable. Un porcentaje significativo necesitaba cambios en su alimentación, siendo los mayores de 90 años los que requirieron una mayor intervención dietética. La mayoría de la población cumplió las recomendaciones de la dieta mediterránea, aunque se observó bajo consumo de verduras, hortalizas, frutos secos y vino; y elevado consumo de embutidos.

Conclusiones: la dieta consumida habitualmente por los españoles mayores de 80 años no institucionalizados presenta desajustes nutricionales que podrían corregirse realizando pequeños cambios en su patrón dietético. Determinar la calidad global de la dieta permite la planificación de estrategias de intervención para promover cambios alimentarios saludables y emprender acciones orientadas al mantenimiento de una salud óptima en el binomio envejecimiento-nutrición.

(Nutr Hosp. 2015;31:2571-2577)

DOI:10.3305/nh.2015.31.6.8864

Palabras clave: *Índice de alimentación saludable. Grado de adhesión a la dieta mediterránea. Envejecimiento. Calidad de vida.*

QUALITY OF THE DIET OF THE SPANISH POPULATION OVER 80 YEARS NON-INSTITUTIONALIZED

Abstract

Introduction: non-institutionalized older adults are a group at high risk of malnutrition. Detect nutritional problems through indicators of overall diet quality is a challenge for health professionals, useful for the planning of nutritional policies.

Objective: determine the overall quality of the diet of the Spanish population over 80 years non-institutionalized for the promotion and enhance the quality of life of the elderly.

Methodology: people over 80 years from various Spanish regions, participants at the Longitudinal Aging Study from 2011 to 2013 (n = 159) were selected. Healthy Eating Index (HEI), the frequency of food consumption and the degree of adherence to the Mediterranean dietary pattern was used to assess the quality of the diet.

Results: the population had higher levels of HEI close to those corresponding to a healthy diet. A significant percentage of participants needed changes in the diet being older than 90 years who required a more significant dietary intervention. Most of the population met the recommendations of the Mediterranean Diet but low consumption of vegetables, nuts and wine and a high consumption of meats were observed.

Conclusions: the customary diet of the non-institutionalized Spanish over 80 years has nutritional imbalances that could be corrected by making small changes in the diet pattern. Determine the overall quality of the diet allows planning intervention strategies to promote healthy dietary changes and take actions to maintain an optimal health during aging.

(Nutr Hosp. 2015;31:2571-2577)

DOI:10.3305/nh.2015.31.6.8864

Keywords: *Healthy Eating Index. Degree of adherence to the Mediterranean Diet. Aging. Quality of life.*

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Recibido: 20-II-15.
Aceptado: 28-III-15.

Abreviaturas

ADM: Adhesión al patrón alimentario de Dieta Mediterránea.

IAS: Índice de Alimentación Saludable.

ELES: Estudio Longitudinal Envejecer en España.

Introducción

El envejecimiento poblacional es un triunfo de la sociedad actual, ya que refleja la mejora de la salud, aunque también plantea desafíos importantes para el futuro. La mejora de las condiciones de vida, en gran parte de los países desarrollados, ha contribuido a aumentar la esperanza de vida al nacer. Actualmente, en España la esperanza de vida se encuentra dentro de las más elevadas de Europa con cifras de 77,8 años para los hombres y de 84,3 años para las mujeres¹. Pero el envejecimiento en nuestro país seguirá creciendo de modo que, para el año 2060, se prevé que un tercio de su población estará compuesta por adultos mayores, destacando el incremento de personas octogenarias que, previsiblemente, pasará a ser un 13% de la población total². El colectivo de adultos mayores, es considerado por los expertos como uno de los grupos más vulnerables de sufrir problemas nutricionales. El estado nutricional de estas personas, es el resultado de una serie de factores que lo condicionan; entre ellos, destacan el nivel nutricional mantenido a lo largo de los años, el proceso fisiológico de envejecimiento, las alteraciones metabólicas y alimentarias, estados de morbilidad tanto crónicos como agudos, la toma de fármacos, el deterioro de la capacidad funcional y las situaciones psicosociales y económicas que mantienen³.

Los adultos mayores no institucionalizados y autónomos son un colectivo que, aunque no suele presentar malnutrición, suele presentar riesgo de malnutrición^{3,4}. Detectar problemas nutricionales en este grupo poblacional, aparentemente sano, es un reto para los profesionales de la salud por su dificultad puesto que, muchos de ellos ni siquiera acuden de forma periódica a los centros de salud. La elaboración de protocolos basados en estrategias de detección precoz a través de la identificación de factores asociados a los problemas nutricionales, podría ayudar en su identificación.

La valoración de la calidad global de la dieta y la determinación de su relación con el buen estado de salud es un desafío clave en epidemiología nutricional para detectar problemas nutricionales. Numerosos estudios evidencian la asociación entre el consumo de algunos alimentos y/o de nutrientes específicos, con un mayor riesgo de padecer enfermedades crónicas⁵ o de favorecer su efecto protector⁶. Es así como cada vez hay mayor interés por el estudio de indicadores de la calidad global de la dieta a través de grupos de alimentos. Aunque los estudios epidemiológicos centrados en un único nutriente, como de tipo de grasas de la dieta, siguen siendo de interés científico, recientemente es más frecuente la utilización de indicadores de la calidad global de la dieta, basados en el consumo de grupos de alimentos, tales

como el grado de adherencia al patrón alimentario de Dieta Mediterránea (ADM)^{7,8} y el índice de alimentación saludable (IAS)⁸. Ambos, son métodos rápidos y económicos para estimación de la calidad global de la dieta siendo útil en la planificación de políticas nutricionales⁸.

Diversos estudios han asociado una mayor longevidad y menor morbilidad con el patrón de Dieta Mediterránea^{9,10}, concretamente el grado de adhesión a la Dieta Mediterránea se ha asociado con una reducción significativa en el riesgo de enfermedad cardiovascular, cáncer y enfermedades degenerativas, entre otras causas de mortalidad^{11,12}. Estas patologías están muy relacionadas con la calidad y cantidad de los alimentos consumidos habitualmente en la totalidad de la dieta.

A pesar de que la Dieta Española se ajusta al patrón de Dieta Mediterránea, la evolución en los últimos años muestra cómo los hábitos alimentarios siguen una trayectoria poco saludable⁸. Este hecho adquiere mayor importancia en poblaciones de riesgo, como son ancianos, niños y adolescentes^{13,14}.

El objetivo principal de este trabajo fue determinar la calidad global de la dieta de una población de mayores de 80 años residente en España en diversas zonas, para establecer estrategias de intervención que permitan fomentar el establecimiento de hábitos alimentarios saludables, y promover la calidad de vida del anciano. La calidad de la dieta se evaluó estudiando los hábitos alimentarios, la frecuencia de consumo de grupos de alimentos y el patrón alimentario seguido por la población.

Metodología

Sujetos

Los participantes formaban parte de la cohorte del Proyecto Estudio Piloto del Estudio Longitudinal Envejecer en España (Proyecto ELES) y fueron seleccionados siguiendo el protocolo establecido en dicho proyecto aprobado por el Comité Ético del Consejo Superior de Investigaciones Científicas¹⁵. La muestra inicial fue de 1747 individuos mayores de 50 años no institucionalizados residentes en España, de los cuales, para este trabajo, se seleccionaron los mayores de 80 años, resultando una población de 159 individuos, 102 mujeres y 57 hombres. La totalidad del grupo se estratificó en tres subgrupos según la edad: 80-84 años (n=115); 85-89 años (n= 36) y mayor o igual a 90 años (n=8). Todos los participantes fueron informados del estudio que se iba a realizar y firmaron el consentimiento.

Consumo de alimentos

Los datos utilizados en este trabajo están recogidos en el cuestionario general y cuestionario de consumo de alimentos del proyecto ELES¹⁵.

El cuestionario de consumo de alimentario contiene 40 variables referentes al consumo de alimentos

(1-arroz, 2-pasta, 3-pan, 4-cereales, 5-galletas, 6-patata, 7-verduras cocidas, 8-verduras crudas, 9-frutas enteras, 10-zumo, 11-leche desnatada, 12-leche semidesnatada, 13-leche entera, 14-yogur, 15-queso fresco, 16-queso graso, 17-aceite de oliva, 18-aceite de girasol, 19-mantequilla/margarina, 20-huevos, 21-carne magra, 22-carne grasa, 23-pescado graso, 24-pescado semigraso, 25-pescado magro, 26-legumbres, 27-frutos secos, 28-embutidos, 29-fiambres, 30-postres, 31-helados, 32-miel, 33-cacao, 34-bollería, 35-chocolate, 36-azúcar, 37-mermelada, 38-salsas, 39-snacks y 40-precocinados).

Índice de alimentación saludable

La valoración del IAS se calculó siguiendo la metodología indicada por Kennedy et al¹⁶ y Norte et al⁸, ligeramente modificada para poder adaptar los cálculos a los grupos de alimentos característicos de la población española y a los objetivos nutricionales marcados en las Guías Alimentarias¹⁷.

Las 40 variables referentes al consumo de alimentos se clasificaron en 10 grupos de alimentos: 1-Cereales y derivados, 2-Verduras y hortalizas, 3-Frutas, 4-Leche y derivados, 5-Grasas, 6-Carnes, pescados y huevo, 7-Legumbres, 8-Embutidos y fiambres, 9-Dulces y 10-Otros: snacks, precocinados y refrescos, (Tabla I).

A cada uno de los 10 grupos se le asignó una de las cuatro categorías siguientes: 1- consumo diario, 2-semanal (consumido algunos días a la semana), 3-ocasional (consumido algunas veces al mes) y 4-nunca (consumido nunca o casi nunca), que corresponden con las categorías de frecuencia de consumo de alimentos especificada en el cuestionario de recogida de datos, (Tabla I).

Los 10 grupos de alimentos señalados anteriormente se ordenaron de la siguiente forma: los 5 primeros grupos corresponden a los alimentos de consumo diario; los grupos 6 y 7 fueron de alimentos de consumo semanal y los grupos 8, 9 y 10 fueron de alimentos de consumo ocasional. Cada variable recibió una puntuación entre 0 y 10, de acuerdo con los criterios establecidos en la tabla I. El IAS se calculó sumando la puntuación obtenida en cada una de las variables, lo que permitió obtener un máximo teórico de 100 puntos. Este valor indicó el cumplimiento de los objetivos nutricionales. Cuando el valor de IAS fue de 80-100, se consideró Alimentación Saludable; cuando el valor de IAS fue de 50-80, la alimentación necesitaba mejorar y cuando el IAS fue <50, la alimentación era poco saludable.

Grado de adhesión a la Dieta Mediterránea

Para la determinación de la ADM se realizó una reagrupación de los alimentos consumidos siguiendo las

Tabla I
Criterios para definir la puntuación de cada variable del Índice de Alimentación saludable¹

<i>Grupos de alimentos</i>	<i>Puntuación máximo de 10</i>	<i>Puntuación de 6</i>	<i>Puntuación de 2.5</i>	<i>Puntuación de 0</i>
Consumo diario				
1. Cereales y derivados (arroz pasta, pan, cereales, galletas María)	Consumo diario	Semanal	Ocasional	Nunca o casi nunca
2. Verduras y hortalizas (verduras cocidas y crudas)	Consumo diario	Semanal	Ocasional	Nunca o casi nunca
3. Frutas (frutas enteras y zumo)	Consumo diario	Semanal	Ocasional	Nunca o casi nunca
4. Leche y derivados (leche desnatada, semidesnatada, entera, yogur, queso fresco, queso graso)	Consumo diario	Semanal	Ocasional	Nunca o casi nunca
5. Grasas (aceite de oliva, de girasol, mantequilla, margarina)	Consumo diario	Semanal	Ocasional	Nunca o casi nunca
Consumo semanal				
6. Carnes y pescados (huevos; carne magra y grasa; pescado graso, semigraso y magro)	Semanal	Ocasional	Consumo diario	Nunca o casi nunca
7. Legumbres y frutos secos	Semanal	Ocasional	Consumo diario	Nunca o casi nunca
Consumo ocasional				
8. Embutidos y fiambres	Nunca o casi nunca	Ocasional	Semanal	Consumo diario
9. Dulces(postres, helados, miel, cacao, bollería chocolate)	Nunca o casi nunca	Ocasional	Semanal	Consumo diario
10. Otros: salsas, snacks, precocinados	Nunca o casi nunca	Ocasional	Semanal	Consumo diario

1. Consumo diario: 5-6 veces; consumo semanal: algunas veces a la semana; consumo ocasional: algunas veces al mes; nunca o casi nunca.

directrices indicadas en el patrón alimentario de Dieta Mediterránea¹⁸.

Resultaron 12 grupos de alimentos: 1-Cereales y derivados, 2-Verduras, hortalizas y tubérculos, 3-Legumbres, 4-Frutas, 5-Leche y derivados, 6-Grasas, 7-Carnes y pescados, 8-Frutos secos, 9-Embutidos y fiambres, 10-Dulces, 11-Otros: snacks, precocinados y refrescos, y 12- Vino.

Se calculó la frecuencia de consumo y el porcentaje de la población que consumía cada uno de los nuevos grupos de alimentos y el consumo de vino. También se tuvo en cuenta el tipo de actividad física realizada.

Análisis estadístico

Se realizó un análisis descriptivo de frecuencias, medias y porcentajes de población segmentado por sexo y edad. El estudio de diferencias de medias según el sexo se realizó mediante el contraste del test Mann-Whitney para dos muestras independientes. Para el estudio de las diferencias de medias respecto a la edad se realizó un contraste no paramétrico de Kruskal-Wallis. Para distribuir a la población teniendo en cuenta las categorías del IAS, se llevó a cabo un contraste de independencia mediante una prueba Chi-Cuadrado y se compararon dichas categorías a través de un contraste de diferencias de proporciones. El análisis y procesamiento de datos se realizó utilizando el software estadístico SPSS V17.

Resultados

La población estudiada presentó unos valores de IAS medios cercanos a los que corresponden a una dieta

saludable, no observándose diferencias significativas entre hombres y mujeres. Tampoco se observaron diferencias significativas entre los tres grupos establecidos de edades, aunque fueron los individuos con edades entre 80 y 89 años los que presentaron IAS superiores. Es destacable que ningún individuo fue clasificado en la categoría de dieta poco saludable, (Tabla II).

La distribución de la población teniendo en cuenta las tres categorías establecidas para los valores de IAS, indicó que un porcentaje significativo de los participantes necesitaba cambios en sus hábitos alimentarios para conseguir una dieta saludable. El grupo que requirió una intervención dietética mayor fue el de las personas mayores de 90 años, (Tabla II).

Por otro lado, la mayor parte de la población estudiada presentó unos buenos hábitos de consumo de alimentos. Consumía diariamente cereales, frutas, lácteos y grasas. Fue destacable el consumo de aceite de oliva como grasa principal, el pan como el cereal más consumido y la leche semidesnatada y el yogur como los lácteos de mayor consumo diario. La frecuencia de consumo de verduras y hortalizas fue ligeramente inferior a lo recomendado, y una parte de la población no consumía nunca estos alimentos o lo hacía ocasionalmente, (Tabla III).

Los grupos de carnes, huevos, pescados, legumbres y vino fueron consumidos semanalmente, predominando el consumo de pescado magro frente al pescado graso y de carne magra frente al de carne grasa. La mayoría de la población no consumió o consumió de manera ocasional dulces, *snacks*, precocinados, refrescos y salsas, (Tabla III).

El consumo de embutidos y fiambres fue superior a lo recomendado aunque sólo una pequeña parte de la población consumía estos alimentos a diario, (Tabla III).

Tabla II
Valoración del Índice de Alimentación Saludable (IAS) según sexo y edad^{1,2}

	IAS			Distribución de la población según categorías del IAS					
	n	Media	SD ³	Saludable		Necesita Cambios		Poco saludable	
				n	%	n	%	n	%
Sexo									
Varón	57	79,04	6,77	22	38,6	35	61,4	0	0
Mujer	102	78,01	6,64	35	34,3	67	65,7	0	0
Edad									
80-84	115	78,89	6,74	42	36,5	73	63,5	0	0
85-89	36	77,58	6,22	13	36,1	23	63,9	0	0
>90	8	74,63	7,28	2	25,0	6	75,0	0	0
Población total	159	78,38	6,68	57	35,84	102	64,15	0	0

1. Criterios de valoración del IAS: IAS 80-100, Alimentación Saludable; IAS 50-80, Necesita Cambios; IAS ≤50, Poco Saludable.

2. Las diferencias estadísticas debidas al sexo y la grupo de edad no fueron significativas (p ≥0.05).

3. SD=Desviación estándar.

Tabla III
Hábitos alimentarios de la población española de edad superior a 80 años. Frecuencia de consumo de alimentos¹

	Cereales		Verduras, Hortalizas, tubérculos		Legumbres		Frutas		Leche y derivados		Grasas		Carnes, pescados, huevo		Frutos secos		Embutidos, fiambres		Dulces		Otros		Vino	
Frecuencia de consumo	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Diario	137	86	52	33	3	2	151	95	143	90	152	96	6	4	16	10	18	11	23	15	1	1	0	0
Semanal	11	7	80	50	118	74	6	3	3	2	6	4	89	56	23	15	44	27	17	11	12	8	48	30
Ocasional	4	3	17	11	34	21	2	1	3	2	1	1	37	24	54	34	43	27	28	18	37	24	0	0
Nunca o casi nunca	7	4	10	6	4	3	0	0	10	6	0	0	27	17	66	42	55	3	90	40	109	68	0	0

1. Los resultados se expresan como número de sujetos (n) y porcentaje respecto a la población total (%).

El grado de ADM, indicó que la dieta de una parte de la población cumplía con las recomendaciones del patrón alimentario de Dieta Mediterránea. Fueron correctos los consumos de frutas, cereales, legumbres, aceite de oliva, leche y derivados, pescado, carne, huevos, alimentos dulces, snacks, refrescos, salsas y precocinados. Más de la mitad de la población no consumía suficientes verduras, hortalizas, frutos secos y vino. Sin embargo, se registró un elevado consumo de embutidos y fiambres, (Tabla IV). La población estudiada era sedentaria. Más de la mitad de los sujetos estudiados no realizaban suficiente actividad física, (Tabla IV).

Discusión

No son muchos los estudios que valoran la calidad de la dieta en las personas de mayor edad que viven en sus domicilios. Normalmente, los trabajos de investigación realizados en este colectivo se centran en el ámbito institucional¹⁹, posiblemente debido, a la facilidad de acceso y recogida de datos en la población institucionalizada. Pero no podemos olvidar que los adultos mayores autónomos no institucionalizados, aunque aparentemente estén sanos, pueden tener hábitos alimentarios poco saludables que ponen en riesgo su salud y su bienestar. Dicho riesgo puede pasar

Tabla IV
Adherencia a la Dieta Mediterránea (ADM) de la población española de edad ≥ 80 años

Grupos de alimentos	Recomendaciones de consumo de alimentos y de actividad física ¹⁶	Porcentaje de población que cumple con las recomendaciones
Cereales	Diario	86,16
Verduras, hortalizas y tubérculos	Diario	32,73
Frutas	Diario	94,96
Leche y derivados	Diario	89,93
Aceite de oliva	Diario	95,59
Carnes, pescados y huevo	Semanal	55,90
Legumbres	Semanal	74,20
Frutos secos	Diario	10,06
Embutidos y fiambres	Ocasional	27,04
Dulces	Ocasional / Nunca o casi nunca	74,52
Otros (snacks, refrescos y precocinados)	Ocasional / Nunca o casi nunca	91,82
Vino	Diario	30,18
Actividad física	Diario	47,20

desapercibido debido al aparente buen estado de salud y grado de independencia.

Una de las características habitualmente presentes en el proceso de envejecimiento es el desarrollo de alteraciones en la alimentación y nutrición de las personas mayores. Diversos autores indican que el grupo de personas de 80 o más años de edad, y sobre todo, el grupo de mujeres, presentan una mayor prevalencia de malnutrición²⁰. Teniendo en cuenta que este colectivo va en aumento, el mantenimiento de un estado nutricional óptimo, adaptado a cada condición física y personal es clave para mantener un equilibrio nutricional saludable y una buena calidad de vida. En este sentido, el papel preventivo de una correcta ingesta de nutrientes es primordial para emprender acciones orientadas al mantenimiento de la salud en el binomio envejecimiento-nutrición, evitando así la malnutrición y sus consecuencias sociosanitarias. Es evidente la necesidad de controlar regularmente el estado nutricional de las personas mayores utilizando herramientas de seguimiento indicadoras de su situación nutricional tales como, IAS y ADM utilizados este trabajo.

Numerosos estudios, en los que se utiliza IAS para valorar la calidad de la dieta, muestran que la mayoría de las poblaciones, independientemente de la edad, necesitan realizar cambios en su dieta habitual para conseguir una alimentación saludable^{8,21}.

Aunque diversos estudios muestran diferencias significativas en todos los grupos etarios, son las mujeres y la población de edad más avanzada los que presentan valores superiores de IAS^{22,8}. Sin embargo, nuestros resultados no mostraron diferencias significativas debidas al grupo etario ni al sexo. Los resultados del IAS fueron significativamente mayores que los publicados en estudios previos utilizando una metodología similar. A pesar de esto, la mayoría de la población estudiada necesitó cambios en su alimentación^{8,21,22}. Resultados similares fueron publicados por Rehm et al²¹ con valores IAS de 63,3 en personas mayores de 75 años. Bowman et al²³ indicaron que el 74% de la población necesitó cambios en su alimentación. En la misma línea, Norte et al⁸, publicaron que más del 69% de la población española necesitaba cambios en su alimentación según IAS, aunque detectaron que las personas mayores de 64 años necesitaban menos cambios.

Por otro lado, se ha demostrado científicamente la asociación del patrón de Dieta Mediterránea y el estilo de vida saludable con una mayor longevidad^{9,10}, menor mortalidad general en personas de edades entre 70-90 años¹⁰ y menor mortalidad cardiovascular en los países mediterráneos respecto a países del norte de Europa y Estados Unidos²⁴⁻²⁶. Concretamente el indicador ADM se ha asociado con una reducción significativa en el riesgo de patologías relacionadas con la calidad de la dieta, tales como diabetes²⁷, síndrome metabólico²⁸, patologías cardiovasculares²⁹ y patologías cognitivas asociadas al consumo de aceite de oliva como grasa principal^{12,30,31} y frutos secos^{30,31}.

La dieta de la mayor parte de la población estudiada cumplió con la mayoría de las recomendaciones del patrón alimentario de Dieta Mediterránea¹⁸. Se hallaron similitudes con diversos estudios en el consumo de aceite de oliva como grasa principal^{11,12,14,26}, insuficiente consumo de verduras^{7,11,32,26} y de frutos secos³³, consumo adecuado de pescado²⁶, mantequilla y carnes grasas¹¹, elevado consumo de embutidos⁸ y sedentarismo en la población³⁴. Sin embargo, el consumo de fruta en la población estudiada fue correcto, a diferencia de lo publicado por otros autores, cuyos resultados indican un consumo deficiente de este grupo de alimentos^{11,32}. Bowman et al²³ indicaron que sólo el 17% de la población estadounidense consume las raciones de fruta recomendadas al día. De forma similar, Norte et al⁸ indica que el 28% de población española tampoco consume suficiente fruta.

Numerosos estudios muestran que las personas de edades avanzadas, respecto a los más jóvenes, presentan valores superiores de ADM¹¹, debido a que la población joven frecuentemente consume una dieta incorrecta que resulta nutricionalmente poco saludable⁸, lo que parece indicar que el establecimiento de unos hábitos alimentarios correctos perduran y repercuten positivamente en la salud del individuo adulto y el adulto mayor³⁴.

Por otro lado, la dieta habitual de la población española difiere cada vez más del patrón de Dieta Mediterránea, independientemente de la edad³². Este hecho es de indudable interés para toda la población, pero adquiere mayor importancia en poblaciones de riesgo como son las personas mayores^{13,14}.

La valoración de la calidad de la dieta con los dos indicadores utilizados en este trabajo, IAS y ADM, estuvo marcada por la limitación de no poder cuantificar los resultados de raciones de alimentos, puesto que en el cuestionario original no figuraban las cantidades consumidas de cada alimento. A pesar de esa limitación, los resultados de este estudio son relevantes para dar a conocer la importancia de elaborar cuestionarios de frecuencia de consumo ajustados a cada grupo poblacional con información cualitativa y cuantitativa. De esta manera, el análisis de datos permitiría obtener un buen conocimiento global de hábitos alimentarios de la población, y establecer las posibles opciones de intervención.

Conclusiones

La dieta consumida habitualmente por la población española mayor de 80 años no institucionalizada presenta algunos desajustes nutricionales que podrían corregirse realizando pequeños cambios en su patrón dietético. En base a los resultados obtenidos en este trabajo, sería muy positivo integrar, en la atención primaria de salud, la valoración de la calidad global de la dieta mediante indicadores como IAS y ADM, para tener un control del estado nutricional y de los hábitos alimenta-

rios de la población, especialmente de los grupos poblacionales más vulnerables. Determinar la calidad global de la dieta permite identificar, de forma más precoz, a aquellas personas que pueden encontrarse con problemas nutricionales subclínicos y apariencia saludable. La planificación de estrategias de intervención para promover cambios alimentarios saludables es primordial para emprender acciones orientadas al mantenimiento de una salud óptima en el binomio envejecimiento-nutrición.

Agradecimientos

Se agradece al proyecto GR3/14 del programa de financiación UCM-Santander 2014 y la colaboración del Proyecto Estudio piloto del Estudio Longitudinal Envejecer en España (Proyecto ELES).

Referencias

1. Instituto Nacional de Estadística (INE). España en cifras 2010. INE. Madrid, 2010.
2. Del Barrio Truchado E, Abellán García A. Indicadores demográficos. En: Las personas mayores en España. Datos estadísticos estatales por Comunidades Autónomas. Informe 2008/ Tomo I. Ministerio de Sanidad y Política social. Secretaría general de política social. Instituto de mayores y servicios sociales (IMSERSO). Madrid, 2009: 33-66.
3. Tena Dávila MC, Serrano Garijo P. Malnutrición en el anciano. En: Manual de Geriátrica. Salgado Alba A, Guillén Llera F, Ruipérez Cantera I. Elsevier Doyma, SL. Barcelona, 2007: 731-40.
4. Montejano Lozoya R, Ferrer Diego RM, Clemente Marín G, Martínez Alzamora N. Estudio del riesgo nutricional en adultos mayores autónomos no institucionalizados. *Nutr Hosp* 2013; 28(5): 1490-8.
5. Ballesteros-Arribas JM, Saavedra M, Pérez-Farinós N, Villar-Villalba C. The Spanish strategy for nutrition, physical activity and the prevention of obesity (NAOS Strategy). *Rev Esp Salud Pública* 2007; 81(5):443-9.
6. Riboli E, Norat T. Epidemiologic evidence of the protective effect of fruit and vegetables on cancer risk. *Am J Clin Nutr* 2003; 78:559-69.
7. Bach-Faig A, Berry EM, Lairon D, Reguant J, Trichopoulou A, Dernini S, et al. Mediterranean diet pyramid today. Science and Cultural updates. *Public Health Nutr* 2011; 14:2274-84.
8. Norte-Navarro AI, Ortiz-Moncada R. Calidad de la dieta española según el índice de alimentación saludable. *Nutr Hosp* 2011; 26(2):330-6.
9. Soto-Prieto M, Zulet MA, Corella D. Evidencia científica de los efectos de la dieta Mediterránea sobre fenotipos intermedios y finales de enfermedad cardiovascular. *Med Clin* 2010; 134(1):22-9.
10. Knoop KT, De Groot LC, Kromhout D, Perrin AE, Moreiras-Varela O, Menotti A, et al. Mediterranean diet, life style factors, and 10-year mortality in elderly European men and women: The HALE project. *JAMA* 2004; 292:1433-9.
11. León-Muñoz LM, Guallar-Castillón P, Graciani A, Lopez-García E, Mesas AE, Aguilera MT et al. Adherence to the Mediterranean diet pattern has declined in spanish adults. *J Nutr* 2012; 142(10):1843-50.
12. Sofi F, Abbate R, Gensini GF, Casini A. Accruing evidence on benefits of Adherence to the Mediterranean diet on health: an updated systematic review and meta-analysis. *Am J Clin Nutr* 2010; 92:1189-96.
13. Trübsswasser U, Branca F. Nutrition policy is taking shape in Europe. *Public Health Nutr* 2009; 12:295-306.
14. Aranceta J, Lobo F, Viedma P, Salvador-Castell G, de Victoria EM, Ortega RM et al. Community nutrition in Spain: advances and drawbacks. *Nutr Rev* 2009; 67(1):135-9.
15. Estudio Longitudinal Envejecer en España: Proyecto ELES. [http://proyectoeles.es]
16. Kennedy ET, Ohls J, Carlo S, Fleming K. The Healthy Eating Index: design and applications. *J Am Diet Assoc* 1995; 95:1103-8.
17. Dapcich V, Salvador Castell G, Ribas Barba L, Pérez Rodrigo C, Aranceta Bartina J, Serra Majen L. Guía de alimentación saludable. Sociedad Española de Nutrición Comunitaria (SENC). Madrid.2004.
18. Fundación Dieta Mediterránea. Pirámide de la dieta Mediterránea: un estilo de vida actual Guía para la población adulta, 2010. [http://dietamediterranea.com/piramide-dietamediterranea].
19. Montejano Lozoya R, Ferrer Diego RM, Clemente Marín G, Martínez Alzamora N, Sanjuan Quiles A, Ferrer Ferrándiz E. Factores asociados al riesgo nutricional en adultos mayores autónomos no institucionalizados. *Nutr Hosp*. 2014;30(4):858-69.
20. Morillas J, García-Talavera N, Martín-Pozuelo G, Reina AB, Zafrilla P. Detección del riesgo de desnutrición en ancianos no institucionalizados. *Nutr Hosp* 2006; 21(6):650-6.
21. Rehm CD, Monsivais P, Drewnowski A. Relation between diet cost and Healthy Eating Index 2010 scores among adults in the United States 2007-2010. *Prev Med* 2015; 73: 70-5.
22. Guo X, Warden BA, Paeratakul S, Bray GA. Healthy Eating Index and obesity. *Eur J Clin Nutr* 2004; 58:1580-6.
23. Bowman SA, Lino M, Gerrior SA, Basiotis PP. The Healthy Eating Index: 1994-96. US Department of Agriculture, Center for Nutrition Policy and Promotion. Washington DC, 1998.
24. Jankovic N, Geelen A, Streppel MT, CPGM de Groot L, Orfanos P, H. van den Hooven E et al. Adherence to a healthy diet according to the world health organization guidelines and all-cause mortality in elderly adults from Europe and the United States. *Am J Epidemiol* 2014; 180(10):978-88.
25. Estruch R, Ros E, Salas-Salvadó J, Covas MI, Corella D, Arós F et al. Primary prevention of cardiovascular disease with a Mediterranean diet. *N Engl J Med* 2013; 368:1279-90.
26. González CA, Argilaga S, Agudo A, Amiano P, Barricarte A, Beguiristain JM et al. Diferencias sociodemográficas en la adhesión al patrón de dieta Mediterránea en poblaciones de España. *Gac Sanit* 2002; 16 (3): 214-21.
27. Schwingshackl L, Missbach B, König J, Hoffman G. Adherence to a Mediterranean diet and risk of diabetes: a systematic review and meta-analysis. *Public Health Nutr* 2014; 22:1-8.
28. Kastorini CM, Milionis HJ, Esposito K, Giugliano D, Goudevenos JA, Panagiotakos DB. The effect of Mediterranean diet on metabolic syndrome and its components: a meta-analysis of 50 studies and 534,906 individuals. *J Am Coll Cardiol* 2011; 57:1299-313.
29. Bendinelli B, Masala G, Saieva C, Salvini S, Calonico C, Sacerdote C et al. Fruit, vegetables, and olive oil and risk of coronary heart disease in Italian women: the EPICOR Study. *Am J Clin Nutr* 2011; 93:275-83.
30. Bonaccio M, Di Castelnuovo A, Bonanni A, Costanzo S, De Lucia F, Pounis G et al. Adherence to a Mediterranean diet is associated with a better health-related quality of life: a possible role of high dietary antioxidant content. *BMJ Open* 2013; 3(8). doi:10.1136/bmj.open.003003.
31. Ros E, Tapsell LC, Sabate J. Nuts and berries for heart health. *Curr Atheroscler Rep* 2010; 12:397-406.
32. Serra-Majem L, Ribas-Barba L, Salvador-Castell G, Román-Viñas B, Castell-Abat C, Cabezas-Peña C et al. Tendencias del estado nutricional de la población española: resultados del sistema de monitorización nutricional de Cataluña (1992-2003). *Rev Esp Salud Pública* 2007; 81:559-70.
33. Alacid F, Vaquero-Cristóbal R, Sánchez-Pato A, Muyor JM, López-Miñarro PA. Adhesión a la dieta Mediterránea y relación con los parámetros antropométricos de mujeres jóvenes kayakistas. *Nutr Hosp* 2014; 29(1):121-7.
34. Tanjani PT, Motlagh ME, Nazar MM, Najafi F. The health status of the elderly population of Iran in 2012. *Arch Gerontol Geriatr* 2015; 60(2):281-7.



Original/*Ancianos*

Asociación de la ingesta de macro y micronutrientes con calidad de vida en adultos mayores

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Resumen

Introducción: la relación entre calidad de vida y nutrientes está cobrando una singular importancia en este grupo etario.

Objetivo: asociar la ingesta de macro y micronutrientes con la calidad de vida de AM autónomos chilenos.

Material y métodos: se evaluaron 1.704 adultos mayores (AM) autónomos, de ambos sexos, a quienes se les valoró la calidad de vida a través de la encuesta de Estilo de Vida y Promotor de Salud y de una encuesta sobre Tendencia de Consumo.

Resultados: el 63,9% de los AM presentaba sobrepeso/obesidad al realizar correlaciones entre calidad de vida y nutrientes; la vitamina A se asoció a mejor manejo de el estrés ($r = 0,166$; $p = 0,001$), responsabilidad en salud ($0,171$; $p = 0,001$) y ejercicio ($r = 0,167$; $p = 0,001$); la vitamina B12 es un factor protector a la hora de tener una buena calidad de vida OR = 0,78 (IC95% 0,67-0,90), en cambio el consumo de bebidas cola OR = 1,92 (IC95% 1,42-2,60), el sobrepeso OR = 1,77 (IC95% 1,02-3,06) y ser de sexo masculino OR = 1,62 (IC95% 1,27-2,07) son factores de riesgo para la calidad de vida.

Conclusiones: la ingesta de vitamina A y vitamina B12 son factores protectores para tener una mejor calidad de vida; en cambio, tener sexo masculino, consumir bebidas cola y el sobrepeso son factores de riesgo para la calidad de vida en adultos mayores autónomos.

(Nutr Hosp. 2015;31:2578-2582)

DOI:10.3305/nh.2015.31.6.8923

Palabras clave: Adulto mayor. Calidad de vida. Estado nutricional. Vitamina B12. Sobrepeso.

ASSOCIATION OF INTAKE MACRO AND MICRONUTRIENTS WITH LIFE QUALITY OF LIFE IN ELDERLY

Abstract

Introduction: the relationship between quality of life life quality and nutrients it is taking a special singular importance in this age group.

Objective: to determine the association between consumption of the macro and micronutrients with quality of life in elderly living in Santiago.

Materials and methods: 1,704 autonomous elderly were assessed. Quality of life was measured by a Life style and Health promotion survey and food patterns were evaluated by a food frequency questionnaire. The quality of life and food intake were evaluated by the Survey of Life Style and Health Promoter and the Feeding and Food Survey were answered by 1,704 non-disabled participant of both sex.

Results: the 63.9 % of the elderly were overweight or /obesity. Perform correlations between quality of life and nutrients consumption were; the vitamin A, which was is associated to better stress management ($r = 0.166$; $p = 0.001$), responsibility for health (0.171 ; $p = 0.001$) and exercise ($r = 0.167$; $p = 0.001$); the vitamin B12 was a protective factor to have a better quality of life OR = 0.78 (IC95% 0.67-0.90). On the other hand, the consumption of cola soft drinks OR = 1.92 (IC95% 1.42-2.60), the overweight OR = 1.77 (IC95% 1.02-3.06) and be male OR = 1.62 (IC95% 1.27-2.07) were risk factors for quality of life.

Conclusions: the vitamin A and B12 consumption are protective factors for a better quality of life. Conversely, being a male, consumer cola soft drinks and the overweight are risk factors of quality of life in autonomous independent elderly.

(Nutr Hosp. 2015;31:2578-2582)

DOI:10.3305/nh.2015.31.6.8923

Key words: Elderly. Quality of life. Nutritional status. Vitamin B12. Overweight.

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Recibido: 7-III-2015.

Aceptado: 8-IV-2015.

Introducción

La calidad de vida es una medición multidimensional de la salud y es clave para el envejecimiento óptimo, entre las dimensiones que dan sentido se mantiene la capacidad funcional, la satisfacción personal, el estado emocional y la interacción social¹, en cuanto a la definición del término calidad de vida dos tendencias emergen: la calidad de vida como un concepto más genérico y la calidad de vida relacionada con la salud.

Factores nutricionales han participado recientemente en las vías que pueden influir en el estado de ánimo y el bienestar. Esta idea es apoyada por un número cada vez mayor de datos que indican los efectos protectores de los factores nutricionales, incluyendo antioxidantes, sobre los síntomas del estado de ánimo, el deterioro cognitivo y deterioro de la calidad de vida en adultos mayores (AM)^{2,3}.

La calidad de la dieta ha sido descrita en varias poblaciones de AM, indicando un bajo consumo de frutas, verduras y lácteos⁴⁻⁶. Otros estudios han examinado la ingesta de micronutrientes en este grupo, mostrando una ingesta inadecuada de estos^{7,8}.

Los AM presentan no solo la deficiencia de macronutrientes, sino también de micronutrientes debido a la demanda de vitaminas, minerales y oligoelementos cuyo requerimiento es el mismo o se aumenta ligeramente en los AM⁹, sumado a una ingesta insuficiente de alimentos. Las deficiencias de ácido fólico, vitamina D, calcio, vitamina B12 son especialmente prevalentes en los AM⁹⁻¹¹.

Vitaminas como la B6, ácido fólico y B12 presentan un efecto sobre el metabolismo de la homocisteína, se ha demostrado que mayores niveles de este compuesto se asocia con el deterioro cognitivo^{12,13}. Por otro lado la suplementación con estas vitaminas se asocia con una mejor autopercepción del estado general¹⁴.

Estudios como el de Jiménez-Redondo y cols. quien aplicó el EuroQoL-5D (EQ-5D) questionnaire a 83 AM, mostró que la calidad de vida se asociaba positivamente con ingesta energética y la dimensión dolor/incomodidad se asoció de forma negativa a ingesta energética, proteínas, lípidos, magnesio, fósforo, selenio y niacina¹⁵, otro estudio en AM donde se correlacionó las concentraciones plasmáticas de alfa-tocoferol con la calidad de vida, los AM con las mayores concentraciones plasmáticas de esta vitamina mostraron niveles más bajos de inflamación, junto con un mejor estado de salud según el cuestionario SF36¹⁶.

El objetivo del presente estudio fue asociar la ingesta de macro y micronutrientes con la Calidad de Vida de AM autónomos chilenos.

Métodos

Estudio transversal, se entrevistó a 1.704 AM de Santiago de Chile quienes fueron reclutados en centros de salud familiar.

Se incluyeron en el estudio a AM de ambos sexos, de 60 o más años de edad y autónomos, para lo cual se utilizó el diagnóstico de funcionalidad del AM (EFAM-Chile)¹⁷, se consideró autónomo a la persona que tenía un puntaje ≥ 43 puntos.

Encuestas:

A los participantes se les aplicó 2 encuestas, realizadas por un profesional nutricionista entrenado. Primero, Encuesta de Estilo de Vida y Promotor de Salud” (EVPS), un instrumento validado y que en la versión en español fue administrada en un grupo diverso de hispanos (485 personas), en Chile fue aplicado y validado en un estudio con 360 sujetos de 18 a 64 años¹⁸. La encuesta evalúa las dimensiones de autorrealización, responsabilidad en salud, ejercicio, nutrición, apoyo interpersonal y manejo del estrés. Esta consiste en 48 aseveraciones sobre estilo de vida o hábitos personales, con 4 posibilidades de respuesta en escala de tipo Likert (nunca, a veces, frecuentemente y siempre).

Por otra parte, se realizó una encuesta alimentaria de tendencia de consumo cuantificada semanal. La encuesta realizada incluyó 31 tipos de alimentos (frutas, verduras, cereales, pan, carnes, pescados, lácteos, papas, aceites y grasas, bebidas y azúcares), la cual entregó información detallada sobre el consumo de alimentos de cada uno de los encuestados. Las porciones fueron descritas como utensilios típicos de uso en el hogar o medidas caseras (vaso, taza, cuchara, cucharita y plato), finalmente el cálculo de nutrientes se realiza de forma diaria.

Antropometría:

Se efectuó una evaluación antropométrica de peso y talla. La determinación del peso se realizó con un mínimo de ropa, utilizando una balanza mecánica (SECA, capacidad máxima de 220 kg precisión en 50 g). La estatura se midió con un tallímetro que está incorporado a la balanza, se calculó el IMC para categorizar la clasificación ponderal de acuerdo a criterio OMS¹⁹.

El protocolo fue revisado y aprobado por el Comité de Ética de la Universidad San Sebastián de Chile, cada participante firmó un consentimiento informado.

Estadística:

Para evaluar normalidad de las variables continuas (edad, peso, talla, IMC, ingesta de nutrientes) se utilizó la prueba de bondad Shapiro Wilk's; Las variables normales fueron expresadas en media $\pm$ DE y las variables sin distribución normal se utilizó la mediana y rango intercuartílico, se compararon los grupos utilizando la prueba de T de Student o Mann Whitney según la distribución de normalidad. Además, se llevó

a cabo un análisis de regresión logística para evaluar la asociación existente entre la calidad de vida y consumo de nutrientes. Se consideró buena calidad de vida al valor sobre el percentil 75 de la encuesta. La regresión logística fue ajustada por edad y sexo. Para el análisis estadístico se utilizó el programa SPSS versión 22.0, considerando significativo un valor de $p < 0,05$.

Resultados

Se evaluaron 1.704 AM (59,9% mujeres), la media de edad fue de $71,5 \pm 7,4$ años, peso $69,5 \pm 11,8$ kg, talla $1,60 \pm 0,08$ mt e IMC $26,8 \pm 4,1$ Kg/mt². El 63,9% de los AM presentaba sobrepeso/obesidad y solo un 0,41% estaba bajo peso (Tabla I).

El 25,7% de los AM consume bebidas colas de forma regular (durante el día), el 95% de ellos consume desayuno diariamente.

Al realizar la correlación entre la calidad de vida y las subescalas de la encuesta de calidad de vida con la ingesta de macro y micronutrientes, ajustados por edad y estado nutricional, se presentan en AM independiente del sexo, correlaciones positivas pero débiles entre el consumo de vitamina A y mejor puntuación manejo de estrés ($r=0,166$; $p=0,001$), responsabilidad en salud ($r=0,171$; $p=0,001$) y ejercicio ($r=0,167$; $p=0,001$). En varones, la actividad física correlaciona positivamente con calorías ($r=0,113$; $p=0,03$), proteínas ($r=0,179$; $p=0,001$), fibra dietaria ($r=0,162$; $p=0,001$), hierro ($r=0,188$; $p=0,001$), vitamina A ($r=0,131$; $p=0,01$), vitamina B3 ($r=0,178$; $p=0,01$), folato ($r=0,149$; $p=0,001$) y ácido pantoténico ($r=0,195$; $p=0,001$). En cambio en las mujeres es la vitamina A la que se correlaciona con una mejor calidad de vida ($r=0,136$; $p=0,001$), manejo del estrés ($r=0,224$; $p=0,001$), responsabilidad en salud ($r=0,190$; $p=0,001$) y ejercicio ($r=0,198$; $p=0,001$) (Tabla II).

Para analizar los factores asociados a la calidad de vida se realizaron modelos de regresión logística. Se puede observar que la vitamina B12 es un factor asociado a una mejor calidad de vida OR=0,78 (IC95% 0,67-0,90), en cambio el consumo de bebidas cola OR=1,92 (IC95% 1,42-2,60), el sobrepeso OR=1,77 (IC95% 1,02-3,06) y ser de sexo masculino OR=1,62 (IC95% 1,27-2,07) son factores asociados a una menor calidad de vida (Tabla III).

Discusión

El principal resultado del presente estudio es que la ingesta de calorías, fibra dietaria, hierro, vitaminas B2 y B12 están asociados positivamente una mejor calidad de vida, en cambio tener sexo masculino, consumir bebidas cola y el sobrepeso está asociado negativamente a la calidad de vida en AM autónomos.

Un estudio realizado en AM de Finlandia, Reino Unido, Italia y Suecia mostró que la calidad de la dieta se asocia negativamente a la capacidad de compra en algunos países, en cambio el sexo femenino y la educación son características positivas a una mejor calidad en la alimentación²⁰. Otro estudio, realizado en Estados Unidos con población de origen chino (>65 años), mostró que el sexo femenino se asoció a menor salud OR=1,65 (IC95% 1,07-2,53) y a mayor edad menor realización de ejercicio OR=1,05 (IC95% 1,02-1,85)²¹. Un estudio en AM nonagenarios españoles observó que a medida aumenta la edad se incrementa la malnutrición y problemas de morbilidad¹⁵.

Además otro estudio, esta vez en adultos de 25 a 74 años, mostró que un patrón de dieta estilo mediterráneo se asociaba con una mejor percepción física y mental²², resultados similares a los encontrados por Henríquez-Sánchez y cols. que indican que la calidad

Tabla I
Comparación antropométrica y de calidad de vida entre AM de ambos sexos

	Hombres N=682	Mujeres N=1022	Valor p
Edad (años)	72,0 $\pm$ 7,3	71,1 $\pm$ 7,5	0,011
Peso (kg)	74,4 $\pm$ 10,8	66,2 $\pm$ 11,2	0,001
Talla (mt)	1,67 $\pm$ 0,07	1,56 $\pm$ 0,06	0,001
IMC (kg/mt ²)	26,5 $\pm$ 3,5	27,0 $\pm$ 4,5	0,016
Autorrealización	38,5 $\pm$ 7,5	39,0 $\pm$ 7,9	0,227
Responsabilidad en salud	22,7 $\pm$ 6,2	24,4 $\pm$ 6,1	0,001
Nutrición	16,4 $\pm$ 3,1	17,3 $\pm$ 3,3	0,001
Apoyo interpersonal	19,8 $\pm$ 4,1	20,8 $\pm$ 3,9	0,001
Ejercicio	9,5 $\pm$ 3,6	9,7 $\pm$ 4,0	0,452
Manejo del estrés	17,4 $\pm$ 4,0	18,0 $\pm$ 4,3	0,001
Calidad de vida	124,9 $\pm$ 20,3	129,7 $\pm$ 21,9	0,001

Prueba T de Student. Valores expresados en media y DE.

Tabla II
Correlación entre calidad de vida y nutrientes en adultos mayores

	<i>Calidad de Vida</i>	<i>Responsabilidad salud</i>	<i>Manejo de estrés</i>	<i>Ejercicio</i>
Total				
Vitamina A	r=0,102*	r=0,171**	r=0,166**	r=0,171**
Hombres				
Calorías	r=0,052	r=-0,009	r=0,039	r=0,113*
Proteínas	r=0,108	r=0,109	r=0,113	r=0,179**
Fibra Dietaria	r=0,119*	r=0,112*	r=0,163**	r=0,162**
Hierro	r=0,110*	r=0,069	r=0,112*	r=0,188**
Vitamina A	r=0,057	r=0,142**	r=0,085	r=0,131*
Vitamina B3	r=0,105	r=0,052	r=0,082	r=0,178*
Mujeres				
Vitamina A	r=0,136**	r=0,190**	r=0,224**	r=0,198**

Correlación parcial ajustado por edad, consumo de tabaco y escolaridad. * p<0,05 ** p<0,01.

mental y física autopercebida se asocian de forma positiva con la adherencia a la dieta mediterránea²³.

En nuestro estudio se observa un elevado consumo de bebidas colas en los AM, Chile es el tercer consumidor de estas bebidas en el mundo²⁴, estudio recientes han mostrado la asociación de las bebidas azucaradas con diversas patologías como obesidad²⁵ diabetes, triglicéridos elevados, enfermedad cerebrovascular, hiperuricemia, osteoporosis y cáncer de páncreas. En Estados Unidos, los adultos mayores de 55 años el 10,2% consume bebidas azucaradas $\geq$ 1 vez/día²⁶. Además en AM brasileiros las bebidas azucaradas son el principal alimento que contribuye a la ingesta de azúcar en este grupo etario²⁷. En el estudio de Yoshimura y cols.²⁸, en

AM de ambos sexos, el consumo de bebidas azucaradas se asoció con un aumento significativo de IMC.

Recientes meta análisis han asociado al consumo de azúcar con incremento de peso y grasa corporal^{29,30} y riesgo de diabetes, como el estudio realizado por Malik y cols.³¹ concluyó que el consumo de 334 ml/día BA incrementaba el riesgo de diabetes RR= 1,25 (IC95% 1,10-1,42).

Entre las fortalezas de nuestro trabajo se puede citar que ocupamos una gran muestra y se utilizaron encuestas estandarizadas internacionalmente. Entre las debilidades de estudio podemos señalar que no podemos generalizar los resultados a toda la población de AM por ser un estudio no probabilístico y no podemos

Tabla III
Factores asociados a calidad de vida

	<i>OR</i>	<i>IC 95%</i>		<i>Valor p</i>
Calorías	0,99	0,99	0,99	0,014
Fibra dietética	0,94	0,91	0,97	0,001
Calcio	1,00	1,00	1,00	0,006
Hierro	0,91	0,84	0,99	0,029
Vitamina B12	0,78	0,67	0,90	0,001
Vitamina B2	0,62	0,45	0,80	0,001
Acido fólico	1,00	1,00	1,00	0,019
Bebidas Cola	1,92	1,42	2,60	0,001
Sexo masculino	1,62	1,27	2,07	0,001
Sobrepeso	1,77	1,02	3,06	0,040
Obesidad	1,60	0,97	2,63	0,060

Modelo ajustado por: edad, consumo de tabaco y escolaridad.

establecer causalidad debido al diseño transversal del estudio.

En conclusión la ingesta de vitamina A y vitamina B12 son factores protectores para tener una mejor calidad de vida en cambio ser sexo masculino, consumir bebidas cola y el sobrepeso son factores de riesgo de calidad de vida en adultos mayores autónomos.

Agradecimientos

Proyecto Código: 2013-007-C Universidad San Sebastián.

Conflicto de interés

Los autores declaran no tener conflictos de intereses.

Referencias

1. De Lorenzi DR. Avaliacao da qualidade de vida no climaterio. Revista brasileira de ginecologia e obstetricia. *Rev Bras Ginecol Obstet* 2008;30(3):103-6.
2. Deschamps V, Barberger-Gateau P, Peuchant E, Orgogozo JM. Nutritional factors in cerebral aging and dementia : epidemiological arguments for a role of oxidative stress. *Neuroepidemiology* 2001;20(1):7-15.
3. Bartali B, Frongillo EA, Guralnik JM, Stipanuk MH, Allore HG, Cherubini A, et al. Serum micronutrient concentrations and decline in physical function among older persons. *JAMA* 2008;299(3):308-15.
4. Holmes BA, Roberts CL. Diet quality and the influence of social and physical factors on food consumption and nutrient intake in materially deprived older people. *Eur J Clin Nutr* 2011;65(4):538-45.
5. Ervin RB. Healthy Eating Index scores among adults, 60 years of age and over, by sociodemographic and health characteristics: United States, 1999-2002. *Adv Data* 2008(395):1-16.
6. Hsiao PY, Mitchell DC, Coffman DL, Allman RM, Locher JL, Sawyer P, et al. Dietary patterns and diet quality among diverse older adults: the University of Alabama at Birmingham Study of Aging. *J Nutr Health Aging* 2013;17(1):19-25.
7. King DE, Mainous AG, 3rd, Lambourne CA. Trends in dietary fiber intake in the United States, 1999-2008. *J Acad Nutr Diet* 2012;112(5):642-8.
8. Roberts SB, Hajduk CL, Howarth NC, Russell R, McCrory MA. Dietary variety predicts low body mass index and inadequate macronutrient and micronutrient intakes in community-dwelling older adults. *J Gerontol A Biol Sci Med Sci* 2005;60(5):613-21.
9. Elmadfa I, Meyer AL. Body composition, changing physiological functions and nutrient requirements of the elderly. *Ann Nutr Metab* 2008;52 Suppl 1:2-5.
10. Stabler SP, Lindenbaum J, Allen RH. Vitamin B-12 deficiency in the elderly: current dilemmas. *Am J Clin Nutr* 1997;66(4):741-9.
11. Sanchez H, Masferrer D, Lera L, Arancibia E, Angel B, Albala C. Vitamin B12 deficiency associated with high doses of metformin in older people diabetic. *Nutr Hosp* 2014;29(6):1394-400.
12. Reitz C, Tang MX, Miller J, Green R, Luchsinger JA. Plasma homocysteine and risk of mild cognitive impairment. *Dement Geriatr Cogn Disord* 2009;27(1):11-7.
13. Selhub J, Bagley LC, Miller J, Rosenberg IH. B vitamins, homocysteine, and neurocognitive function in the elderly. *Am J Clin Nutr* 2000;71(2):614S-20S.
14. von Arnim CA, Dismar S, Ott-Renzer CS, Noeth N, Ludolph AC, Biesalski HK. Micronutrients supplementation and nutritional status in cognitively impaired elderly persons: a two-month open label pilot study. *Nutr J* 2013;12(1):148.
15. Jimenez-Redondo S, Beltran de Miguel B, Gavidia Banegas J, Guzman Mercedes L, Gomez-Pavon J, Cuadrado Vives C. Influence of nutritional status on health-related quality of life of non-institutionalized older people. *J Nutr Health Aging* 2014;18(4):359-64.
16. Capuron L, Moranis A, Combe N, Cousson-Gelie F, Fuchs D, De Smedt-Peyrusse V, et al. Vitamin E status and quality of life in the elderly: influence of inflammatory processes. *Br J Nutr* 2009;102(10):1390-4.
17. Santana V, Itaparica M, de Amorim AM, Araujo Filho JB, Araujo G, Oliveira M, et al. Non-fatal work-related accidents in adolescents. *Cad Saude Publica* 2003;19(2):407-20.
18. Walker SN, Kerr MJ, Pender NJ, Sechrist KR. A Spanish language version of the Health-Promoting Lifestyle Profile. *Nurs Res* 1990;39(5):268-73.
19. Freixas Sepulveda A, Diaz Narvaez VP, Duran Aguero S, Gaeite Verdugo MC. Do vitamins from foods fortified exceed the allowed limits? Study carried out in population young adolescent and young adult of the metropolitan region of Chile. *Nutr Hosp* 2013;28(4):1201-9.
20. Irz X, Fratiglioni L, Kuosmanen N, Mazzocchi M, Modugno L, Nocella G, et al. Sociodemographic determinants of diet quality of the EU elderly: a comparative analysis in four countries. *Public Health Nutr* 2014;17(5):1177-89.
21. Wyatt LC, Trinh-Shevrin C, Islam NS, Kwon SC. Health-related quality of life and health behaviors in a population-based sample of older, foreign-born, Chinese American adults living in New York City. *Health Educ Behav* 2014;41(1 Suppl):98S-107S.
22. Munoz MA, Fito M, Marrugat J, Covas MI, Schroder H. Adherence to the Mediterranean diet is associated with better mental and physical health. *Br J Nutr* 2009;101(12):1821-7.
23. Henriquez Sanchez P, Ruano C, de Irala J, Ruiz-Canela M, Martinez-Gonzalez MA, Sanchez-Villegas A. Adherence to the Mediterranean diet and quality of life in the SUN Project. *Eur J Clin Nutr* 2012;66(3):360-8.
24. Silva P, Durán S. Bebidas azucaradas, más que un simple refresco. *Rev Chil Nutr* 2014;41(1):90-7.
25. Bes-Rastrollo M, Sanchez-Villegas A, Gomez-Gracia E, Martinez JA, Pajares RM, Martinez-Gonzalez MA. Predictors of weight gain in a Mediterranean cohort: the Seguimiento Universidad de Navarra Study 1. *Am J Clin Nutr* 2006;83(2):362-70; quiz 94-5.
26. Kumar GS, Pan L, Park S, Lee-Kwan SH, Onufrak S, Blanck HM. Sugar-sweetened beverage consumption among adults -- 18 states, 2012. *MMWR Morb Mortal Wkly Rep* 2014;63(32):686-90.
27. Bueno MB, Marchioni DM, Cesar CL, Fisberg RM. Added sugars: consumption and associated factors among adults and the elderly. Sao Paulo, Brazil. *Rev Bras Epidemiol* 2012;15(2):256-64.
28. Yoshimura Y, Kamada C, Takahashi K, Kaimoto T, Iimuro S, Ohashi Y, et al. Relations of nutritional intake to age, sex and body mass index in Japanese elderly patients with type 2 diabetes: the Japanese Elderly Diabetes Intervention Trial. *Geriatr Gerontol Int* 2012;12 Suppl 1:29-40.
29. Vartanian LR, Schwartz MB, Brownell KD. Effects of soft drink consumption on nutrition and health: a systematic review and meta-analysis. *Am J Public Health* 2007;97(4):667-75.
30. Te Morenga L, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. *BMJ* 2013;346:e7492.
31. Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. *Diabetes Care* 2010;33(11):2477-83.



Original/*Ancianos*

Anthropometric indicators of obesity as predictors of cardiovascular risk in the elderly

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Abstract

Background: various anthropometric indicators can be used as predictors of cardiovascular risk in the elderly.

Objective: Evaluate the predictive capacity of anthropometric measurements in identifying cardiovascular risk in elderly patients at the Family Health Strategy of Viçosa-MG.

Methodology: this was a cross-sectional epidemiological study with 349 elderly persons. Cardiovascular risk was calculated using the ratio of triglyceride levels with HDL-cholesterol (TG/HDL-c) levels. The anthropometric variables measured were waist circumference, body mass index, waist-to-height ratio, and conicity index. A biochemical assessment of triglycerides and HDL-cholesterol was performed. The anthropometric measurements were also related to cardiovascular risk using Receiver Operating Characteristic (ROC) curves.

Results: the observed results suggest that all these anthropometric indexes can be used to predict cardiovascular risk in males. However, in females, only BMI showed predictive capacity. The cutoff points identified appeared very close to the cutoffs recommended and recognized in other studies, with the exception of waist circumference measured at the midpoint between the last rib and the iliac crest, which showed a considerable difference.

Conclusion: all anthropometric indices can be used to predict cardiovascular risk in males and females. Waist circumference at the midpoint between the last rib and the iliac crest was the best anthropometric measure to predict cardiovascular risk in males and smaller waist circumference and waist-height were the best anthropometric measures in females.

(Nutr Hosp. 2015;31:2583-2589)

DOI:10.3305/nh.2015.31.6.8372

Key words: *Elderly. Cardiovascular risk. Anthropometry. Cutoff points.*

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Recibido: 26-XI-2014.
1.ª Revisión: 5-II-2015.
Aceptado: 29-III-2015.

LOS INDICADORES ANTROPOMÉTRICOS DE OBESIDAD COMO PREDICTORES DE RIESGO CARDIOVASCULAR EN LOS ANCIANOS

Resumen

Introducción: diversos indicadores antropométricos se pueden utilizar como predictores de riesgo cardiovascular en los ancianos.

Objetivo: evaluar la capacidad predictiva de las medidas antropométricas en la identificación de riesgo cardiovascular en pacientes ancianos en la Estrategia Salud de la Familia de Viçosa-MG.

Metodología: se realizó un estudio epidemiológico transversal con 349 ancianos. El riesgo cardiovascular se calculó mediante la relación de los niveles de triglicéridos con niveles de HDL-colesterol (TG / HDL-c). Las variables antropométricas medidas fueron: circunferencia de la cintura, índice de masa corporal, relación cintura-altura e índice de conicidad. Se realizó una evaluación bioquímica de triglicéridos y HDL-colesterol. Las mediciones antropométricas también estaban relacionados con el riesgo cardiovascular utilizando la característica (ROC) Curvas Receiver Operating.

Resultados: los resultados observados indican que todos estos índices antropométricos se pueden usar para predecir el riesgo cardiovascular en los hombres. Sin embargo, en las mujeres, solo el IMC mostró capacidad predictiva. Los puntos de corte identificados aparecieron muy cerca de los puntos de corte recomendados y reconocidos en otros estudios, con la excepción de la circunferencia de la cintura, que se mide en el punto medio entre la última costilla y la cresta ilíaca, que mostró una diferencia considerable.

Conclusión: todos los índices antropométricos se pueden usar para predecir el riesgo cardiovascular en hombres y mujeres. La circunferencia de la cintura en el punto medio entre la última costilla y la cresta ilíaca era la mejor medida antropométrica para predecir el riesgo cardiovascular en los varones y la circunferencia de cintura más pequeña y cintura-altura fueron las mejores medidas antropométricas en las mujeres.

(Nutr Hosp. 2015;31:2583-2589)

DOI:10.3305/nh.2015.31.6.8372

Palabras clave: *Ancianos. Riesgo cardiovascular. Antropometría. Puntos de corte.*

Introduction

A worldwide phenomenon, population aging is a major challenge for public health. The demographic transition can be understood as a major change in the age structure of the population pyramid, influenced by cultural, historical, and socioeconomic determinants. Concomitantly, we have passed through the epidemiological transition, characterized by a substantial increase in non-transmissible chronic diseases, over the years. Data from the Brazilian Institute of Geography and Statistics show that 75.5% of elderly Brazilians manifest some form of chronic illness^{1,2}.

Cardiovascular diseases are responsible as the major causes of mortality among the elderly, most notably coronary atherosclerosis. About 20-30% of elderly people over 70 show symptoms of such diseases, and more than 70% of these cases are detected as coronary atherosclerosis after autopsy is performed^{3,4}.

The relation between triglycerides and HDL-cholesterol (TG/HDL-c) is used as an indicator of dyslipidemia due to its connection to increased cardiovascular risk. Recent analyses demonstrate that this ratio is a powerful predictor of the development of coronary heart disease, being directly correlated with plasma levels of type-B LDL-cholesterol. The use of the triglyceride to HDL-cholesterol ratio to assess cardiovascular risk has actually been widely used⁵⁻⁹.

Obesity, especially the abdominal form, predisposes individuals to a number of cardiovascular risk factors such as dyslipidemia, hypertension, insulin resistance, and diabetes, and is associated with increased cardiovascular risk, represented by myocardial infarction, stroke, and premature death. In this scenario, it is essential to use anthropometric measures that assess excess body fat to predict cardiovascular risk in elderly persons^{10,11}.

This points out the relevance of studies that relate cardiovascular risk and anthropometric factors in the elderly population, taking into account the significance of the population group in question and the scarcity of related studies.

Objective

Therefore this study aims to assess the predictive capacity of anthropometric measurements in identifying cardiovascular risk in elderly patients in the Family Health Strategy of Viçosa-MG.

Methodology

This paper integrates the largest extension project "Epidemiological study of functional capacity in elderly patients with metabolic syndrome". This is a cross-sectional epidemiological study with elderly patients, 60 years or older, of the Family Health Strategy

(FHS) in the city of Viçosa-MG. Cardiovascular risk was calculated by the relation of triglyceride levels with HDL-cholesterol levels (TG/HDL-c)^{12,13,14}. Metabolic syndrome affects significantly to the increase in morbidity and mortality cardiovascular^{13,15,16}.

The sample size calculation considerations included a 95% confidence level, a 65% prevalence of metabolic syndrome¹⁷, and a 5% error tolerance. Thus, the sample size was 331, which was raised by 20% to cover possible losses, thus totaling 398 elderly to be studied. The final sample consisted of 402 elderly persons. After exclusion of the elderly who did not include the information in the database the final sample of 349 individuals.

Data collection was conducted in two meetings, at the FHS. In the first, an anthropometric assessment was performed and in the second, was held with the participant having fasted for 12 hours, for biochemical assessment, evaluating triglycerides and HDL-cholesterol.

The variable dependent was cardiovascular risk, calculated by the relation of triglyceride levels with HDL-cholesterol levels (TG/HDL-c), considering elderly persons with ratios over 3.5 to be at cardiovascular risk¹⁴.

Waist circumference was measured at three points: at the midpoint between the iliac crest and the last rib, and at the minimal circumference point, with three repetitions at each point.

The weight was measured using a Kratos® brand digital electronic (modelo Linea - São Paulo-SP, Brasil). The height was determined using a Welmy® brand stadiometer portátil (Santa Barbara d'Oeste-SP, Brasil).

From height and weight, body mass index (BMI) was calculated as the ratio of weight in kilograms to height in meters squared (weight/height²).

Waist-height ratio (WHR) was determined by dividing waist circumference in centimeters by height in centimeters.

Conicity index was determined from the weight, height, and waist circumference measurements, using the mathematical equation proposed by Valdez¹⁸.

$$C \text{ index} = \frac{\text{Waist Circumference (m)}}{0.109 \times \sqrt{\frac{\text{Body Weight (kg)}}{\text{Height (m)}}}}$$

All variables were tested for normality using the Shapiro-Wilk test. The study used the Student's *t*-test to compare the means of the variables with a normal distribution between two independent groups, and the Mann-Whitney test for variables with nonparametric distribution. The significance level was 5%.

Anthropometric measurements were related to cardiovascular risk through Receiver Operating Characteristic (ROC) curves, frequently used to determine screening cutoff points. The total area under the ROC curve was determined using a confidence interval of

95%. Initially the cutoff point with a balance between sensitivity and specificity was obtained, and then the cutoff that presented a higher sensitivity, since the aim of the study was to identify anthropometric measures intended for screening for cardiovascular risk. The Z-test was used to verify differences between the areas under the curve¹⁹.

The data were analyzed using the statistical software, Stata, version 9.1 (Stata Corp., College Station, United States).

The study fully met the standards for conducting research involving human subjects, Resolution 196/96 of the Brazilian National Health Council of 1996 and the Declaration of Helsinki. The research project was previously approved by the Ethics Committee on Human Research at the Federal University of Viçosa (No. 04/2013)^{20,21}.

Results

The sample included 402 elderly people, of which 349 granted the information necessary for evaluation of the proposed relationship. Cardiovascular risk, represented by the triglyceride/HDL-cholesterol ratio, showed a prevalence of 26.07%. In males, the prevalence was 32.41% and in females, the prevalence was 21.57%.

The distributions of the anthropometric variables by gender are shown in table I, with their medians and interquartile range (p25 and p75). The variables cardiovascular risk and all waist circumference taken at the midpoint between the last rib and the iliac crest, showed no differences between the sexes. While the variables BMI, waist-height ratio, the minimal waist circumference, the circumference measured at the umbilicus and conicity index did show such differences, with higher values for females.

The ROC curve analysis has been recommended in epidemiological studies, for determining cutoffs. ROC curves were constructed to assess the capacity of the different anthropometric measures in predicting the presence of cardiovascular risk. For this, the area under the curve (AUC) is an indicator of how well the anthropometric measurements can detect a positive result for the problem in question. The area under the curve ranges from 0 to 1, with 0.5 indicating no predictive power, and 1 indicating perfect predictive power. It is valid to point out that the larger the area of the curve, the more accurate and the greater diagnostic power that the test presents. The cutoff points also showed a balance between sensitivity and specificity¹⁹.

Figure 1 identifies the areas under the ROC curve. It was observed that the minimum portion of the interval under the ROC curves is greater than 0.5 for all the anthropometric measurements in both sexes. This clearly shows that all the anthropometric measurements have the capacity to predict cardiovascular risk in males and females.

In males, it is observed that there were statistical differences between the areas under the ROC curve. Note that all the anthropometric variables displayed the power to predict cardiovascular risk, with the lowest confidence interval being greater than 0.50. The largest area was for the minimal waist circumference variable (0.75).

In females, as well, there were differences between the areas under the curves ($p=0.01$), and all the variables also appeared capable of predicting cardiovascular risk. The variables, minimal waist circumference and waist-height ratio, presented the largest areas under the curve (0.70).

In table II, cutoff points were suggested for the anthropometric indicators that proved valid for predicting cardiovascular risk, considering the best cutoff

Table I
Median, p25, and p75 for the variables, broken down by gender, in the elderly patients attended by the Family Health Strategy. Viçosa, Minas Gerais, Brazil, 2013. n=349

Variables	Men (N = 108) Median (p25-p75)	Women (N = 113) Median (p25-p75)	P*
Age	71 (66-77)	72 (67-78)	0.14
TG/HDL	2.79 (1.54-4.45)	2.56 (1.73-3.52)	0.40
WC ₁ (cm)	92.00 (84.0-100.0)	94.00 (86.16-102.00)	0.06
WC ₂ (cm)	87.10 (80.5 -94.0)	82.90 (77.6- 91.00)	0.01
WC ₃ (cm)	92.30 (84.2-99,30)	94.80 (87.00-102.8)	0.01
BMI (kg/m ²)	25.05(22.53-27.99)	27.51 (24.00-30.43)	<0.01
WtR	0.56 (0.50-0.60)	0.62 (0.57-0.68)	<0.01
CI	1.31 (1.25-1.37)	1.35 (1.29-1.40)	<0.01

Legend: TG/HDL = ratio of triglycerides to HDL (cardiovascular risk); WC₁ = waist circumference at the midpoint between the last rib and the iliac crest; WC₂ = minimal waist circumference; WC₃ = umbilical waist circumference BMI = body mass index; WtR = waist-height ratio; CI = conicity index. *Mann-Whitney test.

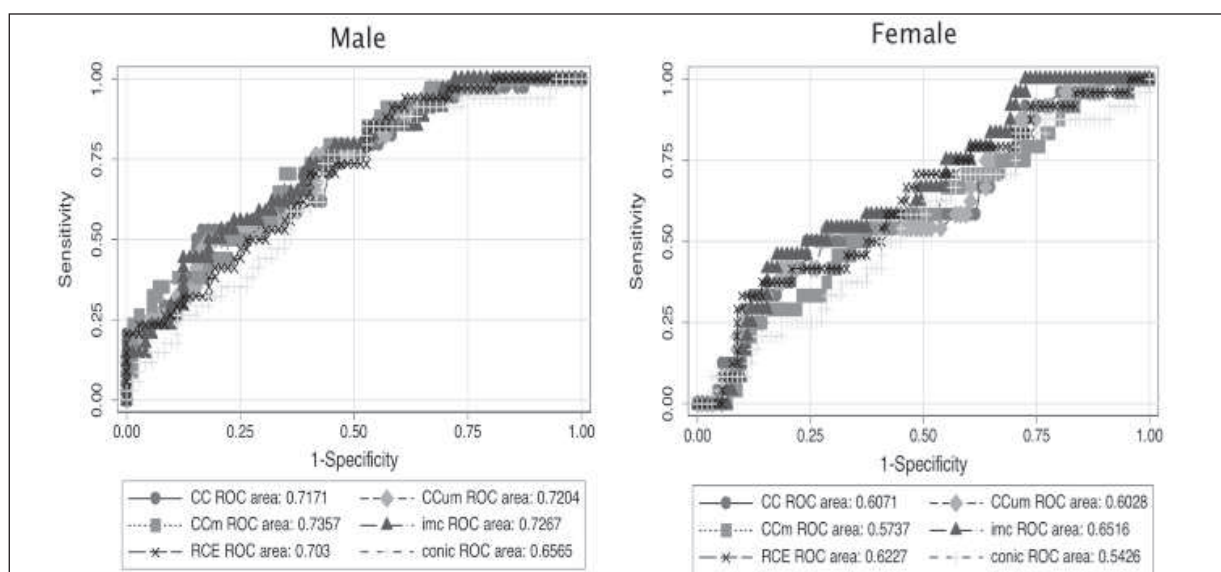


Fig. 1.—Areas under the ROC curves for the anthropometric variables in predicting cardiovascular risk, broken down by gender, in the elderly patients attended by the Family Health Strategy, Viçosa, Minas Gerais, Brazil, 2013. $n = 349$.

Legend: CC = waist circumference at the midpoint between the last rib and the iliac crest; CCm = minimal waist circumference; CCum = umbilical waist circumference; imc = body mass index; conic = conicity index

Table II

Cutoff points, sensitivity and specificity in balance, for the anthropometric indicator predictors of cardiovascular risk in elderly patients attended by the Family Health Strategy, Viçosa, Minas Gerais, Brazil, 2013. $n = 349$

Anthropometric variables	Cutoff point	Sensitivity	Specificity
WC ₁ (cm)	>92.00	68.09%	61.22%
WC ₂ (cm)	>88.00	70.21%	64.29%
WC ₃ (cm)	>92.50	65.96%	60.20%
BMI (kg/m ²)	>24.73	72.34%	60.20%
WHtR	>0.57	68.09%	68.37%
CI	>1.31	65.96%	54.08%
WC ₁ (cm)	>95.60	61.36	60.63
WC ₂ (cm)	>84.00	72.73	60.00
WC ₃ (cm)	>97.00	65.91	62.50
BMI (kg/m ²)	>27.80	61.36	59.38
WHtR	>0.63	70.45	60.00
CI	>1.35	61.36%	55.00%

Legend: WC₁ = waist circumference at the midpoint between the last rib and the iliac crest; WC₂ = minimal waist circumference; WC₃ = umbilical waist circumference; BMI = body mass index; WHtR = waist-height ratio; CI = conicity index.

point to be the one that showed better balance between sensitivity and specificity.

Table III shows the cutoff points with higher sensitivity for identifying individuals with cardiovascular

risk, for treating anthropometric measures that are generally used for screening.

Discussion

No studies were found that used anthropometric indicators to predict cardiovascular risk exclusively in the elderly. It is clearly shown that the study reveals a simple, easily applied, low cost, and high validity proposal for predicting cardiovascular risk in the elderly, by seeking to elucidate the accuracy of anthropometric indicators regarding this risk.

For men, waist circumference at the midpoint between the last rib and the iliac crest showed the largest area (AUC=0.75), followed by BMI, umbilical waist circumference, and waist-height ratio (AUC=0.73), minimal waist circumference (AUC=0.72), and, finally, the conicity index (AUC=0.66). While for women, minimal waist circumference and waist-height ratio had the largest areas under the curve (AUC=0.70), followed by minimal waist circumference (AUC=0.68), umbilical waist circumference, and BMI (AUC=0.66), and subsequently by conicity index (AUC=0.65). Thus, waist circumference at the midpoint between the last rib and the iliac crest in males, and minimal waist circumference and waist-height ratio in females, had a higher predictive capacity to assess cardiovascular risk, when there is a balance between sensitivity and specificity. The cutoff point for waist circumference at the midpoint between the last rib and the iliac crest in males was 92 cm. In females, the cutoff point for minimal waist circumference was 84 cm, and 0.63 for waist-height ratio.

Table III

Cutoff points with higher sensitivity and specificity of anthropometric indicators predicting cardiovascular risk, in elderly patients attended by the Family Health Strategy, Viçosa, Minas Gerais, Brazil, 2013. n = 349

<i>Anthropometric variables</i>	<i>Cutoff point</i>	<i>Sensitivity</i>	<i>Specificity</i>
WC ₁ (cm)	>89.10	80.85%	46.94%
WC ₂ (cm)	>86.00	80.85%	59.18%
WC ₃ (cm)	>89.00	80.85%	47.96%
BMI (kg/m ²)	>24.06	80.85%	55.10%
WHtR	>0.54	80.85%	48.98%
CI	>1.30	80.85%	50.00%
WC ₁ (cm)	>88.50	81.82	37.50
WC ₂ (cm)	>79.50	81.82	38.75
WC ₃ (cm)	>89.60	81.82	37.5
BMI (kg/m ²)	>25.45	81.82	44.38
WHrR	>0.60	84.09	45.63
CI	>1.31	84.09%	36.87%

Legend: WC₁ = waist circumference at the midpoint between the last rib and the iliac crest; WC₂ = minimal waist circumference; WC₃ = umbilical waist circumference; BMI = body mass index; WHtR = waist-height ratio; CI = conicity index.

Table IV

Cutoff points, sensitivity and specificity in balance, for the anthropometric indicator predictors of cardiovascular risk in elderly patients attended by the Family Health Strategy, Viçosa, Minas Gerais, Brazil, 2013. n = 349

<i>Anthropometric variables</i>	<i>Cutoff point</i>	<i>Sensitivity</i>	<i>Specificity</i>
WC ₁ (cm)	>92.00	68.09%	61.22%
WC ₂ (cm)	>88.00	70.21%	64.29%
WC ₃ (cm)	>92.50	65.96%	60.20%
BMI (kg/m ²)	>24.73	72.34%	60.20%
WHtR	>0.57	68.09%	68.37%
CI	>1.31	65.96%	54.08%
WC ₁ (cm)	>95.60	61.36	60.63
WC ₂ (cm)	>84.00	72.73	60.00
WC ₃ (cm)	>97.00	65.91	62.50
BMI (kg/m ²)	>27.80	61.36	59.38
WHtR	>0.63	70.45	60.00
CI	>1.35	61.36%	55.00%

Legend: WC₁ = waist circumference at the midpoint between the last rib and the iliac crest; WC₂ = minimal waist circumference; WC₃ = umbilical waist circumference; BMI = body mass index; WHtR = waist-height ratio; CI = conicity index.

Table V

Cutoff points, sensitivity, and specificity of anthropometric indicators predicting cardiovascular risk, in elderly patients attended by the Family Health Strategy, Viçosa, Minas Gerais, Brazil, 2013. n = 349

<i>Anthropometric variables</i>	<i>Cutoff point</i>	<i>Sensitivity</i>	<i>Specificity</i>
WC ₁ (cm)	>89.10	80.85%	46.94%
WC ₂ (cm)	>86.00	80.85%	59.18%
WC ₃ (cm)	>89.00	80.85%	47.96%
BMI (kg/m ²)	>24.06	80.85%	55.10%
WHtR	>0.54	80.85%	48.98%
CI	>1.30	80.85%	50.00%
WC ₁ (cm)	>88.50	81.82	37.50
WC ₂ (cm)	>79.50	81.82	38.75
WC ₃ (cm)	>89.60	81.82	37.5
BMI (kg/m ²)	>25.45	81.82	44.38
WHrR	>0.60	84.09	45.63
CI	>1.31	84.09%	36.87%

Legend: WC₁ = waist circumference at the midpoint between the last rib and the iliac crest; WC₂ = minimal waist circumference; WC₃ = umbilical waist circumference; BMI = body mass index; WHtR = waist-height ratio; CI = conicity index.

When evaluating the cutoff points with a higher sensitivity, since the purpose is to use anthropometric measurements for cardiovascular risk screening, we observed that the cutoff point for waist circumference at the midpoint between the last rib and the iliac crest, for males, was 89.1 cm, and for females, the cutoff point for minimal circumference was 79.5 cm and the cutoff point for waist-height ratio was 0.60.

Almeida in a study with 270 adult and elderly women, employees of a public university in Feira de Santana (BA), found conicity index to be an indicator, with a cutoff point of 1.25, sensitivity of 71.2%, and specificity 64.0%, presenting better discriminatory power for coronary risk, having also identified cutoffs for waist circumference at 86 cm (sensitivity = 69.5% and specificity = 63.5%), and for waist-height ratio at 0.55 (sensitivity = 67.8% and specificity = 65.9%), with values very close to those found by this study²⁵.

Also, Haun with 968 adults and elderly in the city of Salvador (BA), identified the anthropometric indicators: conicity index, waist-hip ratio, waist-height ratio, waist circumference, and BMI, for predicting coronary risk, broken down by gender. The coronary risk used in the study by Haun was the algorithm proposed in the Framingham cohort study by Wilson^{10,26}.

The cutoff points in the present study were very close to the cutoff points proposed by Haun when we compared the anthropometric indicators BMI, waist-height ratio, conicity index, and waist circumfe-

rence in males. BMI corresponded to 24.06 and 24 kg/m², waist-height ratio to 0.54 and 0.52, and the conicity index to 1.30 and 1.25, waist circumference to 89.10 and 88.0, respectively, observing higher sensitivity in this study. The sensitivity and specificity in the study previously cited were, respectively, 67% and 53% for BMI, 68% and 64% for waist-height ratio, 74% and 75% for conicity index, and 65% and 67% for waist circumference. Conicity index was the anthropometric indicator that presented the greatest area under the curve in the study by Haun in contrast to the present study that showed waist circumference measured at the midpoint between the last rib and the iliac crest as a better indicator for predicting cardiovascular risk in males¹⁰.

The study by Haun, in females, also identified conicity index, waist-height ratio, waist circumference, and BMI as measures with the power to predict cardiovascular risk, considering conicity index to be the indicator with greatest area under the curve. In this study, minimal waist circumference and waist-height ratio had greater area under the curve. The analyses from these studies showed, respectively, conicity index of 1.31 and 1.18, waist-height ratio of 0.60 and 0.53, midpoint waist circumference of 88.5 and 83 cm, and BMI of 25.45 and 26.0 kg/m². The sensitivity and specificity were, respectively, 73% and 61% for conicity index, 67% and 58% for waist-height ratio, 64% and 62% for waist circumference, and 62% and 53% for BMI in the study by Haun¹⁰.

There are three points where waist circumference can be measured. According to the National Cholesterol Education Program - NCEP (2001), it is recommended that waist circumference be measured at the midpoint between the last rib and the iliac crest, suggesting values greater than 88 cm for women and 102 cm for men for predicting the risk of atherosclerosis. With regard to males, higher sensitivity values, with a cutoff point of 89.10 cm or higher, are observed as predicting cardiovascular risk, being approximately 13 cm lower than the recommended value. In females, the value was 88.5 cm, very close to the one recommended. The measurement of minimal waist circumference is slightly different from the midpoint between the last rib and the iliac crest, suggesting a cutoff point of 86 cm or higher in males and 79.50 cm in females. Thus, it is important to review the cutoff proposed by the NCEP, especially for males, since the same recommended cutoff points are used for adults²⁷.

With regard to the International Diabetes Federation (2005), it is suggested that the measurement be performed at the umbilicus, with a cutoff point for males of 94 cm or greater, and 80 cm for females, to predict abdominal obesity. The cutoffs found in the study were 89 cm in males and 89.60 cm in females²⁸.

Body mass index (BMI) in this study identified a cutoff at 24.06 and 25.45 kg/m² or greater, respectively, for men and women, to predict cardiovascular risk. The WHO (1995) recommends a >25 kg/m² cutoff for overweight, and Lipchitz²⁹ recommends >27 kg/m².

Interestingly, the cutoff points identified in the present study correspond to the approximate value proposed by the WHO³⁰.

Waist-height ratio has been appearing in studies as a predictive factor of chronic illness, but there are no recommended cutoff points for the elderly. A study conducted in Taiwan with 55,563 individuals found that waist-height ratio was a good predictor for cardiovascular risk factors, and even for the relationship between total cholesterol and HDL-cholesterol. In that study, the cutoff identified for predicting a cardiovascular risk factor varies between 0.48 and 0.50, close to the data found in this work, which is 0.54 for men and 0.60 for women³¹⁻³².

Conicity index is an interesting indicator for providing information on the profile of body fat distribution. There are no recommended cutoff points for the elderly population. A study done by Pitanga and Lessa, with adults and elderly, found that the cutoff point for predicting coronary risk corresponds to 1.25 in males and 1.18 in females. In the present study, the value corresponds to 1.30 in males and 1.31 in females, the value proposed approximating the value for males in this study³³.

Conclusion

The results seen here suggest that all these anthropometric indexes can be used to predict cardiovascular risk in males and females. The cutoff points with higher sensitivity ought to be considered, since the anthropometric measurements are used for cardiovascular risk screening purposes. The study found that, for males, the cutoff point for waist circumference between the lowest rib and the iliac crest was 89.1 cm, and that, for females, the cutoff point for minimal waist circumference was 79.5 cm and 0.60 for waist-height ratio.

References

1. Brito F. Transição demográfica e desigualdades sociais no Brasil. *Rev. bras. estud. popul.* 2008 Jan-June; 25(1).
2. Brasil. Ministério do Planejamento, Orçamento e Gestão. Instituto Brasileiro de Geografia e Estatística. Contagem Populacional. Brasília, DF; 2012. [acesso em 2012 out. 13]. Disponível em: <<http://www.sidra.ibge.gov.br/bda/popul>>
3. Cabrera MAS, Andrade SM, Mesas AE. A prospective study of risk factors for cardiovascular events among the elderly. *Clinical Interventions in Aging*. 2012;7:463-468.
4. Gravina-Taddei CF, Batlouni M, Sarteschi C, et al. Hiper-Homocisteinemia como Fator de Risco para Doença Aterosclerótica Coronariana em Idosos. *Arq. Bras. Cardiol.* 2005 Sept; 85(3):166-173.
5. Da Luz PL, Favarato D, Faria-Neto Junior JR, et al. High ratio of triglycerides to HDL cholesterol predicts extensive coronary disease. *Clinics*. 2008; 64:427-32.
6. Holmes DT, Frohlich J, Buhr KA. The concept of precision extended to the atherogenic index of plasma. *Clin Biochem*. 2008; 41(7-8): 631-635.
7. McLaughlin T, Abbasi F, Cheal K, et al. Use of metabolic markers to identify overweight individuals who are insulin resistant. *Ann Intern Med*. 2003; 139(10):802-809.

8. Vieira EA, Carvalho WA, Aras Júnior R, et al. Razão triglicérides/HDL-C e proteína C reativa de alta sensibilidade na avaliação do risco cardiovascular. *J Bras Patol Ned Lab*. 2011; 47(2): 113-118.
9. Frohlich J, Docia'sova M. Fractional Esterification Rate of Cholesterol and Ratio of Triglycerides to HDL-Cholesterol Are Powerful Predictors of Positive Findings on Coronary Angiograph. *Clin Chem*. 2003 Nov; 49(11):1873-80
10. Haun DRS, Pitanga FJG, Lessa I. Razão cintura/estatura comparado a outros indicadores antropométricos de obesidade como preditor de risco coronariano elevado. *Rev Assoc Med Bras*. 2009; 55(6): 705-11.
11. Pitanga FJG, Lessa I. Indicadores Antropométricos de Obesidade como Instrumento de Triagem para Risco Coronariano Elevado em Adultos na Cidade de Salvador – Bahia. *Arquivos Brasileiros de Cardiologia*. 2005; 86 (1):26-31.
12. Silva ARA, Dourado KF, Pereira PB, Lima DSC, Fernandes AO, Andrade AM, Henriques, MAM. Razão TG/HDL-c e indicadores antropométricos preditores de risco para doença cardiovascular. *Rev Bras Cardiol*. 2012; 25(1):41-9.
13. Da Luz, P.L., Favarato, D., Faria, J.R., Lemos, P. and Chagas, A.C.P. (2008) High Ratio of Triglycerides to HDL Cholesterol Predicts Extensive Coronary Disease. *Clinics*, 63, 427-432.
14. Vieira, E.A., Carvalho, W.A., Aras, R., Couto, F.D. and Couto, R.D. Triglycerides/HDL-C Ratio and High Sensible C-Reactive Protein to the Evaluation of Cardiovascular Risk. *Jornal Brasileiro de Patologia e Medicina Laboratorial*. 2011; 47, 113-118.
15. He Y, Jiang B, Wang J, Feng K, Chang Q, Fan L, et al. Prevalence of the metabolic syndrome and its relation to cardiovascular disease in an elderly Chinese population. *J Am Coll Cardiol*. 2006; 47 (8): 1588-94.
16. Scherer F, Vieira JLC. Estado nutricional e sua associação com risco cardiovascular e síndrome metabólica em idosos. *Rev Nutr., Campinas*. 2010; 23(3):347-55.
17. Martinho K.O., et al. Comparison of functional autonomy with associated sociodemographic factors, lifestyle, chronic diseases (CD) and neuropsychiatric factors in elderly patients with or without the metabolic syndrome (MS). *Archives of Gerontology and Geriatrics*, 2013; 57 (2): 117-242.
18. Valdez R. A simple model-based index of abdominal adiposity. *J Clin Epidemiol*. 1991; 44(9):955-6.
19. Martinez EZ, Francisco LN, Basílio BP. Analysis of diagnostic test using ROC curves. *Cadernos de Saúde Coletiva*, 2003;11 (1): 7-31.
20. Brasil. Conselho Nacional de Saúde. Resolução 196/96. Normas para a Realização de Pesquisa em Seres Humanos. 1996.
21. WMA. Declaration of Helsinki. Ethical principles for Medical Research Involving Human Subject. 59TH WORLD MEDICAL ASSOCIATION GENERAL ASSEMBLY. Seoul 2008.
22. Pagano M, Gauvreau K. Princípios de bioestatística. Tradução da 2.ed. Norte-americana. São Paulo: Pioneira Thomson Learning; 2004.
23. Fletcher R, Fletcher S, Wagner E. Epidemiologia Clínica: elementos essenciais. 3. ed. Porto Alegre: Artmed; 1996.
24. Erdreich LS, LEE ET. Use of relative operating characteristic analysis in epidemiology. A method for dealing with subjective judgment. *Am J Epidemiol*. 1981 Nov; 114(5):649-62.
25. Almeida RT, Almeida MMG, Araújo TM. Obesidade Abdominal e Risco Cardiovascular: Desempenho de Indicadores Antropométricos em Mulheres. *Arq Bras Cardiol*. 2009; 92(5):375-380.
26. Wilson PWF, Dagostino RB, Levy D, et al. Prediction of coronary heart disease using risk factors categories. *Circulation*. 1998; 97(2): 1837-1847.
27. Nation cholesterol education program (NCEP). Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *J Am Med Assoc*. 2001; 285(19).
28. International Diabetes Federation (IDF). The IDF Consensus Worldwide Definition of the Metabolic Syndrome. (IDF 2005).
29. Lipchitz DA. Screening for nutritional status in the elderly. *Prim Care*. 1994; 21(1).
30. World Health Organization (WHO). World Health Organization. Physical Status: The use and interpretation of anthropometry. Genebra: World Health Organization, 1995.
31. Lin WY, Lee LT, Chen CY, et al. Optimal cut-off values for obesity: using simple anthropometric indices to predict cardiovascular risk factors in Taiwan. *Int J Obes Relat Metab Disord*. 2002; 26(9): 1232-1238.
32. Schisterman EF, Faraggi D, Reiser B, Trevisan M. Statistical Inference for the Area under the Receiver Operating Characteristic Curve in the Presence of Random Measurement Error. *Am J Epidemiol*. 2001 Jul; 154(2):174-9.
33. Pitanga FJG, Lessa I. Sensibilidade e especificidade do índice de conicidade como discriminador do risco coronariano de adultos em Salvador, Brasil. *Rev. Bras. Epidemiol*. 2004; 7 (3):259-269.



Original/*Ancianos*

Valor pronóstico de la homocisteína sérica en enfermos ancianos hospitalizados en un servicio de medicina interna

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Resumen

Antecedentes y objetivos: el aumento de la homocisteína se relaciona con la enfermedad vascular y un incremento de la mortalidad. La disminución de la homocisteína se asocia también con un peor pronóstico en enfermos en hemodiálisis; sin embargo, esta relación no ha sido bien estudiada en otro tipo de pacientes. El objetivo del estudio fue analizar el valor pronóstico de los niveles de homocisteína en enfermos ancianos pluripatológicos ingresados en un servicio general de medicina interna

Pacientes y métodos: estudiamos a 239 pacientes (121 mujeres y 118 varones; edad media: 78 años) en los que determinamos la homocisteína sérica y la relacionamos con los factores de riesgo vascular, enfermedad vascular: cardiopatía isquémica, ACV isquémico y arteriopatía periférica, estado de nutrición, creatinina, albúmina, ácido fólico y vitamina B12.

Resultados: la mortalidad durante el ingreso de los enfermos con homocisteína menor de 9 $\mu\text{mol/l}$ fue del 33%, del 9% cuando estaba entre 9 y 20 $\mu\text{mol/l}$ y del 17% si era superior a 20 $\mu\text{mol/l}$. La disminución de la homocisteína se relacionó con mayor comorbilidad, pérdida de peso y disminución de la albúmina. A largo plazo, el aumento de la homocisteína se relacionó con mayor mortalidad, especialmente en los pacientes con enfermedad vascular.

Conclusión: en los pacientes ancianos pluripatológicos tanto la disminución como el aumento de la homocisteína se asocian con una mayor mortalidad.

(Nutr Hosp. 2015;31:2590-2597)

DOI:10.3305/nh.2015.31.6.9011

Palabras clave: Homocisteína. Pronóstico. Mortalidad. Enfermedad cardiovascular. Pacientes ancianos pluripatológicos.

PROGNOSTIC VALUE OF SERUM HOMOCYSTEINE LEVELS IN ELDERLY HOSPITALIZED PATIENTS

Abstract

Background and objectives: increased serum homocysteine levels are related to vascular disease and increased mortality. The decrease of homocysteine is also associated with a worse prognosis in patients on hemodialysis; however, this relationship has not been well studied in other patients. Our goal is to study the prognosis of increased and decreased serum homocysteine levels in elderly patients admitted to a general internal medicine unit.

Patients and methods: we included 239 patients (121 women and 118 men; mean age, 78 years) in which we determined serum homocysteine levels and study its relationship with vascular risk factors, vascular disease: ischemic heart disease, ischemic stroke and peripheral arterial disease, nutritional status, creatinine, albumin, folate and B12 vitamin.

Results: mortality during hospitalization of patients with homocysteine levels below 9 $\mu\text{mol/l}$ was 33%, 9% for those with levels between 9 and 20 $\mu\text{mol/l}$ and 17% for those with levels above 20 $\mu\text{mol/l}$. Low homocysteine values were related to increased comorbidity, higher degree of weight loss and decreased serum albumin levels. In a survival analysis using Kaplan-Meier curves, increased homocysteine was associated with increased mortality especially in patients with vascular disease.

Conclusion: in elderly patients with multiple comorbidities, both decreased and increased serum homocysteine levels are associated with increased mortality.

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DOI:10.3305/nh.2015.31.6.9011

Key words: Homocysteine. Prognosis. Mortality. Cardiovascular disease. Elderly patients with multiple comorbidities.

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Recibido: 30-III-2015.
Aceptado: 23-IV-2015.

Introducción

Diversos estudios han demostrado una estrecha relación entre el aumento de la homocisteína y la enfermedad vascular: cardiopatía isquémica, infarto de miocardio, accidente cerebro vascular y arteriopatía periférica¹⁻². Como consecuencia, en estudios de cohortes se ha demostrado una menor supervivencia a largo plazo en los sujetos con hiperhomocisteinemia³⁻⁴. Sin embargo, en enfermos en diálisis, en los que la homocisteína se encuentra muy elevada se ha observado que la disminución de la homocisteína se relaciona con una mayor mortalidad. Como la homocisteína se encuentra principalmente unida a la albúmina, la hipoalbuminemia puede hacer disminuir las concentraciones de homocisteína⁵⁻⁷.

Agkul A et al (2008) refieren en 124 pacientes en hemodiálisis (39,8% tenían enfermedad cardiovascular) que la disminución de las concentraciones de homocisteína se relacionaba con una mayor mortalidad mientras que las concentraciones elevadas tenían una supervivencia más prologada⁸. Esta mayor mortalidad de las concentraciones bajas de homocisteína parece asociada con un síndrome combinado de malnutrición e inflamación que es frecuente en los enfermos con hemodiálisis^{9,10}.

Los estudios que demuestran una mayor mortalidad con cifras bajas de homocisteína se han realizado siempre en enfermos con enfermedad renal terminal en hemodiálisis, excepto el de Viña JJ et al (2006), quien en enfermos mayores de 65 años ingresados en un servicio de medicina interna, ninguno en hemodiálisis, refiere un aumento de la mortalidad en relación tanto con concentraciones altas como bajas de homocisteína¹¹.

El objetivo del estudio fue analizar el valor pronóstico de los niveles de homocisteína en enfermos ancianos pluripatológicos ingresados en un servicio general de medicina interna.

Método

Estudiamos de forma prospectiva a 239 enfermos ingresados en el Hospital Universitario de Canarias durante el primer semestre del año 2010; 118 varones y 121 mujeres, con edad superior a 60 años (rango entre 61 y 99 años, edad media de 78 ± 0.5). El pronóstico se valoró por la mortalidad, tanto a corto plazo, durante la hospitalización, como a largo plazo, incluyendo el tiempo desde el ingreso hasta el último seguimiento después del alta.

Criterios de exclusión: edad de 60 años o inferior; enfermedad terminal al ingreso con una esperanza de vida inferior a 6 meses; enfermedad vascular aguda al ingreso: infarto de miocardio, ictus o síndrome isquémico agudo en MMII; insuficiencia renal terminal en diálisis; y haber recibido durante el último años preparados vitamínicos que contuvieran vitaminas B1, B6, B12 o ácido fólico.

Comorbilidad

Las enfermedades y los factores de riesgo cardiovascular se recogieron en relación con los diagnósticos del informe de alta: cardiopatía coronaria, ACV isquémico, arteriopatía periférica; factores de riesgo: hipertensión, hiperlipidemia, obesidad, diabetes mellitus, y tabaco –fumador actual o exfumador–; también los antecedentes o diagnósticos de insuficiencia cardíaca, EPOC, cáncer, consumo excesivo de alcohol, cirrosis, insuficiencia renal crónica y demencia; infecciones: neumonía, infección urinaria y sepsis. También se calculó el índice de comorbilidad de Charlson (sin edad)¹².

Estado de nutrición

Se interrogó por la presencia de anorexia y disminución de la ingesta de alimentos durante el último año. Se calculó el IMC (peso/talla²). Se midió el perímetro braquial (PB) y el pliegue cutáneo del tríceps (PCT) mediante un lipocalibre tipo Holtain y se calculó el área muscular del brazo (AMB). Los datos antropométricos se compararon con los de la población occidental de las Islas Canarias para adultos de igual edad y sexo¹³.

Análisis

Se extrajeron muestras para análisis de sangre a las 8.00 de la mañana posterior al ingreso. Se determinaron datos del estado de nutrición como albúmina, colesterol total, HDL y LDL, triglicéridos, vitamina B12, ácido fólico y homocisteína en suero; también reactivantes de fase aguda como proteína C reactiva (PCR), ferritina y fibrinógeno; y pruebas de función renal y hepática como creatinina sérica, BUN, bilirrubina, fosfatasa alcalina, LDH, ASAT, ALAT y GGT.

Función de órganos

Se valoró la función de órganos mediante el cálculo del SOFA (sequential organ failure assessment) basado en seis datos: 1) PaO₂/FiO₂; 2) recuento de plaquetas; 3) bilirrubina; 4) hipotensión; 5) escala de Glasgow; y 6) creatinina¹⁴.

Índice Tobillo Brazo (ITB)

Tras descanso en decúbito supino durante cinco minutos, se localizaron mediante ecografía doppler (HADO ES-100 Kawasaki, Japan) y midió la presión arterial sistólica en las arterias tibial posterior, pedia y braquial. El ITB se calculó como el cociente entre la presión más baja en los miembros inferiores y la más

alta en los superiores. Se consideró normal un ITB entre 0.9 and 1.3 y muy disminuido por debajo de 0.5¹⁵.

El estudio fue aprobado por el comité de investigación del hospital. Se obtuvo consentimiento informado de todos los pacientes.

Análisis estadístico

Como las variables principales, homocisteína, ITB, folato, B12, creatinina, SOFA e índice de comorbilidad de Charlson no tienen una distribución normal en la prueba de Kolmogorov Smirnov, hemos utilizado test no paramétricos: Chi2, U de Mann Whitney y Correlación de Spearman. Para conocer el estado (vivo o muerto) de los pacientes, después del alta del hospital los enfermos fueron seguidos mediante llamada telefónica. Se utilizaron curvas de Kaplan-Meier y la prueba de log rank para valorar diferencias en la supervivencia a largo plazo y análisis de regresión de Cox para discernir que variables podían tener valor pronóstico independiente. Se utilizó el programa estadístico SPSS15.0.

Resultados

Nuestros pacientes eran de edad avanzada, mediana (rango intercuartílico) de 78 (73-84) años, y tenían un alto índice de comorbilidad con una mediana (rango intercuartílico) de 3 (2-6).

Eran frecuentes los antecedentes de enfermedad cardiovascular: cardiopatía coronaria, 47 (19.7%), ACV isquémico, 44 (18.4%) y arteriopatía periférica, 60 (25.1%); y los factores de riesgo vascular: hipertensión, 73 (30.5%), hiperlipidemia, 116 (48.5%), obesidad (IMC mayor de 30 kg/m²), 68 (28.5%), diabetes mellitus, 108 (45.2%) y tabaco –fumador actual o exfumador–, 71 (29.7%). Otras enfermedades: insuficiencia cardíaca, 99 (41.4%); EPOC, 40 (16.7%); cáncer, 30 (12.6%); consumo excesivo de alcohol, 24 (10%); cirrosis, 8 (3.3%); insuficiencia renal crónica, 92 (38.5%) y demencia, 30 (12.6%). Las infecciones más frecuentes fueron neumonía en 73 (30.56%), infección urinaria en 33 casos (13.8%) y sepsis en 105 casos (43.9%).

La tabla I muestra las características del grupo total de pacientes así como las diferencias entre los que

Tabla I
Características generales de los enfermos y diferencias entre vivos y muertos durante el ingreso

	<i>Todos (239)</i>	<i>muertos (31)</i>	<i>vivos (208)</i>	<i>p</i>
Edad	78 (73-84)	79 (72-86)	78 (73-83)	0.244
Sexo varón	118 (49.4%)	18 (58.1%)	100 (48.1%)	0.398
IMC kg/m ²	26.7 (23.7-30.5)	28.1 (23.4-30.1)	26.7(23.7-30.7)	0.855
AMB %	81 (59.4-97.5)	71.9 (56.4-83.7)	83 (60.3-99.5)	0.028
Albúmina g/dl	3.4 (2.9-3.7)	3 (2.2-3.6)	3.4 (3-3.8)	0.004
PCR mg/l	52.2 (14.2-90)	90 (20.4-112.6)	45.6 (13.9-90)	0.025
SOFA	1 (0-3)	2 (0-5)	1 (0-2)	0.021
Charlson	3 (2-6)	5 (3-6)	3 (2-5)	<0.001
Folato	4.6 (3.2-7.4)	4.2 (3.1-5.8)	4.9 (3.2-7.6)	0.122
B12	458 (312-716)	581 (384-1026)	451 (310-690)	0.047
Homocisteína	18.1 (14.1-21.6)	18.3 (12.8-23.4)	18 (14.6-21.2)	0.622
Hcys				0.023
<9	12 (5%)	4 (12.9%)	8 (3.8%)	
9-20	144 (60.3%)	13 (42%)	131 (63%)	
>20	83 (34.7%)	14 (45.2%)	69 (33.2%)	
Diabetes	108 (45%)	16 (52%)	92 (44%)	0.564
HTA	73 (30.5%)	5 (16.1%)	68 (32.7%)	0.097
Obesidad	68 (28.5%)	9 (29%)	59 (28.4%)	1.000
Dislipemia	116 (48%)	11 (36%)	105 (51%)	0.172
Tabaco IPA >20	95 (39.7%)	12 (38.7%)	83 (40%)	1.000
Enf coronaria	47 (19.7)	7 (22.6%)	40 (19.2%)	0.845
ACV isquémico	44 (18.4%)	5 (16.1%)	39 (18.8%)	0.918
EVP	60 (25.1%)	8 (25.8%)	52 (25%)	1.000
ITB	1 (0.77-1.11)	0.98 (0.47-1.13)	1 (0.79-1.10)	0.643
ITB < 0.65	40 (17.2%)	10 (33.3%)	30 (14.8)	0.024

Los datos se presentan como mediana y (rango intercuartílico) o como número de casos y (porcentaje). La significación estadística corresponde a la U de Mann-Whitney en el caso de las variables cuantitativas y a la Chi-2 en el caso de las cualitativas.

IMC: Índice de Masa Corporal Kg/m². AMB %: Área Muscular del brazo en porcentaje de la mediana poblacional. PCR: Proteína C Reactiva. SOFA: Sequential Organ Failure Assessment. EVP: Enfermedad Vascular Periférica. ACV: Accidente Cerebro Vascular. ITB: Índice Tobillo Brazo

fallecen durante el ingreso y los que sobreviven al mismo.

La mediana de homocisteína sérica de los 239 enfermos fue de 18.1 $\mu\text{mol/l}$, con un rango intercuartílico de 14.1-21.6, sin que hubiera diferencias entre varones y mujeres con medianas similares de 18.1 y 18.0 $\mu\text{mol/l}$ respectivamente.

Las concentraciones de homocisteína correlacionaban de forma significativa y directa con la edad, BUN, creatinina e índice de comorbilidad de Charlson (sin edad), y de forma inversa con las concentraciones de ácido fólico, vitamina B12, porcentaje de pérdida de peso, y recuento de plaquetas (Tabla II). No encontramos relación entre las concentraciones de homocisteína y la existencia de eventos vasculares, cardiopatía isquémica, accidente cerebro vascular y enfermedad vascular periférica; ni con los factores de riesgo vascular, diabetes, hipertensión arterial, dislipemia, obesidad y tabaco, ni con la disminución del ITB; tampoco con el estado de nutrición: IMC, PB, AMB y PCT. Con respecto a la metformina, que puede influir en las concentraciones de homocisteína, encontramos una tendencia a que estas fueran más altas en los que tomaban metformina, pero sin alcanzar la significación estadística ($p=0.079$).

Tabla II
Relaciones de la homocisteína

	<i>Homocisteína</i>		<i>Homocisteína</i>	
Edad	rho = 0.157 p = 0.015 n = 239	Albúmina	rho = 0.070 p = 0.285 n = 238	
Ac fólico	rho = -0.251 p < 0.001 n = 238	Pérdida peso%	rho = -0.142 p = 0.035 n = 221	
B12	rho = -0.221 p = 0.001 n = 236	IMC	rho = 0.016 p = 0.811 n = 223	
Hemoglobina	rho = -0.111 p = 0.087 n = 239	AMB%	rho = 0.050 p = 0.442 n = 238	
Plaquetas	rho = -0.144 p = 0.026 n = 239	Pfeiffer	rho = 0.025 p = 0.707 n = 222	
Creatinina	rho = 0.238 p = 0.023 n = 239	PCR	rho = -0.031 p = 0.637 n = 239	
BUN	rho = 0.203 p = 0.002 n = 239	ITB	rho = -0.049 p = 0.457 n = 233	
Charlson	rho = 0.141 p = 0.029 n = 239	SOFA	rho = 0.115 p = 0.076 n = 239	

IMC: Índice de Masa Corporal Kg/m^2 . AMB %: Área Muscular del brazo en porcentaje de la mediana poblacional. PCR: Proteína C Reactiva. SOFA: Sequential Organ Failure Assessment. ITB: Índice Tobillo Brazo.

El 73.2% de los enfermos presentaba concentraciones séricas de homocisteína superiores a 15 $\mu\text{mol/l}$. Hemos considerado elevadas de forma empírica (por relacionarse con una mayor mortalidad) las concentraciones de homocisteína superiores a 20 $\mu\text{mol/l}$, 83 enfermos (35%), y, de igual modo, disminuidas las concentraciones inferiores a 9 $\mu\text{mol/l}$, 12 enfermos (5%). Las concentraciones bajas de homocisteína (en comparación con el grupo entre 9 y 20 $\mu\text{mol/l}$) se relacionaron con disminución de la albúmina, con aumento del índice de comorbilidad de Charlson, con aumento del SOFA, aumento de la ferritina y mayor pérdida de peso. La elevación de la homocisteína (también en comparación con el grupo entre 9 y 20 $\mu\text{mol/l}$) se relacionó con mayor edad, mayor comorbilidad aumento del índice de comorbilidad de Charlson, y mayor prevalencia de insuficiencia cardíaca y de insuficiencia renal crónica con aumento de la creatinina. En cambio, no encontramos relación con los antecedentes de cardiopatía isquémica, de ACV o de enfermedad vascular periférica.

Durante el ingreso fallecieron 4 (33%) de los 12 enfermos con homocisteína inferior a 9 $\mu\text{mol/l}$, 13 (9%) de los 144 con homocisteína entre 9 y 20 $\mu\text{mol/l}$ y 14 (16.9%) de los 83 con homocisteína mayor de 20 $\mu\text{mol/l}$ ($p=0.023$); el RR de morir de los que tenían la homocisteína por debajo de 9 $\mu\text{mol/l}$ respecto a los que la tenían entre 9 y 20 $\mu\text{mol/l}$ era de 5.0 (1.3-19.0) y el de los que la tenían por encima de 20 $\mu\text{mol/l}$ era de 2.04 (0.91-4.6), en este último caso sin alcanzar la significación estadística.

Los enfermos fueron seguidos durante una media de 733 ± 45 días, y tuvieron una mediana de supervivencia de 615 días. Cuando comparamos el pronóstico a largo plazo de los enfermos que tenían una homocisteína entre 9 y 20 $\mu\text{mol/l}$ con la de los que la tenían superior a 20 $\mu\text{mol/l}$, encontramos una peor supervivencia en el grupo de enfermos con homocisteína superior a 20 $\mu\text{mol/l}$ ($p=0.002$), con un riesgo relativo 1.92 (1.25-2.95). Pese a que la B12 y la homocisteína correlacionaban de forma inversa, los enfermos con B12 mayor de 600 (lo que correspondería a una homocisteína más baja) tenían una peor supervivencia a largo plazo RR 1.62 (1.05-2.5).

El valor pronóstico a largo plazo de la homocisteína elevada se relaciona con la enfermedad vascular (Tabla III, Fig. 1). Los enfermos con antecedentes de infarto de miocardio, ACV o arteriopatía periférica tenían peor supervivencia cuando también tenían elevadas las concentraciones de homocisteína. Lo mismo ocurría con los que tenían un ITB menor de 0.65, historia de HTA, dislipemia o un IPA mayor de 20. En cambio, era en los enfermos no obesos (IMC menor de 30 kg/m^2) en los que el aumento de la homocisteína se relacionaba con un aumento de la mortalidad.

Mediante análisis de regresión de Cox estudiamos que variables tenían valor predictivo independiente, encontrando que la homocisteína $> 20 \mu\text{mol/l}$, el ITB < 0.65 , la albúmina $< 3 \text{ g/dl}$, el SOFA > 3 y la edad mayor

Tabla III
Valor pronóstico de la homocisteína en relación con la existencia de antecedentes de enfermedad vascular y factores de riesgo vascular

	Homocisteína >20 vs Homocisteína 9-20		
	Log Rank	p	RR
Todos los casos	9.33	0.002	1.93 (1.25-2.95)
No enfermedad arterial	0.32	0.572	1.19 (0.65-2.19)
Sí enfermedad arterial (CI, ACV, EVP)	15.5	<0.001	3.34 (1.77-6.30)
No cardiopatía isquémica	4.89	0.027	1.71 (1.06-2.77)
Sí cardiopatía isquémica	6.30	0.012	3.37 (1.23-9.20)
No ACV	5.11	0.024	1.71 (1.07-2.73)
Sí ACV	4.72	0.030	3.05 (1.06-8.80)
No enfermedad vascular periférica	3.71	0.054	1.62 (0.97-2.66)
Sí enfermedad vascular periférica	8.56	0.003	3.42 (1.43-8.19)
No HTA	2.79	0.095	1.50 (0.93-2.43)
Sí HTA	11.8	0.001	5.80 (1.86-18.0)
No diabetes	5.52	0.019	1.99 (1.11-3.57)
Sí diabetes	4.17	0.041	1.90 (1.02-3.57)
No dislipemia	2.41	0.121	1.57 (0.88-2.77)
Sí dislipemia	8.15	0.004	2.52 (1.31-4.87)
No tabaco (IPA ≤20)	3.11	0.078	1.62 (0.94-2.80)
Sí tabaco (IPA >20)	7.22	0.007	2.57 (1.26-5.26)
No Obesidad IMC <30	8.14	0.004	2.09 (1.25-3.52)
Sí Obesidad IMC ≥30	1.65	0.199	1.85 (0.71-4.82)
ITB ≥ 0.65	4.96	0.026	1.74 (1.06-2.84)
ITB <0.65	7.03	0.008	3.86 (1.32-11.3)

CI: Cardiopatía Isquémica. EVP: Enfermedad Vascular Periférica. ACV: Accidente Cerebro Vascular. IPA: Índice Paquetes Año.
ITB: Índice Tobillo Brazo.

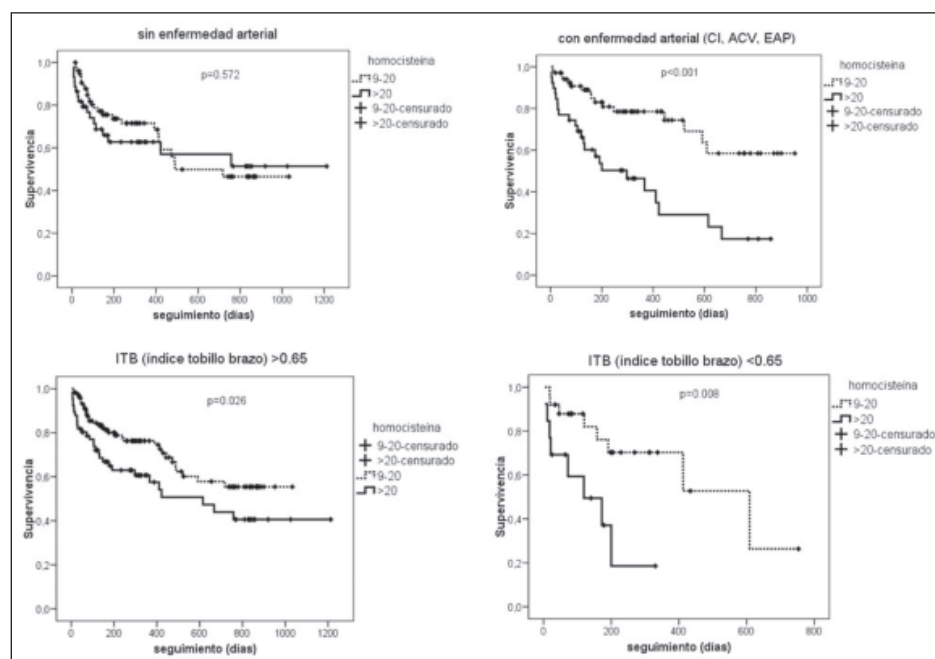


Fig. 1.—Los enfermos con antecedentes de enfermedad cardiovascular (cardiopatía isquémica (CI), accidente cerebrovascular isquémico (ACV) o enfermedad arterial periférica (EAP)) tienen mayor riesgo de mortalidad si tienen elevada la homocisteína. También tienen mayor riesgo de mortalidad los que tienen disminución del índice tobillo brazo (ITB) y aumento de la homocisteína.

Tabla IV
Análisis multivariante: variables con valor predictivo independiente a largo plazo

Variables con valor predictivo independiente	Supervivencia a largo plazo (Regresión de Cox con covariantes)		
	Wald	p	RR (IC 95%)
Homocisteína > 20 (vs 9-20)	6.28	0.012	1.80 (1.14-2.84)
Índice Tobillo Brazo <0.65	4.31	0.038	1.90 (1.04-3.47)
Albúmina <3 g/dl	14.1	<0.001	2.45 (1.54-3.92)
SOFA > 3	8.47	0.004	1.22 (1.07-1.39)
Edad > 80 años	5.96	0.015	1.74 (1.12-2.72)

En el análisis se incluyeron las siguientes variables: Homocisteína > 20; Índice Tobillo Brazo <0.65; Albúmina <3 g/dl; Índice de insuficiencia de órganos; SOFA > 3; Índice de comorbilidad de Charlson (sin incluir la edad) > 4; Edad > 80 años e Hipertensión arterial.

de 75 años tenían valor predictivo independiente con el riesgo relativo que figura en la tabla IV.

Discusión

Nuestros resultados muestran una alta prevalencia de aumento de la homocisteína en los enfermos hospitalizados en un servicio de medicina interna. Si consideramos el punto de corte más habitual de 15 $\mu\text{mol/l}$ (1,16), el 73.2% de nuestros enfermos está por encima de dicha cifra. Esta alta prevalencia hay que relacionarla con algunas características de los pacientes ingresados en los servicios de Medicina interna de nuestro país como son la edad avanzada y la pluripatología¹⁷. En este sentido, en nuestros enfermos la homocisteína correlaciona de forma directa con la edad y con la comorbilidad; también con la creatinina y el BUN, además de la conocida relación inversa con la vitamina B12 y el ácido fólico. Otros estudios en pacientes ancianos hospitalizados han demostrado también una alta prevalencia y similares relaciones^{11,16,18}.

Tanto la disminución como el aumento de la homocisteína se han relacionado con una mayor mortalidad. La relación entre la disminución de la homocisteína y el aumento de la mortalidad se describió inicialmente en pacientes en hemodiálisis por insuficiencia renal avanzada. Se atribuyó a un síndrome de desnutrición-inflamación con disminución de la albúmina y pérdida de masa muscular. Como la homocisteína va ligada a la albúmina la disminución de esta explica la disminución de aquella mientras que la desnutrición justifica el peor pronóstico⁶⁻⁷. Sin embargo, fuera de los pacientes en diálisis, esta relación ha sido raramente estudiada. Viña JJ et al (2006) en enfermos ingresados en un servicio de medicina interna general, con una edad media de 77 años, describen un aumento de la mortalidad tanto con cifras bajas (<9.6 $\mu\text{mol/l}$) como elevadas (>14.4 $\mu\text{mol/l}$) de homocisteína sérica¹¹. Las concentraciones bajas de homocisteína se relacionaban con la presencia de sepsis, leucocitosis e hipoalbuminemia, lo que concuerda con la hipótesis de desnutrición e inflamación^{8,9,10}.

En el presente estudio, igualmente en enfermos pluripatológicos y con una edad similar, también encontramos un peor pronóstico con cifras bajas y altas de homocisteína. Los enfermos con una homocisteína de 9 $\mu\text{mol/l}$ o inferior tienen una mortalidad durante el ingreso del 33%. Los enfermos con cifras bajas de homocisteína tienen menores concentraciones de albúmina, mayores de ferritina, y un mayor índice de comorbilidad de Charlson; además, la pérdida de peso es mayor cuanto menor la homocisteína, todo lo cual también apoya la hipótesis de desnutrición e inflamación. No conocemos de otros estudios que hayan encontrado que las concentraciones bajas de homocisteína tengan valor pronóstico, aparte de los pacientes en hemodiálisis⁸⁻¹⁰. Sin embargo, ha de tenerse en cuenta que el número de pacientes con el que se han obtenido estos resultados es pequeño, por lo que han de ser considerados con prudencia.

En cambio, es bien conocida la relación entre concentraciones altas de homocisteína y mortalidad, que se ha atribuido a la enfermedad vascular. Además, en nuestros enfermos ancianos pluripatológicos ambas situaciones son muy frecuentes: el 48% tiene antecedentes de cardiopatía isquémica, de ACV o de enfermedad arterial periférica, y el 73% tienen más de 15 $\mu\text{mol/l}$ y el 34% más de 20 $\mu\text{mol/l}$ de homocisteína con un riesgo relativo de mortalidad de 1.93 (1.25-2.95), respecto a los que estaban entre 9 y 20 $\mu\text{mol/l}$.

Aunque los enfermos con un ITB por debajo de 0.65 tenían mayor mortalidad a largo plazo, con un riesgo relativo de 1.87 (1.10-3.18), no hemos encontrado diferencias en la mortalidad en relación con la existencia o no de antecedentes de cardiopatía isquémica, de ACV o de enfermedad arterial periférica. Sin embargo, sí que hemos encontrado que la presencia de dicha enfermedad arterial condiciona la relación entre aumento de la homocisteína y mortalidad. Como muestran la tabla III y la figura 1, la relación entre aumento de la homocisteína y mortalidad es más estrecha en los enfermos con antecedentes de enfermedad vascular y en aquellos con un ITB < 0.65. También con algunos factores de riesgo vascular como HTA,

hiperlipidemia y tabaco. Diversos estudios realizados en los últimos diez años demuestran como la existencia de enfermedad vascular previa condiciona el valor pronóstico de la homocisteína. Así, los enfermos con un ACV isquémico y homocisteína elevada tienen mayores tasas de recurrencia y peor pronóstico^{19,20}, especialmente si existe hipertensión arterial²¹. El aumento de la homocisteína en pacientes con enfermedad arterial periférica se asocia con la aparición posterior de problemas coronarios e ictus²². Así mismo, en enfermos con un ITB disminuido el aumento de la homocisteína se asocia con un aumento de mortalidad cardiovascular²³. En pacientes con enfermedad coronaria, el aumento de la homocisteína es un factor independiente de mal pronóstico junto a la edad y la hipertensión^{24,25,26}. Finalmente, los enfermos con insuficiencia cardiaca fallecen antes cuando tienen elevada la homocisteína²⁷.

En nuestro estudio encontramos que el aumento de la homocisteína es un factor pronóstico de mortalidad independiente de la edad, de la disminución del ITB, de la albúmina y de la disfunción de órganos. Ahora bien, el que el aumento de la homocisteína tenga valor pronóstico quiere decir que es un indicador y no que sea el responsable del mal pronóstico. La mayoría de los estudios controlados y revisiones sistemáticas, realizados en estos enfermos, no han demostrado que, una vez establecida la enfermedad vascular, el disminuir la concentración de homocisteína mejore la supervivencia²⁸⁻³⁰.

Como conclusión, en pacientes ancianos pluripatológicos con frecuentes antecedentes de enfermedad vascular, tanto la disminución como el aumento de la homocisteína se asocian con una mayor mortalidad.

Referencias

- Malinow MR, Bostom AG, Krauss RM. Homocysteine, diet, and cardiovascular diseases: a statement for healthcare professionals from the Nutrition Committee, American Heart Association. *Circulation* 1999;99:178-82.
- Bautista LE, Arenas IA, Peñuela A, Martínez LX. Total plasma homocysteine level and risk of cardiovascular disease: a meta-analysis of prospective cohort studies. *J Clin Epidemiol* 2002;55:882-7.
- Bostom AG, Rosenberg IH, Silbershatz H, Jacques PF, Selhub J, D'Agostino RB et al. Nonfasting plasma total homocysteine levels and all-cause and cardiovascular disease mortality in elderly Framingham men and women. *Arch Intern Med* 1999;159:1077-80.
- Vollset SE, Refsum H, Tverdal A, Nygård O, Nordrehaug JE, Tell GS, et al. Plasma total homocysteine and cardiovascular and noncardiovascular mortality: the Hordaland Homocysteine Study. *Am J Clin Nutr* 2001;74:130-6.
- Sirrs S, Duncan L, Djurdjev O, Nussbaumer G, Ganz G, Frohlich J et al. Homocyst(e)ine and vascular access complications in haemodialysis patients: insights into a complex metabolic relationship. *Nephrol Dial Transplant* 1999;14:738-43.
- Suliman ME, Stenvinkel P, Qureshi AR, Bárány P, Heimbürger O, Anderstam B, et al. Hyperhomocysteinemia in relation to plasma free amino acids, biomarkers of inflammation and mortality in patients with chronic kidney disease starting dialysis therapy. *Am J Kidney Dis* 2004;44:455-65.
- Sengupta S, Wehbe C, Majors AK, Ketterer ME, DiBello PM, Jacobsen DW. Relative roles of albumin and ceruloplasmin in the formation of homocystine, homocysteine-cystine-mixed disulfide, and cystine in circulation. *J Biol Chem* 2001;276:46896-904.
- Akgül A, Bilgic A, Sezer S, Arat Z, Ozdemir FN, Haberal M. Low total plasma homocysteine level in relation to malnutrition, inflammation, and outcome in hemodialysis patients. *J Ren Nutr* 2008;18:338-46.
- Kalantar-Zadeh K, Block G, Humphreys MH, McAllister CJ, Kopple JD. A low, rather than a high, total plasma homocysteine is an indicator of poor outcome in hemodialysis patients. *J Am Soc Nephrol* 2004;15:442-53.
- Ducloux D, Klein A, Kazory A, Devillard N, Chalopin JM. Impact of malnutrition-inflammation on the association between homocysteine and mortality. *Kidney Int* 2006;69:331-5.
- Viña-Rodríguez JJ, Santolaria F, Martínez-Riera A, González-Reimers E, de la Vega Prieto MJ, Aleman-Valls MR et al. Clinical significance of homocysteine in elderly hospitalized patients. *Metabolism* 2006;55:620-7.
- Charlson M.E., Pompei P., Ales K.L., MacKenzie C.R. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*, 1987;40:373-38.
- González-Hermoso F, Porta R, Herrero A. Resultados del estudio antropométrico de la población canaria adulta. *Nutr Hosp* 1990;5:238-247.
- Vincent JL, Moreno R, Takala J, Willatts S, De Mendonça A, Bruining H, et al. The SOFA (sepsis-related organ failure assessment) score to describe organ dysfunction/failure. *Intensive Care Med* 1996;22:707-10.
- Ghannam M, Rodríguez Y, Ehrmann D, Grossman PM. Ankle-brachial index as a clinical tool. *Am J Med* 2012;125, 1171-1172.
- Ventura P, Panini R, Verlato C, Scarpetta G, Salvioli G. Hyperhomocysteinemia and related factors in 600 hospitalized elderly subjects. *Metabolism* 2001;50:1466-71.
- Zambrana García JL, Velasco Malagón MJ, Díez García F, Cruz Caparrós G, Martín Escalante MD, Adarraga Cansino MD. Características clínicas diferenciales de los enfermos pluripatológicos hospitalizados en servicios de Medicina Interna. *Rev Clin Esp* 2005;205:413-7.
- Marengoni A, Cossi S, De Martinis M, Calabrese PA, Orini S, Grassi V. Homocysteine and disability in hospitalized geriatric patients. *Metabolism* 2004;53:1016-20.
- Wu XQ, Ding J, Ge AY, Liu FF, Wang X, Fan W. Acute phase homocysteine related to severity and outcome of atherothrombotic stroke. *Eur J Intern Med* 2013;24:362-7.
- Boysen G, Brander T, Christensen H, Gideon R, Truelsen T. Homocysteine and risk of recurrent stroke. *Stroke* 2003;34:1258-61.
- Zhong C, Lv L, Liu C, Zhao L, Zhou M, Sun W et al. High homocysteine and blood pressure related to poor outcome of acute ischemia stroke in chinese population. *PLoS One* 2014;9(9):e107498. doi:10.1371/journal.pone.0107498
- Kumakura H, Fujita K, Kanai H, Araki Y, Hojo Y, Kasama S et al. High-sensitivity C-reactive Protein, Lipoprotein(a) and Homocysteine are Risk Factors for Coronary Artery Disease in Japanese Patients with Peripheral Arterial Disease. *J Atheroscler Thromb*. 2014 doi.org/10.5551/jat.25478
- Lange S, Trampisch HJ, Haberl R, Darius H, Pittrow D, Schuster A et al. Excess 1-year cardiovascular risk in elderly primary care patients with a low ankle-brachial index (ABI) and high homocysteine level. *Atherosclerosis* 2005;178:351-7.
- Ma Y, Li L, Shang XM, Tan Z, Geng XB, Zhao BQ et al. Analysis of factors related to short-term prognosis in patients undergoing percutaneous coronary intervention for acute myocardial infarction. *Exp Ther Med* 2013;5:1206-1210.
- Schaffer A, Verdoia M, Cassetti E, Marino P, Suryapranata H, De Luca G; Novara Atherosclerosis Study Group (NAS). Relationship between homocysteine and coronary artery disease. Results from a large prospective cohort study. *Thromb Res* 2014;134:288-93.
- Haim M, Tanne D, Goldbourt U, Doolman R, Boyko V, Brunner D et al. Serum homocysteine and long-term risk of myocar-

- dial infarction and sudden death in patients with coronary heart disease. *Cardiology*. 2007;107:52-6.
27. Gibelin P, Serre S, Candito M, Houcher B, Berthier F, Baudouy M. Prognostic value of homocysteinemia in patients with congestive heart failure. *Clin Chem Lab Med*. 2006;44:813-6.
 28. Lonn E, Yusuf S, Arnold MJ, Sheridan P, Pogue J, Micks M et al. Homocysteine lowering with folic acid and B vitamins in vascular disease. *N Engl J Med*. 2006;354:1567-77.
 29. Bønaa KH, Njølstad I, Ueland PM, Schirmer H, Tverdal A, Steigen T et al. Homocysteine lowering and cardiovascular events after acute myocardial infarction. *N Engl J Med*. 2006;354:1578-88.
 30. Clarke R, Halsey J, Lewington S, Lonn E, Armitage J, Manson JE et al. Effects of lowering homocysteine levels with B vitamins on cardiovascular disease, cancer, and cause-specific mortality: Meta-analysis of 8 randomized trials involving 37 485 individuals. *Arch Intern Med*. 2010;170:1622-31.



Original/Cáncer

Food intake and nutritional status influence outcomes in hospitalized hematology-oncology patients

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Abstract

Background: malnutrition in oncology and hematology-oncology patients is important due to its prevalence and associated mortality and morbidity. The aims of the study were to assess the prevalence of malnutrition in oncology and hematology patients and determine if intake or malnutrition influences hospitalization outcomes.

Methodology: a cohort study was performed in all patients admitted to the oncology and hematology wards in a 30-day period. Nutritional assessment was performed within 24-hours of admission and repeated after 7 days of hospitalization, including Subjective Global Assessment, anthropometry, dietary assessment (24-hour recall) and estimation of caloric and protein needs. Medical records were reviewed 30 days after discharge.

Results: seventy-three patients were evaluated on admission and 29 on day 7 of hospitalization. The prevalence of malnutrition was 47.7%. On admission, patients consumed 71.6 (SD 22.0)% of the prescribed dietary calories and 68.2 (SD 23.5)% of prescribed proteins. The death rate was 2.8% among patients who ate $\geq 75\%$ and 17.9% among those who ate $< 75\%$ ($p = 0.040$). No significant differences were observed between the intake of calories ($p = 0.124$) and protein ($p = 0.126$) on admission and on day 7 of hospitalization. Nutritional status was related to readmission rate, being 35.1% for malnourished vs. 8% for well-nourished ($p = 0.014$). Nutritional status and food intake were not related to the rest of the studied outcomes (length of stay and mechanical, metabolic or infectious complications).

Conclusions: intake did not decrease during hospitalization. There was an upward trend between reduced intake and mortality. Malnutrition was related to hospital readmission.

(Nutr Hosp. 2015;31:2598-2605)

DOI:10.3305/nh.2015.31.6.8674

Key words: Malnutrition. Nutritional assessment. Energy intake. Medical oncology.

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Recibido: 15-I-2015.
Aceptado: 16-II-2015.

INFLUENCIA DE LA INGESTA Y EL ESTADO NUTRICIONAL EN LAS COMPLICACIONES DE LOS PACIENTES ONCOHEMATOLÓGICOS HOSPITALIZADOS

Resumen

Introducción: la malnutrición en el paciente oncohematológico es importante debido a su prevalencia y a su morbimortalidad asociadas. El objetivo de este estudio fue analizar la prevalencia de malnutrición en el paciente oncohematológico y determinar si la ingesta o la malnutrición afectan a las complicaciones del paciente hospitalizado.

Metodología: estudio de corte realizado en todos los pacientes admitidos en las plantas de oncología y hematología durante un periodo de 30 días. La valoración nutricional se realizó durante las 24 primeras horas tras el ingreso y se repitió a los 7 días de hospitalización, incluyendo Valoración Subjetiva Global, antropometría, recuerdo de 24 horas y estimación de las necesidades calóricas y proteicas. Las historias médicas fueron revisadas a los 30 días tras el alta.

Resultados: setenta y tres pacientes fueron evaluados al ingreso y 29 a los siete días de su hospitalización. La prevalencia de malnutrición fue 47,7%. Al ingreso, los pacientes consumieron 71,6 (DE 22,0)% de las calorías prescritas y 68,2 (DE 22,0)% de las proteínas prescritas. La tasa de fallecimientos fue 2,8% entre los pacientes que consumieron $\geq 75\%$ y 17,9% entre aquellos que consumieron $< 75\%$ ($p = 0.040$). No se observaron diferencias significativas entre la ingesta calórica ($p = 0.124$) y proteica ($p = 0.126$) en el ingreso y a los 7 días de hospitalización. El estado nutricional estaba relacionado con la tasa de reingreso, siendo 35,1% en malnutridos vs. 8% en pacientes sin desnutrición ($p = 0.014$). El estado nutricional y la ingesta no se relacionaron con el resto de las complicaciones estudiadas (duración de hospitalización y complicaciones metabólicas, mecánicas o infecciosas).

Conclusión: la ingesta no aumentó durante la hospitalización. Hubo una tendencia ascendente entre una ingesta reducida y la mortalidad. La malnutrición se relacionó con los reingresos.

(Nutr Hosp. 2015;31:2598-2605)

DOI:10.3305/nh.2015.31.6.8674

Palabras clave: Malnutrición. Valoración nutricional. Ingesta. Oncología médica.

Abbreviations

APMT: Adductor Pollicis Muscle Thickness.
HGS: Handgrip Strength.
LBM: Lean Body Mass.
LMI: Lean Mass Index.
MM: Muscle Mass.
SGA: Subjective Global Assessment.
SGA-PG: Subjective Global Assessment – Patient Generated.

Background

Malnutrition in cancer can be defined as the set of deficits induced by tumor disease in different body compartments¹. Oncological and oncohematological diseases are highly prevalent and influence quality of life, morbidity and mortality². In Spain, cancer accounted for nearly 30% of all deaths in 2011³.

Between 15 and 40% of oncological and oncohematological patients present with malnutrition at the time of diagnosis. This situation may be aggravated with progression of the disease, increasing the number of malnourished patients to 80% in advanced stages⁴. Nutritional status can vary depending on the tumor type, location and stage of disease⁵. The worsening of nutritional status can be multifactorial, due to the tumor itself or its treatment: anorexia, metabolic alterations, malabsorption, obstruction, diarrhea, vomiting, fatigue, depression, anxiety and pain⁶.

Decreased food intake is one of the most common problems in cancer patients. This situation might arise due to different factors such as taste alterations, anorexia, vomiting and tumor location⁷. This decreased intake directly affects nutritional status⁸.

The consequences of malnutrition can lead to complications, reduced tolerance to treatment, prolonged hospital stay, higher economic cost and higher mortality and morbidity. An early diagnosis is essential to initiate an adequate nutritional regimen, improving the patient's evolution. Nutritional screening tools have been developed to identify those patients who are malnourished or at risk of suffering from it. Performing an early nutritional assessment allows classification of cancer patients according to their level of malnutrition and identifying adverse clinical situations that affect intake (vomiting, anorexia, nausea, etc.)⁷. Implementing screening and nutritional assessment allows malnourished patients to be recognized and protocols to be established to achieve a good nutritional status, increase weight, improve neoplastic treatment response, reduce the occurrence of complications and shorten the length of stay⁹.

The objective of the study was to determine the prevalence of malnutrition in patients admitted to the oncology and hematology wards, assess their intake and causes that lead to non-consumption of the prescribed diet, and determine the morbidity and mortality

associated with dietary intake and malnutrition during hospitalization.

Methodology

A cohort study performed in the University Hospital of León during March and April 2011. Every adult patient (older than 18 years) admitted to the Oncology and Hematology wards was included, excluding those admitted to isolation rooms.

Nutritional assessment was performed within 24 hours of admission, and patients who remained hospitalized more than a week were reassessed using the same methodology on day 7 of hospitalization.

The nutritional assessment included Subjective Global Assessment (SGA)¹⁰. All patients were weighed standing, wearing light clothes (hospital pajamas) and barefoot on a digital scale OMRON TBF 500® (Tanita Corp., Kyoto, Japan). Percentages of muscle mass (%MM) and lean body mass (%LBM) were also obtained. Lean mass index was calculated (LMI) [Lean mass (kg)/height (m)²]. Height was estimated using ulna length [methodology validated by British Association for Parenteral and Enteral Nutrition (BAPEN)]¹¹. A handgrip strength (HGS) test was carried out with a Smedley's Dynamo Meter® in the non-dominant arm and the maximum value of three measurements performed consecutively was taken. Also, the adductor pollicis muscle thickness (APMT) in the hand was measured in both the dominant and non-dominant hand by a Holtain 98610 ND® mechanical caliper, taking the maximum value of three measurements performed consecutively.

The Harris-Benedict formula was used to calculate energy and protein needs, including a mild (1.1) or moderate (1.2) stress factor. Patient protein requirements were calculated by multiplying their actual weight by a factor of 1.2 g/kg/day.

According to our center's experience and the study by Barton et al, complete energy diets were considered those above 2100 kcal (normal, admission, complete diabetic, low-fat), moderately hypocaloric diets those between 1700 and 2100 kcal (mildly hypocaloric diabetic, easily digestible, astringent, liver protection) and hypocaloric diets those with less than 1700 kcal (crushed, low-fat soft, diabetic-soft, liquid)¹².

The 24-hour intake was assessed through a self-administered visual scale. The 24-hour intake recalls were divided into the number of items on the hospital menu (first course, second course and dessert for lunch and dinner, breakfast and snack). The amount ingested was recorded depending on whether they had eaten the entire menu, more than half or less than half (along the scale used in NutritionDay)^{12,13}. In those patients who refused food, reasons for non-consumption (anorexia, taste, texture or other reasons) were requested. The 24-hour recalls were subsequently analyzed nutritionally

with Dietsource 3.0® software (Novartis Medical Nutrition SA, 1997-2003).

At 30 days of admission, patients' medical records were reviewed to assess the length of hospital stay, death rate, readmission rates and the presence of complications during admission: mechanical (e.g. paralytic ileus, intestinal obstruction), infectious (e.g. pneumonia, diarrhea) and metabolic (e.g. hyperglycemia, ionic imbalances).

The normal distribution of quantitative variables was examined by the Kolmogorov-Smirnov test. Those with normal distribution were summarized as the mean and standard deviation (SD), and compared by Student t test (for independent samples or dependent, as appropriate); when more than 2 groups were compared an ANOVA test was used. Categorical variables were summarized with percentages and compared with the χ^2 test. A *p* value less than 0.05 was considered significant.

Results

Seventy-three patients were evaluated, 53 in Oncology and 20 in the Hematology wards. Of these, 61.6% were male and the mean age was 65.3 (SD 11.7) years. Twenty-five percent had a gastrointestinal tumor, 20% lung, 17%, lymphoma, 9% gynecological, 7% breast, 6% head and neck, 6% myeloma and the remaining 11% had other types of tumors. The primary reasons for admission were complications related to treatment (84%), followed by receiving chemotherapy (14%) and staging of the disease (2%).

At day 7 of hospitalization, 29 patients from the initial 73 studied were still admitted (31.51%), 15.1% had died during hospitalization and 45.2% had been discharged.

Nutritional status

On admission, 37.3% of the patients exhibited risk of malnutrition or mild malnutrition (category B according to SGA) and 23.2% had severe malnutrition (category C). After 7 days of hospitalization, SGA results showed that 45.5% of patients were at risk of malnutrition or had mild malnutrition (category B), while 36.4% were severely malnourished. There were no differences in the prevalence of malnutrition between the two time points (*p*=0.725).

On admission, weight loss was 5.6 (SD 9.5) % [4.2 (SD 7.3) Kg] and 35% of patients showed hypoalbuminemia. The results of both nutritional assessments, on admission and after 7 days, are summarized in Table I.

Food Intake, consumption and requirements

The prescribed diets on admission were: complete (41.0%), hypocaloric (41.0%), potentially hypocaloric (11.0%) and "nil per os" (NPO) (7.0%). No differences between prescribed diets on admission and on the 7th day of hospitalization were found. The prescribed diets covered 93.0 (SD 56.7) % of the energy requirements and 99.8 (SD 51.2) % of the protein requirements. On

Table I
Anthropometric, biochemical and functional data on admission, on the 7th day and the difference between the two results

	Admission (SD) (69 patients)	7th day (SD) (24 patients)	Dif (SD) (24 patients)	<i>P</i>
Weight (kg)	68.44 (12.72)	69.29 (12.70)	↓0.48 (2.70)	0.373
Lean mass (kg)	26.13 (11.98)	33.07 (5.00)	↓1.30 (2.24)	0.100
Fat (kg)	32.78 (6.29)	24.58 (9.26)	↑2.27 (3.54)	0.073
Dynamometry (kg)	21.97 (9.38)	22.02 (9.48)	↓2.06 (4.84)	0.044
Adductor thumb thickness dominant hand (mm)	17.73 (3.36)	15.95 (2.52)	↑1.26 (2.82)	0.034
Adductor thumb thickness non-dominant hand (mm)	15.85 (3.50)	14.18 (2.66)	↑0.972 (1.88)	0.016
Protein (g/l)	6.11 (0.82)	5.81 (0.84)	↑0.27 (0.87)	0.172
Albumin (g/dl)	3.64 (0.61)	3.62 (0.56)	↓0.75 (0.39)	0.502
Cholesterol (mg/dl)	173.65 (56.60)	252.00 (90.51)	↓75.50 (4.95)	0.029
Lymphocyte (mm ³)	965.36 (315.48)	1213.04 (716.88)	↓300 (674.87)	0.044
Total metabolic rate (Kcal)	1697.21 (272.89)	1723.05 (326.89)	↓7.59 (81.71)	0.724
Protein needs (g)	81.73 (17.74)	82.33 (18.14)	↑0.13 (4.81)	0.914

the 7th day, the prescribed diets covered 93.6 (SD 6.03) % of the energy needs and 89.6 (SD 51.4) % of protein needs. No significant differences in the coverage of energy needs ($p=0.976$) or protein needs ($p=1.000$) by the prescribed diets were found between admission and day 7.

The results of the 24 h-recall analyses, both at admission and after 7 days of hospitalization, are listed in table II. Overall, there was low intake in patients who were hospitalized more than 7 days. On admission, breakfast (65.6%) and snack (78.2%) were the meals with the best acceptance; also, desserts at lunch (75.9%) and dinner (76.0%). Table III shows a complete consumption analysis of dishes in the hospital diet.

The semiquantitative analysis (everything, > 50%, < 50%) of the 24-hour recall on the 7th day showed a decreasing trend in food intake, which was statistically significant for breakfast ($p=0.003$), snack ($p=0.050$), first course at dinner ($p=0.024$) and dinner dessert ($p=0.003$) (Table II). The reasons for non-consumption on admission and after 7 days of hospitalization are listed in table IV. No differences in the causes of non-consumption were detected in any of the meals: breakfast ($p=0.513$), first course at lunch ($p=0.135$), second course at lunch ($p=0.500$), first course at dinner ($p=0.667$) or second course at dinner ($p=0.323$).

On admission, patients consumed 71.6% (SD 22.0) of the prescribed calories and 68.2% (SD 23.5) of prescribed proteins. At 7 days, the energy consumption was 73.9% (SD 26.3) and protein consumption was 70.5% (SD 28.8). No significant differences were observed between the consumption of calories ($p=0.124$) and protein ($p=0.126$) on admission and on the 7th day of hospitalization. Comparing energy and protein needs with caloric and protein intake, no statistical differences were observed either in calories consumed ($p=0.566$) or in protein consumption ($p=0.742$). With the prescribed diets, the energy and protein contributions compared to the patient's needs on admission and at 7 days are listed in table V.

Only 59.1% of patients received a diet that covered their energy requirements and just 67.2% received

their full protein needs. Just 14.3% of patients consumed 100% of the received food, 71.4% consumed 50–99% of the received food and 14.3% ingested 0–49%.

The energy and protein contribution of the intake toward covering the patient's nutritional needs were 100% of the energy for 28.1% of the patients and 25.0% for protein; 99–50% of the energy for 43.8% of the patients and 39.1% for protein; and 0–49% of the energy for 28.1% of the patients and 25.9% for protein.

For a second assessment, the menu consumption on admission was grouped as $\geq 75\%$ (meaning they did not need nutritional intervention) and $< 75\%$ (patients requiring nutritional intervention). It was observed that 56.3% of patients who consumed $\geq 75\%$ of the menu covered their energy requirements and 45.3% covered their protein requirements. No statistically significant differences were found between being well-nourished or malnourished and having a reduced intake ($p=0.311$).

Complications, length of hospital stay, readmission and death

Of the 73 patients evaluated on admission, 29 remained hospitalized after 7 days. Readmission rates were higher among those patients with malnutrition (31%) compared to those who were well nourished (8%) ($p=0.014$) [OR 6.23 (CI 95% 1.26 – 30.69)]. No statistically significant differences were observed between nutritional status and readmission on the 7th day of hospitalization or on admission ($p=0.522$). Reduced intake was not related to the patient's readmission rate ($p=0.887$) [OR 0.92 (CI 95% 0.30 – 2.87)]

During hospitalization, 7.4% of patients with a good nutritional status and 12.1% of malnourished patients died ($p=0.525$) [OR 1.74 (CI 95% 0.31 – 9.67)]. Reduced intake was related to patient death. The death rate was 2.8% for patients that ate $\geq 75\%$ and 17.9% for those who ate $< 75\%$ ($p=0.040$) [OR 7.60 (CI 95% 0.83 – 69.40)].

The difference in length of hospital stay was not statistically significant [malnourished patients [8.6 (SD 6.7) days] vs. well-nourished [7.7 (SD 7.2) days] ($p=0.604$). There was an upward trend between decreased intake and length of hospital stay. Those who consumed 100% were in hospital for 5.7 (SD 3.3) days, 99–50% for 8.6 (SD 7.0) days and those who consumed 0–49% for 10.5 (SD 8.1) days ($p=0.091$). Hospital stay was slightly higher in patients who consumed $< 75\%$ of the diet [7.0 (SD 3.7)] versus those who consumed $\geq 75\%$ [10.0 (SD 9.04)], although it did not reach statistical significance ($p=0.070$).

Similar rates of complications were found between well-nourished and malnourished patients [metabolic ($p=0.678$) [OR 1.67 (CI 95% 0.15 – 18.87)], infectious ($p=0.795$) [OR 1.39 (CI 95% 0.12 – 16.23)], mechanical ($p=0.865$) [OR 0.80 (CI 95% 0.06 – 10.56)] complications] or considering food intake (consuming more

Table II
Hospital menu intake on admission

	All	$\geq 50\%$	$< 50\%$
Breakfast	65.6%	31.1%	3.3%
Lunch	42.2%	40.6%	17.0%
1 st course	34.0%	41.5%	24.5%
2 nd course	75.9%	5.6%	18.5%
Dessert			
Snack	78.2%	18.2%	3.6%
Dinner			
1 st course	66.1%	21.4%	12.5%
2 nd course	27.5%	31.3%	41.2%
Dessert	76.0%	6.0%	18.0%

Table III
Comparison between intake on admission and on the 7th day

	<i>Admission</i>	<i>7th day</i>	
	Breakfast		p
Nothing	5.3%	5.3%	
Almost nothing	-	-	
Half	15.8%	10.5%	0.003
Almost all	5.3%	15.8%	
All	73.6%	68.4%	
	Lunch - 1st course		p
Nothing	0%	10.5%	
Almost nothing	15.8%	5.3%	
Half	26.3%	10.5%	0.596
Almost all	21.0%	10.5%	
All	47.4%	52.6%	
	Lunch - 2nd course		p
Nothing	6.6%	13.3%	
Almost nothing	13.3%	0.0%	
Half	33.3%	20.0%	0.212
Almost all	20%	13.3%	
All	26.6%	53.3%	
	Lunch - Dessert		p
Nothing	23.5%	23.5%	
Almost nothing	-	-	
Half	5.9%	-	0.168
Almost all	-	-	
All	70.6%	76.5%	
	Snack		p
Nothing	-	6.3%	
Almost nothing	-	6.3%	
Half	6.6%	18.8%	0.050
Almost all	6.6%	6.3%	
All	86.6%	62.5%	
	Dinner – 1st course		p
Nothing	11.1%	11.1%	
Almost nothing	5.5%	5.6%	
Half	5.5%	5.6%	0.024
Almost all	11.1%	16.7%	
All	66.6%	61.1%	
	Dinner – 2nd course		p
Nothing	14.2%	7.1%	
Almost nothing	14.2%	7.1%	
Half	21.4%	21.4%	0.099
Almost all	14.2%	21.4%	
All	35.7%	42.9%	
	Dinner - Dessert		p
Nothing	6.2%	18.8%	
Almost nothing	-	-	
Half	-	6.3%	0.003
Almost all	6.2%	-	
All	87.5%	75%	

Table IV <i>Reasons for non-consumption of hospital food</i>				
	<i>Anorexia</i>	<i>Flavor</i>	<i>Texture</i>	<i>Others</i>
Breakfast	78.9%	10.5%	0.0%	10.5%
Lunch	69.7%	18.2%	0.0%	12.1%
1 st course	74.2%	3.2%	9.7%	12.9%
2 nd course	30.8%	7.7%	0.0%	61.5%
Dessert				
Snack	63.6%	9.1%	0.0%	27.3%
Dinner	52.6%	31.6%	5.3%	10.5%
1 st course	64.9%	18.9%	2.7%	13.5%
2 nd course	58.3%	16.7%	0.0%	25.0%
Dessert				

Table V <i>Energy and protein in both prescribed diets and patient intake</i>				
	<i>Admission (69 patients)</i>	<i>7th day (24 patients)</i>	<i>Difference (24 patients)</i>	<i>p</i>
Prescribed energy (kcal)	2014.8 (SD 2624.4)	1605.1 (SD 855.0)	↑ 61.9 (SD 931.2)	0.748
Prescribed protein (g)	77.8 (SD 38.4)	71.9 (SD 39.8)	↑ 2.6 (SD 41.4)	0.759
Energy intake (kcal)	1216.1 (SD 705.3)	1209.1 (SD 795.7)	↑ 157.4 (SD 582.3)	0.219
Protein intake (g)	51.6 (SD 32.2)	51.8 (SD 36.4)	↑ 61.9 (SD 931.2)	0.748

than 75% or less than 75%) [metabolic ($p=0.782$) [OR 1.33 (CI 95% 0.17 – 10.25)], infectious ($p=0.572$) [OR 1.86 (CI 95% 0.21 – 16.18)], mechanical ($p=0.265$) [OR 4.00 (CI 95% 0.31 – 52.07)] complications].

Discussion

Malnutrition is a major problem in cancer patients due to its prevalence and incidence, especially during hospitalization and at advanced stages of the disease. According to SGA results, on admission 60.5% of patients had some form of malnutrition, which shows the importance of nutritional screening and assessment in cancer patients. In a study by Gómez Candela et al, 129 cancer patients were assessed using SGA-PG resulting in 49% of patients being identified as at risk of malnutrition and 7% with severe malnutrition¹⁴. These results are lower than ours, which could be explained because we evaluated inpatients and Gómez Candela et al studied outpatients. On the contrary, Sotelo González et al assessed 28 oncology inpatients by SGA, obtaining an 82.1% rate of malnutrition, with 57.1% severely malnourished; these values were higher than those obtained in our study¹⁵.

APMT has been described in various studies as a reliable method for nutritional assessment. APMT is fast and inexpensive and correlates well with various anthropometric methods currently used to check nutritional status^{16,17}. The APMT is decreased in both

the dominant and non-dominant hands, which can be caused either by the presence of edema or by inter- and intra-observer variability. Bragagnolo et al studied adductor thickness in 87 surgical patients, obtaining a direct relationship between adductor thickness and patient nutritional status; values obtained in their study are slightly lower than ours¹³. Caporossi et al evaluated 248 critically ill patients admitted, noting that those with severe malnutrition had a lower adductor thickness than those who were well nourished, and associating this with an increased mortality in patients who had abnormal values on the APMT¹⁸.

After a week of hospitalization the overall intake decreased in hospitalized patients, although there were no changes in causes of non-consumption. The hospital where this study took place has a weekly menu, so it could be hypothesized that repetition of dishes (especially breakfast and lunch, which are the same every day) could lead to monotony and rejection of the hospital menu. Ferreira et al conducted a study involving 100 inpatients and evaluated the acceptance of the menu¹⁹. In this case they performed an evaluation between 3 and 6 days of hospitalization in order to avoid monotony. They found that the absence of taste (40%), the monotony of the preparations (33%), poor appetite (26%), very large plates (29%) and improper temperature (24%) were the main causes of rejection in well-nourished patients, while the malnourished referred mainly to

anorexia or dysphagia. In 2010, Agarwal et al conducted a multicenter study in Australia and New Zealand analyzing the acceptance of inpatient hospital diets (including cancer patients)²⁰. In this study it was found that cancer patients ate less than half of the prescribed diet. A study made in Geneva by Thibault et al compared the results of hospital menu intake in 1999 and 2008²¹. The results from 1677 inpatients showed that the main reasons to consider a diet unacceptable were inadequate flavor, time of receipt, inadequate cooking and little variability in the menu. As a result, patients didn't cover their caloric and protein needs.

In Nutrition Day 2006 a relationship between decreased intake and deaths was found⁸. It was observed that 30 days after the survey 634 patients had died, this being related to decreased intake. Of all patients surveyed, 73% gave a reason as to why they rejected the hospital menu; among the causes of non-consumption were anorexia, nausea and inadequate food flavor. The results obtained in Nutrition Day 2006 confirmed the relationship between reduced intake and mortality⁸. In our study was a statistically significant difference between lower intake and higher death rate was observed with χ^2 that could not be confirmed by OR, which could be related to an insufficient sample size. It should also be taken into account that lower intake can be related to the severity of a disease that could not be checked.

Fuchs et al evaluated 117 inpatients in México²². They calculated the energy and protein coverage of the prescribed diets in cancer patients, obtaining approximate consumptions of 1000 Kcal and 42 g of protein, which was 67% of inpatient requirements. Those values are similar to our own data. A similar study was conducted by Barton et al evaluating whether hospital diets and actual intake covered energy and protein needs and also the percentage of food rejected by patients¹². They determined that although hospital diets covered only between 71% and 77% of their needs, taking the minimum recommended by the Health Department in the UK, which is 1800 kcal. Schindler et al observed that 47% of patients studied in 2008 didn't meet their energy and protein needs even though they ate 100% of the hospital diet¹³.

It is interesting to see that those patients who consumed $\geq 75\%$ still did not cover their energy and proteins needs, proving that the diets in our center are not well calibrated and have insufficient energy and above all protein which will have to be solved.

Finally, although it was not significant, an upward trend to a longer hospital stay being related to reduce food intake of the prescribed diet was observed. Fuchs et al in their study in Mexico related the length of hospital stay to malnutrition²². They related severe malnutrition with a reduced intake that did not meet the energy and protein requirements of the patients. As in our results they did not find differences between those

who were malnourished or at risk and patients with a good nutritional status.

Limitations

Possible limitations of this study are related to the sample size, especially after 7 days of hospitalization. In addition, the intake assessment was not performed by a double weighing technique; instead, it was the patient himself who estimated intake visually, lacking proper training that can affect quantitative results between patients. Also, the severity of disease was not known in most patients who were studied, which could also influence intake and nutritional status.

Conclusions

Oncological and hematological patients, as shown in previous studies, have a high rate of malnutrition. Malnourished patients showed a higher rate of readmission but no relationship was observed with other complications, length of stay or death. The food intake did not change after a week of admission except for those meals or dishes repeated every day. Monotony in hospital diets may be one of the main reasons for non-consumption after one week of hospitalization. There was an upward trend between reduced intake and a higher death rate. Hospital menus usually do not cover nutritional needs, even in patients with a high intake; therefore, it is necessary to reevaluate them and plan a specific one for oncohematologic patients.

Statement of human and animal rights

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee, and with the 1964 Helsinki Declaration and its later amendments or with comparable ethical standards.

Informed consent was obtained individually from all participants included in the study.

Acknowledgements

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

We would like to acknowledge the participation of Ms. Cecilia Álvarez del Campo, Ms. María Luisa García García-Bueno, and all the medical and nursing staff of the Hematology and Oncology wards of Complejo Asistencial Universitario de León.

References

1. Belda-Iniesta C, De Castro Carpeño J, Casado Saenz E, González Barón M. Malnutrición y enfermedad neoplásica. Soporte nutricional en la Enfermedad Oncológica, ED. Gomez Candela C and Sastre A. You&Us, Madrid 2004:3.
2. Ottery FD. Cancer cachexia: prevention, early diagnosis and management. *Cancer Pract* 1994;2(2):123-31.
3. Instituto Nacional de Estadística Nota de Prensa Año 2011 <http://www.ine.es/prensa/np767.pdf> (Accessed on 8/21/2013).
4. Nelson KA, Walsh D, Sheehan FA. The cancer anorexia-cachexia syndrome. *J Clin Oncol* 1994; 12:213-225.
5. Tisdale MJ. The "cancer cachectic factor". *Support Care cancer* 2003;11(2):73-8.
6. Capra S, Ferguson M, Ried K. Cancer: impact of nutrition intervention outcome-nutrition issues for patients. *Nutrition* 2001;17(9):769-772.
7. Gómez-Candela C, Luengo LM, Cos AI, Martínez-Roque V, Iglesias C, Zamora P et al. Valoración global subjetiva en el paciente neoplásico. *Nutr Hosp* 2003;18(6):353-357.
8. Hiesmayr M, Schindler K, Pernicka E, Schuh C, Schoeniger-Hekele A, Bauer P et al. Decreased food intake is a risk factor for mortality in hospitalized patients: The NutritionDay survey 2006. *Clin Nutr* 2009;28:484-491.
9. Isabel M, Correia TD, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003;22(3):235-239.
10. Allison SP, Elia M, Vellas B, Plauth M. and Clinical Practice Committee. European Society of Parenteral and Enteral Nutrition (ESPEN). ESPEN Guidelines for Nutrition Screening 2002. *Clin Nutr* 2003; 22: 415-421.
11. British Association for Parenteral and Enteral Nutrition (BAPEN). (2003) http://www.bapen.org.uk/pdfs/must/must_page6.pdf (accessed on 8/21/2013).
12. Barton AD, Beigg CL, Macdonald IA, Allison SP. High food wastage and low nutritional intakes in hospital patients. *Clin Nutr* 2000;19(6):445-449.
13. Schindler K, Pernicka E, Laviano A, Howard P, Schütz T, Bauer P et al. How nutritional risk is assessed and managed in European hospitals: A survey of 21,007 patients findings from the 2007-2008 cross-sectional nutritionDay survey. *Clin Nutr* 2010;29:552-559.
14. Gómez Candela C, Olivar Roldán J, García M, Marin M, Madero R, Perez-Portabella C et al. Utilidad de un método de cribado de malnutrición en pacientes con cáncer *Nutr Hosp* 2010;25(3):400-405.
15. Sotelo González S, Sánchez Sobrino P, Carrasco Álvarez JA, Villarreal P, Páramo Fernández C. Parámetros antropométricos en la evaluación de la malnutrición en pacientes oncológicos hospitalizados; utilidad del índice de masa corporal y del porcentaje de pérdida de peso *Nutr Hosp* 2013;28(3):965-968.
16. Braga Lameu E, Freitas Gerude M, Correa RC, Azevedo Lima K. Adductor Policis Muscle: A new Anthropometric parameter. *Rev Hosp Clin Fac med S. Paulo* 2004;59(2):57-62.
17. Bragagnolo R, Stephan Caporossi F, Borges Dock-Nascimento D, de Aguilar-Nascimento JE, TCBC-MT. Espessura do músculo adutor do polegar: um método rápido e confiável na avaliação nutricional de pacientes cirúrgicos. *Rev Col Bras Cir* 2009;36(5):371-376.
18. Caporossi FS, Caporossi C, Borges Dock-Nascimento D, de Aguilar-Nascimento JE. Measurement of the thickness of the adductor pollicis muscle as a predictor of outcome in critically ill patients. *Nutr Hosp* 2012;27(2):490-495.
19. Ferreira D, Gomes Guimarães T, Marcadenti A. Acceptance of hospital diets and nutritional status among inpatients with cancer. *Einstein* 2013;11(1):41-46.
20. Agarwal E, Ferguson M, Banks M, Bauer J, Capra S, Isenring E. Nutritional status and dietary intake of acute patients: Results from the Nutrition Care Survey 2010. *Clin Nutr* 2012;31:41-47.
21. Thibault R, Chikhi M, Clerc A, Darmon, P, Chopard P, Genton L et al. Assessment of food intake in hospitalized patients: A 10-year comparative study of a prospective hospital survey. *Clin Nutr* 2011;30:289-296.
22. Fuchs V, Mostkoff D, Salmeán GG, Amancio O. Nutritional status in hospitalized patients in a public hospital in Mexico City. *Nutr Hosp* 2008;23(3):294-303.



Original/Deporte y ejercicio

Correlates of objectively measured physical activity in adolescents with Down syndrome: the UP & DOWN Study

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Abstract

Introduction: correlates of physical activity (PA) have not been explored in adolescents with Down syndrome (DS). Understanding correlates of PA could provide information to develop strategies to increase levels of PA in this target population.

Objective: the aim of this study was to identify potential correlates of PA in adolescents with DS.

Method: information about levels of PA and their potential correlates was collected in 98 adolescents with DS (63 males, aged 11-20 years) using accelerometers and proxy-reported questionnaires. Analysis of covariance and multiple linear regression analyses were conducted to examine correlates of PA.

Result: our findings showed that participant's age and socioeconomic status were associated with levels of PA as non-modifiable correlates. Also, parental support, father PA, television-viewing time with siblings and with friends were associated with levels of PA as modifiable correlates.

Discussion and conclusion: both modifiable and non-modifiable factors are associated with levels of PA in adolescents with DS. Therefore, a better understanding of correlates of PA could contribute to develop strategies on PA promotion in adolescents with DS.

(Nutr Hosp. 2015;31:2606-2617)

DOI:10.3305/nh.2015.31.6.8694

Key words: Adolescent. Down syndrome. Correlates. Physical activity.

CORRELATOS DE ACTIVIDAD FÍSICA MEDIDOS OBJETIVAMENTE EN ADOLESCENTES CON SÍNDROME DE DOWN: ESTUDIO UP & DOWN

Resumen

Introducción: los correlatos de actividad física (AF) no han sido estudiados en adolescentes con síndrome de Down (SD). Entendiendo los correlatos de AF se podría aportar información para desarrollar estrategias para incrementar los niveles de AF en esta población diana.

Objetivo: el objetivo de este estudio fue identificar correlatos de AF en adolescentes con SD.

Métodos: la información de los niveles de AF y sus potenciales correlatos fue recogida en 98 adolescentes con SD (63 hombres, con edades comprendidas entre 11-20 años), usando acelerómetros y cuestionarios proxy-reportados. Se utilizó análisis de covarianza y análisis de regresión lineal múltiple para examinar los correlatos de AF.

Resultados: nuestros resultados muestran que la edad y el estatus socioeconómico de los participantes fue asociado con niveles de AF como correlatos no modificables. Además, el apoyo de los padres, la AF del padre y el tiempo dedicado a ver la televisión con hermanos y amigos fueron asociados con niveles de AF como correlatos modificables.

Discusión y conclusión: ambos factores modificables y no modificables se asocian con niveles de AF en adolescentes con SD. Por lo tanto, una mejor comprensión de los correlatos de AF podría contribuir a desarrollar estrategias de promoción de la AF en adolescentes con SD.

(Nutr Hosp. 2015;31:2606-2617)

DOI:10.3305/nh.2015.31.6.8694

Palabras clave: Adolescentes. Síndrome de Down. Correlatos. Actividad física.

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Recibido: 19-I-2015.

Aceptado: 2-III-2015.

Abbreviations

PA: Physical activity.

DS: Down syndrome.

SES: Socioeconomic status.

ICC: Intra-class correlation.

AVENA: Alimentación y Valoración del Estado Nutricional de los adolescentes.

TV: Television.

ALPHA: European research project Assessing LEVEL of Physical Activity.

Introduction

Physical activity (PA) is a lifestyle factor with an important influence on health across the lifespan¹. According to international PA guidelines recommendations, children and adolescents should engage in at least 60 minutes of moderate-to-vigorous PA every day in order to maintain a healthy lifestyle¹. However, recent studies indicated that adolescents with intellectual disabilities are often inactive compared with those adolescents without disabilities².

Down syndrome (DS) is a genetic condition with numerous clinical characteristics (i.e. increased risk in congenital heart disease, muscle hypotonicity, hypermobility of the joints or ligaments laxity)³, which may limit their daily activity including PA⁴. In fact, objectively measured PA in adolescents with DS is often lower than recommendations^{5,6,7}. Therefore, identifying potential factors that could influence levels of PA is a relevant research issues in order to develop specific interventions in this target population.

Currently, researches addressing factors that influence PA distinguishes between correlates and determinants. Correlates research demonstrates a statistical association between factors and PA while determinants research demonstrates strong causal-relationship⁸. Evidences indicate that PA should be understood within an ecological framework since PA can be influenced by multidimensional factors (demographic, behavioural, psychological, environmental and social)^{9,10}. As such, it is relevant consider multiple levels of influence on PA in adolescents with DS.

To date, several studies have focused in correlates of objectively measured PA in adolescents without disabilities⁸, whereas few studies focused on understanding correlates of PA in adolescence with DS¹¹. Majority of studies used qualitative approaches and identified barriers to PA such as the functional independence profiles of youth with DS, lack of accessible and appropriate programs of this population, lack of friends and parents education^{4,12,13}. However, to our knowledge, there are no studies exploring correlates of objectively measured PA in this population.

Therefore, the aim of the current study was to identify correlates of objectively measured PA in a relatively and heterogeneous sample of adolescents with DS.

Methods

Study design and sample

For the present study, baseline data from the UP&DOWN study (Follow UP school children AND in adolescents with DOWN syndrome: psycho-environmental and genetic determinants of PA and its impact on fitness, cardiovascular diseases, inflammatory biomarkers and mental health) were used¹³. For the purposes of this cross-sectional study, we had baseline data of a total of 98 adolescents with DS (63 males and 35 females) aged 11-20 years.

Before starting the study, all parents or legal guardians gave their written informed consent. DS participants in the UP&DOWN study met two specific inclusion criteria for participating: having an intelligence quotient over 35 and not having physical disabilities for doing PA. The relevant institutions provided us with this information according to internal clinical mandatory reports before starting the meetings with parents. The study protocols were approved by the Ethics Committee of the Hospital Puerta de Hierro (Madrid, Spain) and the Bioethics Committee of the National Research Council (Madrid, Spain).

Data collection

This study was conducted from October 2011 to December 2012 in special education schools, associations and foundations of people with intellectual disabilities from the regions of Madrid and Toledo (Spain). At each institution, accelerometers and questionnaires were distributed to the participants and collected by researchers. Adolescents wore the accelerometer attached on their lower back, fitted with an elastic belt and were instructed to take it off during aquatic activities and sleep time. Oral and written instructions and demonstrations on how to use the accelerometer were given to adolescents and parents or guardians.

Questionnaire information was obtained by parent-report due to cognitive limitations of adolescents with DS. The questionnaires analysed in the current study were part of an adapted version of the principal questionnaire of the UP&DOWN study for adolescents without disabilities, which were based on previous studies¹⁴. In addition, some part of this questionnaire where specifically developed to obtain information that could be especially relevant in adolescents with DS. Prior to data collection, questionnaires were piloted in 22 families with adolescents with intellectual disability and DS to assess the rea-

ding and response level was appropriate for parents' proxy-responses, as well as test-retest reliability. Specific information is provided below.

Measurements

Physical activity. Objective assessments of PA were obtained using the ActiGraph accelerometer models GT1M, GT3X and GT3X+ (Actigraph, LLC, Pensacola, FL). Previous studies have demonstrated that there is strong agreement between measures from GT1M, GT3X and GT3X+ activity monitors without needing additional calibration^{15,16}. These accelerometers are valid and reliable tools to measure PA in children and adolescents^{17,18}. Adolescents with DS wore the ActiGraph for at least 8 hours per day during 7 consecutive days, except during water-based activities (i.e., swimming activities). To be included in the analysis, at least 3 days of data with a minimum of 8 hours of registration per day were necessary¹⁹. Non-wear time was considered as sequences of 60 min of zero and these periods were removed from the analysis. Freedson's age-specific cut-point¹⁷ for total PA, moderate PA, and vigorous PA was used to estimate time spent in levels of PA. Moderate-to-vigorous PA was calculated by summing the time spent in moderate PA and vigorous PA (min/day). To calculate PA guidelines recommendations, moderate-to-vigorous PA was recoded as dichotomous variable between compliers and non-compliers (< 60 min/day and $\geq$ 60 min/day). Further information on procedures was presented elsewhere⁵.

Demographics and health factors. Demographic factors included participant's gender, participant's age, parents' age and socio-economic status (SES) assessed by the Family Affluence Scale²⁰. Positive health was assessed by the first item of the KIDSCREEN-10, scored on a 5-point Likert scale²¹. Additionally, height and weight of participants and parents were assessed and body mass index was calculated by standard formula (kg/m^2). In participants, weight was recorded to the nearest 0.1 kg using an electronic scale (model SECA 701) with participants dressed in lightweight clothing and without shoes and height was measured to the nearest 1 mm using a telescopic height-measuring instrument (model SECA 220). To classify participants as normal weight or overweight (including obese) the gender and age-specific cut-offs according to the International Obesity Task Force were used²². Self-reported weight in kilograms and height in meters were used to calculate parents' body mass index and they were also classified as normal weight or overweight (including obese)²³.

Functional profiles factors

Functional independence profile factors were assessed using a specific questionnaire designed by

the research group based on Adaptive Behavior Scale-School assessment²⁴. The scale was composed of 12-items scored on 4-response categories (1=none, 2=little, 3=fairly and 4=a lot) about social, routine and autonomy of participants' skills. The factorial structure designed by the research group was assessed using confirmatory factorial analyses and satisfactory adjustment was observed with the dimensional structure: $\chi^2/\text{gl}=1.64$; GFI=0.89; CFI=0.94; RMSEA=0.79. Furthermore, the dimensional structure showed satisfactory intra-class correlation (ICC) with values between 0.62 and 0.93 (all $p < 0.001$) as well as high internal consistency reliability with values α entre 0.73 and 0.87.

Familial factors

Eleven familial factors were included in this study. Father and mother education were assessed by a specific question extracted from a questionnaire of the AVENA (Alimentación y Valoración del Estado Nutricional de los adolescentes) study²⁵, comprised by 5 response categories from "no studies" to "university studies". Father and mother working status were assessed by 13-items scale from "high-level" to "low-level". Perceived parents' availability to take care of their adolescents was assessed using 1-item with 5-response categories from "having little time" to "having a lot of time". This item showed an ICC value of 0.79 in the test-retest reliability ($p < 0.001$). Parental support of transportation was assessed by composed of 2-items (i.e. parents usually allow the participants to walk alone for the neighbourhood by their own, parents allow the participants to take the public transportation by their own) with 4-response categories based on the Evenson et al.²⁶ study. These items showed an ICC value of 0.81 and 0.90 in the test-retest reliability ($p < 0.001$), respectively. Perceived importance of PA benefits, assessed by 5-items composed of 5-response categories created by the research group. This set of items showed a moderate to high test-retest reliability assessed by ICC values between 0.54 and 0.83 (all $p < 0.05$). The father and mother PA were assessed by single-item questions about the compliance of PA guidelines for adults (i.e., Do you do vigorous PA at least three times per week or moderate PA at least five times per week?) with 2-response categories (no/yes). The number of siblings was assessed, ranged from 0 to 10-response scale and birth order, based on the number of pregnancies, ranged from "only child" to "ninth born".

Social factors

Nine potential social factors were assessed. Six of them included information about the frequency that their parents, siblings and friends spent watching te-

levision (TV) and doing PA together. Items were scored on a 5-point Likert scale from “never” to “very frequently”. Family dietary habits during watching TV was assessed based on a specific item obtained from the HELENA sedentary behavior questionnaire with the question: ‘How often do you eat while you watch TV?’ using 6 categories response scale from “never” to “several times per day”²⁷. The time the participants spent indoor during afternoon-weekdays (Monday to Friday) and weekend days (Saturday and Sunday) was assessed, using 5-point Likert scale from “nothing” to “entire evening”.

Home, neighborhood and school environmental factors. Seven home environmental factors were analyzed. Sport facilities at home, assessed by 7-items with 5 response categories ranging from “0” to “4 or more”; home technology equipment and technology at the participants’ bedroom, both assessed by 4-items with 7-response categories ranging from “0” to “6 or more”. These questionnaires were adapted from a standard survey^{28,29}. In addition, specific construction features of participants’ home were assessed as the size of the house in square meters, the number of bedrooms and having a garden or terrace at home. Eleven neighborhood and school environmental factors were assessed using the short and adapted version of the environmental questionnaire developed in the European research project Assessing Level of Physical Activity (ALPHA)³⁰. This questionnaire was rated on 4-response categories scale for each item from “strongly disagree” to “strongly agree”.

Statistical analysis

Given the large number of variables considered as potential correlates of PA in this study, the statistical approach was developed in two steps. In the first step, we conducted analysis of covariance in order to select candidate factors associated with levels of PA, adjusting for participant gender, age and SES. Frequency distributions were calculated for all variables considered as correlates and natural groups for categorical variables and dichotomized groups for ordinal and continue variables (split by the median value in order to obtain similar size groups) where used for comparisons. All levels of PA were checked for normality of distribution before the analysis and transformation were performed when it was necessary. A square rooted transformation was applied for total PA and vigorous PA in order to achieve normality.

In the second step, those factors considered as potential correlates of PA with p value of <0.10 in the analysis of covariance were selected to test their association in a final model, using a stepwise multiple linear regression ($p<0.05$). We ensure that the final model met the assumptions of linear regression. We explored collinearity between correlates using criteria of a tolerance index of 0.10, variation inflation

factor index of 0.10 and a condition index of 30 or higher to consider the presence of multicollinearity.

Statistical analyses were carried out using IBM SPSS statistical software package (version 19.0, Chicago, IL, USA) for Macintosh. The level of significance was set at $p<0.05$.

Results

Analysis of covariance

Result from the analysis of covariance was performed to select factors associated with levels of PA. Tables show those significant factors with p value of <0.05 and those selected factors for the final analysis with p value of <0.10 . As shown in table I, the selected factors for the final analysis were mother’s age, SES and positive health for total PA; participant’s age, father age and SES for moderate PA; gender, participant’s age, SES and positive health for vigorous PA and participant’s age and SES for moderate-to-vigorous PA. As shown in table II, the selected factors were parental support and father PA for moderate PA and moderate-to-vigorous PA, while only father PA was associated with vigorous PA. As shown in table III, the selected factors were TV viewing time with friends for moderate PA, TV viewing time with sibling and weekend time indoor for vigorous PA. As shown in table IV, the only selected factors for the final analysis were home bedroom’s number for moderate PA and moderate-to-vigorous PA.

Stepwise multiple linear regression

A stepwise multiple linear regression was performed to evaluate which selected factors were associated with levels of PA ($p<0.05$). As shown in table V, the regression model shows that SES was negatively associated with total PA ($p<0.05$). Participant’s age, SES and father PA were negatively associated with moderate-to-vigorous PA, while parental support and TV viewing time with friends were positively associated (all $p<0.05$). Participant’s age and father PA were also negatively associated with vigorous PA, while TV viewing time with siblings were positively associated (all $p<0.05$). Finally, participant’s age, SES and father PA were negatively associated with moderate-to-vigorous PA and parental support was positively associated (all $p<0.05$).

Discussion

This study analyzed potential correlates of objectively measured PA in adolescents with DS. This information can be useful to guide interventions designed to increase levels of PA. Our findings revealed that

Table I
Demographic, health, functional factors of physical activity in adolescents with Down syndrome

	<i>n</i>	<i>Total PA*</i> (counts/day)	<i>MPA</i> (min/day)	<i>VPA*</i> (min/day)	<i>MVPA</i> (min/day)
Demographic factors					
<i>Gender</i>					
Males	63	404 ± 153	48 ± 17	12 ± 9¹	59 ± 25
Females	35	367 ± 115	44 ± 16	9 ± 6	53 ± 20
<i>Participant's age</i>					
≤ 15	47	411 ± 127	51 ± 17¹	15 ± 8¹	66 ± 24¹
≥ 16	51	373 ± 151	42 ± 16	7 ± 6	49 ± 20
<i>Father's age</i>					
≤ 49	47	410 ± 146	49 ± 18	13 ± 9	62 ± 26
≥ 50	45	371 ± 143	42 ± 15	9 ± 7	51 ± 20
<i>Mother's age</i>					
≤ 49	52	418 ± 131¹	49 ± 14	13 ± 8	62 ± 20
≥ 50	46	361 ± 148	44 ± 20	9 ± 8	53 ± 27
<i>SES</i>					
Low-medium	43	455 ± 165¹	53 ± 17¹	14 ± 10¹	67 ± 2¹
High	55	341 ± 94	42 ± 15	8 ± 6	50 ± 20
Health factors					
<i>Positive health</i>					
Regular-good	34	366 ± 138¹	45 ± 19	10 ± 9¹	55 ± 28
Very good-excellent	58	405 ± 146	47 ± 16	12 ± 8	58 ± 21
<i>Participant's BMI</i>					
Normal-weighted	47	384 ± 137	44 ± 15	11 ± 8	54 ± 21
Overweight or obese	51	397 ± 146	49 ± 19	11 ± 9	60 ± 25
<i>Father's BMI</i>					
Normal-weighted	29	413 ± 121	49 ± 14	12 ± 7	61 ± 19
Overweight or obese	59	377 ± 157	45 ± 18	10 ± 9	55 ± 26
<i>Mother's BMI</i>					
Normal-weighted	48	392 ± 138	48 ± 19	11 ± 8	59 ± 26
Overweight or obese	43	391 ± 154	44 ± 13	11 ± 9	55 ± 19
Functional factors					
<i>Social functional</i>					
Low	44	387 ± 144	46 ± 18	12 ± 9	58 ± 25
High	54	395 ± 140	47 ± 16	10 ± 7	57 ± 22
<i>Routine functional</i>					
Low	46	415 ± 155	48 ± 18	13 ± 10	61 ± 25
High	51	371 ± 127	45 ± 16	9 ± 6	54 ± 21
<i>Autonomy functional</i>					
Low	49	398 ± 147	47 ± 18	12 ± 9	59 ± 26
High	48	386 ± 137	46 ± 16	10 ± 7	56 ± 21
<i>Total functional scale</i>					
Low	47	406 ± 152	48 ± 18	14 ± 10	62 ± 26
High	49	380 ± 133	45 ± 16	8 ± 6	54 ± 21

Values are mean ± SD. Abbreviations: PA, physical activity; MPA, moderate PA; VPA vigorous PA; MVPA, moderate to vigorous PA; SES, socio-economic status; BMI, Body mass index (kg/m²). * Values were square-root-transformed before analysis, but the non-transformed values are presented in the table. Statistically significant values, controlling for gender, participant's age and SES, are showed in bold (all p<0.05).

¹Selected factors for the final model (p<0.10).

Table II
Familial factors of physical activity in adolescents with Down syndrome

	<i>n</i>	<i>Total PA*</i> (counts/day)	<i>MPA</i> (min/day)	<i>VPA*</i> (min/day)	<i>MVPA</i> (min/day)
Familial factors					
<i>Father education</i>					
Less than high school	43	411 ± 128	47 ± 16	12 ± 8	59 ± 21
More than high school	47	372 ± 161	44 ± 18	10 ± 9	54 ± 26
<i>Mother education</i>					
Less than high school	38	420 ± 136	50 ± 18	13 ± 9	62 ± 25
More than high school	57	379 ± 139	45 ± 15	10 ± 8	55 ± 21
<i>Father work status</i>					
Low-medium	46	422 ± 152	50 ± 18	14 ± 10	63 ± 25
High – very high	44	361 ± 134	43 ± 17	9 ± 7	52 ± 22
<i>Mother work status</i>					
Low-medium	44	406 ± 126	48 ± 18	12 ± 8	60 ± 24
Very high – high	53	380 ± 153	44 ± 16	10 ± 9	54 ± 22
<i>Adolescents care availability</i>					
Few	69	381 ± 142	46 ± 16	10 ± 8	56 ± 22
Enough-adequate	27	407 ± 141	47 ± 19	12 ± 10	59 ± 26
<i>Parental support</i>					
Low	58	386 ± 134	46 ± 18 ¹	11 ± 9	57 ± 25 ¹
High	36	399 ± 154	47 ± 16	10 ± 8	57 ± 22
<i>Parents benefits PA</i>					
Less important	48	400 ± 145	48 ± 19	11 ± 9	59 ± 26
Very important	47	376 ± 140	44 ± 15	11 ± 8	54 ± 21
<i>Father PA</i>					
No	48	413 ± 144	49 ± 17 ¹	12 ± 9 a	62 ± 24 ¹
Yes	42	362 ± 144	42 ± 18	9 ± 8	51 ± 24
<i>Mother PA</i>					
No	50	386 ± 149	46 ± 18	11 ± 9	57 ± 26
Yes	47	393 ± 133	47 ± 16	11 ± 8	58 ± 21
<i>Sibling's number</i>					
≤ 1	66	388 ± 134	48 ± 18	11 ± 9	59 ± 25
≥ 2	31	398 ± 159	44 ± 14	10 ± 8	54 ± 19
<i>Birth order</i>					
≤ 1	41	366 ± 103	48 ± 17	11 ± 9	59 ± 25
≥ 2	56	410 ± 163	45 ± 17	11 ± 8	56 ± 22

Values are mean ± SD. Abbreviations: PA, physical activity; MPA, moderate PA; VPA vigorous PA; MVPA, moderate to vigorous PA.
* Values were square-root-transformed before analysis, but the non-transformed values are presented in the table. Statistically significant values, controlling for gender, participant's age and SES, are showed in bold (all p<0.05). ¹Selected factors for the final model (p<0.10).

Table III
Social factors of physical activity in adolescents with Down syndrome

	<i>n</i>	<i>Total PA*</i> (counts/day)	<i>MPA</i> (min/day)	<i>VPA*</i> (min/day)	<i>MVPA</i> (min/day)
Social factors					
<i>TV viewing time with parents</i>					
None-little	44	356 ± 129	42 ± 15	9 ± 8	51 ± 21
A lot of	50	416 ± 150	50 ± 18	12 ± 9	62 ± 25
<i>TV viewing time with siblings</i>					
None-little	35	357 ± 127	42 ± 17	9 ± 8 ^a	51 ± 23
A lot of	44	408 ± 151	47 ± 15	12 ± 8	59 ± 21
<i>TV viewing time with friends</i>					
None-little	54	383 ± 152	44 ± 16¹	11 ± 8	55 ± 22
A lot of	29	408 ± 128	51 ± 18	11 ± 9	62 ± 26
<i>PA with parents</i>					
None-little	59	385 ± 141	46 ± 15	10 ± 7	56 ± 20
A lot of	32	396 ± 150	47 ± 20	13 ± 11	56 ± 29
<i>PA with siblings</i>					
None-little	49	384 ± 152	45 ± 16	10 ± 9	55 ± 23
A lot of	30	392 ± 126	47 ± 17	11 ± 6	58 ± 22
<i>PA with friends</i>					
None-little	39	375 ± 134	44 ± 16	10 ± 8	54 ± 22
A lot of	45	405 ± 151	49 ± 17	9 ± 8	60 ± 25
<i>Family dietary habits watching TV</i>					
≤ 2 meals per week	60	387 ± 143	46 ± 16	11 ± 8	56 ± 22
≥ 2 meals per week	36	391 ± 139	47 ± 19	11 ± 8	58 ± 26
<i>Weekly time indoor</i>					
Little time	46	384 ± 137	47 ± 18	10 ± 8	57 ± 25
Much time	45	401 ± 150	46 ± 17	11 ± 9	58 ± 22
<i>Weekend time indoor</i>					
Little time	57	408 ± 138	49 ± 17	12 ± 9 ¹	61 ± 23
Much time	37	363 ± 147	43 ± 17	9 ± 8	52 ± 24

Values are mean ± SD. Abbreviations: PA, physical activity; MPA, moderate PA; VPA vigorous PA; MVPA, moderate to vigorous PA; TV, television. * Values were square-root-transformed before analysis, but the non-transformed values are presented in the table. Statistically significant values, controlling for gender, participant's age and SES, are showed in bold (all $p < 0.05$). ¹Selected factors for the final model ($p < 0.10$).

participant's age and SES were negatively associated with levels of PA as non-modifiable correlates. Moreover, parental support, TV viewing time with siblings and TV viewing time with friends were positively associated with levels of PA, whereas father PA was negatively associated with levels of PA as modifiable correlates. To our knowledge, this is the first study to explore correlates of objectively measured PA in adolescents with DS. A better understanding of correlates of PA could contribute to develop strategies on PA promotion in adolescents with DS.

Age has been previously identified as a consistent non-modifiable correlate associated with PA in adolescents without disabilities³¹, and similar results have been also obtained among youths with DS^{5,6}. The present study found that participant's age was negatively associated with levels of PA. This finding supports the hypothesis that a decline of PA with age might have a biological basis since it has been consistently identified not only through a wide range of diverse populations but also in animal studies³².

Table IV
Home, neighbourhood, school environmental factors of physical activity in adolescents with Down syndrome

	<i>n</i>	<i>Total PA*</i> (counts/day)	<i>MPA</i> (min/day)	<i>VPA*</i> (min/day)	<i>MVPA</i> (min/day)
Home environmental factors					
<i>Sport facilities at home</i>					
≤ 3	50	378 ± 127	45 ± 15	9 ± 8	54 ± 20
≥ 4	39	418 ± 154	50 ± 18	13 ± 9	64 ± 26
<i>Technology equipment at home</i>					
≤ 8	42	431 ± 151	51 ± 17	13 ± 10	65 ± 25
≥ 9	44	350 ± 130	41 ± 15	8 ± 7	49 ± 20
<i>Participants' bedroom technology</i>					
≤ 1	42	376 ± 135	44 ± 15	10 ± 8	55 ± 21
≥ 2	45	393 ± 130	49 ± 17	11 ± 8	60 ± 24
<i>Participants' bedroom TV</i>					
No	50	379 ± 151	44 ± 16	11 ± 9	54 ± 22
Yes	46	399 ± 133	49 ± 18	11 ± 9	60 ± 25
<i>House sizes square meters</i>					
≤ 120	46	409 ± 129	51 ± 17	12 ± 9	62 ± 24
≥ 121	49	380 ± 152	43 ± 16	10 ± 8	54 ± 22
<i>Home bedrooms' number</i>					
≤ 3	54	416 ± 133	51 ± 17 ¹	12 ± 9	62 ± 23 ¹
≥ 4	44	361 ± 147	41 ± 16	9 ± 8	51 ± 22
<i>Have garden or terrace</i>					
No	40	414 ± 133	51 ± 18	12 ± 9	63 ± 25
Yes	49	373 ± 153	42 ± 15	10 ± 8	52 ± 22

Values are mean ± SD. Abbreviations: PA, physical activity; MPA, moderate PA; VPA vigorous PA; MVPA, moderate to vigorous PA; TV, television. * Values were square-root-transformed before analysis, but the non-transformed values are presented in the table. Statistically significant values, controlling for gender, participant's age and SES, are showed in bold (all $p < 0.05$). ¹Selected factors for the final model ($p < 0.10$).

Evidence regarding the association of SES with PA in adolescents without disability reported mixed results depending on whether PA is measured objectively (e.g. accelerometry) or subjectively (e.g. questionnaires). For example, some studies found negatively association between SES and levels of PA when PA was measured by accelerometry³⁶, while no association^{8,31} or a positive association³⁷ were found when PA was measured by self-reported. The results of our study are in concordance with studies of adolescents without disabilities when PA was measured by accelerometry. Discrepancies between these studies might be due to different definitions and measures of SES and also the specific component of the PA measured. For example, De Cocker et al.³⁸ found that only self-reported walking time was higher among those with low and medium SES while self-reported vigorous PA was higher among those adolescents with medium and high SES.

Previous reviews in adolescents without disabilities have produced mixed results^{9,31,39}. Some have concluded that parental modeling, support and encouragement are positively associated with young's PA whilst others have showed unclear or no association of familial factors with PA⁴⁰. In adolescents with intellectual disability or DS, there is a lack of studies regarding familial influence and PA. Only one study examined the association of familial factors and PA in adolescents with intellectual disabilities reporting that caregiver's preference of PA could significantly predict regular PA⁴¹. Our results showed that parental support was positively associated with PA, whereas parental modeling (e.g. father PA) was negatively associated with levels of PA. This result suggest that parental support may influence on levels of PA in adolescents with DS since this population has a greater dependence of their parents or caregivers due to their cognitive limitations. However, the evidence regarding parent modeling

Table IV
(Continued) Home, neighbourhood, school environmental factors of physical activity in adolescents with Down syndrome

	<i>n</i>	<i>Total PA*</i> (counts/day)	<i>MPA</i> (min/day)	<i>VPA*</i> (min/day)	<i>MVPA</i> (min/day)
Neighbourhood / school factors					
<i>Item 1: Abundance of houses</i>					
Less agreement	43	408 ± 155	49 ± 19	12 ± 10	61 ± 27
Greater agreement	49	364 ± 128	43 ± 14	10 ± 8	53 ± 21
<i>Item 2: Nearby shops and walkable</i>					
Less agreement	35	340 ± 104	43 ± 16	9 ± 6	51 ± 20
Greater agreement	60	414 ± 153	48 ± 18	12 ± 9	60 ± 25
<i>Item 3: Nearby public transport stops</i>					
Less agreement	73	384 ± 147	46 ± 17	10 ± 8	56 ± 23
Greater agreement	19	405 ± 127	48 ± 19	13 ± 10	60 ± 28
<i>Item 4: Alternative paths</i>					
Less agreement	49	372 ± 132	44 ± 16	10 ± 8	53 ± 23
Greater agreement	46	402 ± 149	49 ± 17	12 ± 8	61 ± 24
<i>Item 5: Traffic insecurity</i>					
Less agreement	67	388 ± 145	47 ± 18	11 ± 9	57 ± 25
Greater agreement	29	390 ± 134	45 ± 13	11 ± 8	56 ± 19
<i>Item 6: Neighbourhood security</i>					
Less agreement	39	340 ± 151	46 ± 15	12 ± 8	58 ± 21
Greater agreement	57	381 ± 135	46 ± 19	10 ± 9	57 ± 25
<i>Item 7: Pleasant environment</i>					
Less agreement	48	396 ± 139	48 ± 18	11 ± 9	59 ± 24
Greater agreement	48	382 ± 145	44 ± 16	11 ± 8	55 ± 22
<i>Item 8: Sport equipment</i>					
Less agreement	44	420 ± 161	50 ± 18	12 ± 10	62 ± 25
Greater agreement	52	362 ± 118	43 ± 16	10 ± 7	53 ± 21
<i>Item 9: Active conmmuting to school</i>					
Less agreement	62	363 ± 124	44 ± 15	10 ± 7	54 ± 20
Greater agreement	28	418 ± 162	47 ± 18	12 ± 9	58 ± 25
<i>Item 10: School sports facilities</i>					
Less agreement	40	379 ± 135	45 ± 15	11 ± 8	56 ± 21
Greater agreement	53	388 ± 143	46 ± 16	10 ± 8	55 ± 22
<i>Total score</i>					
Less agreement	42	389 ± 141	47 ± 15	11 ± 8	58 ± 21
Greater agreement	45	374 ± 142	42 ± 16	10 ± 8	52 ± 22

Values are mean ± SD. Abbreviations: PA, physical activity; MPA, moderate PA; VPA vigorous PA; MVPA, moderate to vigorous PA.
* Values were square-root-transformed before analysis, but the non-transformed values are presented in the table. Statistically significant values, controlling for gender, participant's age and SES, are showed in bold (all $p < 0.05$). 'Selected factors for the final model ($p < 0.10$).

Table V
Correlates of physical activity in adolescents with Down syndrome analyzed by stepwise multiple linear regression

	β	P	Adj. R ²	β	P	Adj. R ²	MPA (min/day)	β	P	Adj. R ²	VPA* (min/day)	β	P	Adj. R ²	MVPA (min/day)
n	92		0.092	81		0.346		75		0.368		94		0.365	
Participant's age	-	-		-0.419	<0.001			-0.526	<0.001			-0.485	<0.001		
SES	-0.319	0.002		-0.264	0.007			-	-			-0.267	0.002		
Parental support	-	-		0.336	0.001			-	-			0.287	0.002		
Father PA	-	-		-0.203	0.029			-0.224	0.019			-0.233	0.006		
TV viewing time with siblings	-	-		-	-			0.203	0.032			-	-		
TV viewing time with friends	-	-		0.199	0.036			-	-			-	-		

Abbreviations: PA, physical activity; MPA, moderate PA; VPA, vigorous PA; MVPA, moderate to vigorous PA; SES, socio-economic status; TV, television. * Values were square-root-transformed before analysis. Statistically significant values are showed in bold (all $p < 0.05$).

should be further examined because it is likely that adolescents with DS might not be able to copy parent behavior due to their low autonomy.

Another finding in our study was the positively association between TV viewing time and levels of PA. This finding could seem an unexpected finding because PA and sedentary behaviors (as TV viewing time) are usually interpreted as opposite behaviors. However, previous studies have shown that there is null or weak association between both behaviors in youth without disabilities^{9,39,42}, which means that they are independent behaviors. The findings of our study could be explained in terms of social interactions. It is likely that those adolescents with DS who have more frequently interactions with peers (sibling or friend) during leisure sedentary activities (e.g. TV viewing time) have more opportunities to interact with each other in active behaviors (e.g. spontaneous active playing).

Previous researches have found that environmental factors were associated with PA in adolescents without disabilities. For example, a present review pointed out that the most robust built environment correlates of PA are land-use mix and residential density⁴³. However, our data suggest that neighborhood environmental correlates are not associated with levels of PA in adolescents with DS. A possible explanation of this lack association is that adolescents with DS are not allowed to move by their own in the neighborhood due to their reduced autonomy and greater parents' dependence.

To develop effective PA interventions in adolescents with DS, it is relevant to understand correlates and determinants of PA. Data from this study identified only two non-modifiable correlates (participants' age and SES) and four modifiable correlates (parental support, father PA, frequency of TV viewing time with siblings and with friends) were associated with levels of PA in adolescents with DS. This finding may suggest that both non-modifiable and modifiable correlates have an impact on levels of PA in adolescents with DS, but more attention should point toward modifiable factors for increasing levels of PA.

This study had several limitations and strengths. Limitations included: (i) cross-sectional design, thus, cause effect cannot be inferred; (ii) correlates of PA were reported by proxy-respondent due to cognition limitation of adolescents with DS; (iii) accelerometers cannot measure aquatic activities, which could influence measured PA in adolescents with DS; (iv) the lack rigorously validated questionnaire for parents with /or adolescents with DS to assess potential factors that could be influencing levels of PA is a weakness in our study. Strengths include: (i) relatively large and homogeneous sample of adolescents with DS; (ii) the use of accelerometer to measure objectively PA; (iii) the assessment of the large number of potential correlates across several domains (demographic, personal, environmental, etc.).

In conclusion, the results of our study suggest that few correlates may influences levels of PA in adoles-

cents with DS. In addition, the key modifiable correlate might contribute to develop strategies on PA promotion specifically addressed to youth with DS. However, further researches are needed on the role of factors associated with PA since this issue is almost unexplored in this population.

Acknowledgments

This study was supported by the DEP 2010-21662-C04-00 grant from the National Plan for Research, Development and Innovation (R+D+i) MICINN. None of the authors had any conflicts of interest. Authors declare that manuscript submitted has not been published elsewhere or is not being considered for publication elsewhere. All authors approved the final version of this manuscript.

References

- Physical Activity Guidelines Advisory Committee. *Physical Activity Guidelines Advisory Committee Report*, 2008. Washington: Department of Health and Human Services.
- Phillips AC, Holland AJ. Assessment of objectively measured physical activity levels in individuals with intellectual disabilities with and without Down's syndrome. *PLoS One*. 2011;6(12):e28618.
- Pueschel SM. Clinical aspects of Down syndrome from infancy to adulthood. *Am J Med Genet*. 1990;7:52-6.
- Wuang Y, Su CY. Patterns of participation and enjoyment in adolescents with Down syndrome. *Res Dev Disabil*. 2012; 33(3):841-8.
- Izquierdo-Gomez R, Martínez-Gómez D, Acha A, Veiga OL, Villagra A, Diaz-Cueto M; UP&DOWN study group. Objective assessment of sedentary time and physical activity throughout the week in adolescents with Down syndrome. The UP&DOWN study. *Res Dev Disabil*. 2014;35(2):482-9.
- Esposito PE, MacDonald M, Hornyak JE, Ulrich DA. Physical activity patterns of youth with Down syndrome. *Intellect Dev Disabil*. 2012;50(2):109-19.
- Matute-Llorente A, González-Agüero A, Gómez-Cabello A, Vicente-Rodríguez G, Casajús JA. Physical activity and cardiorespiratory fitness in adolescents with Down syndrome. *Nutr Hosp*. 2013;28(4):1151-5.
- Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW; Lancet Physical Activity Series Working Group. Correlates of physical activity: why are some people physically active and others not? *Lancet*. 2012;380(9838):258-71.
- Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J. An ecological approach to creating active living communities. *Annu Rev Public Health*. 2006;27:297-322.
- Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. *Med Sci Sports Exerc*. 2000;32(5):963-75.
- Pitteti K, Baynard T, Agiovlasis S. Children and adolescents with Down syndrome, physical fitness and physical activity. *J Sport Health Sci*. 2012;2:47-57.
- Oates A, Bebbington A, Bourke J, Girdler S, Leonard H. Leisure participation for school-aged children with Down syndrome. *Disabil Rehabil*. 2011;33(19-20):1880-9.
- Barr M, Shields N. Identifying the barriers and facilitators to participation in physical activity for children with Down syndrome. *J Intellect Disabil Res*. 2011;55(11):1020-33.
- Castro-Piñero J, Carbonell-Baeza A, Martínez-Gómez D, Gómez-Martínez S, Cabanas-Sánchez V, Santiago C et al. Follow-up in healthy schoolchildren and in adolescents with Down syndrome: psycho-environmental and genetic determinants of physical activity and its impact on fitness, cardiovascular diseases, inflammatory biomarkers and mental health; the UP&DOWN study. *BMC Public Health*. 2014; 25:14:400.
- Robusto KM, Trost SG. Comparison of three generations of ActiGraph™ activity monitors in children and adolescents. *J Sports Sci*. 2012;30(13):1429-35.
- Vanhelst J, Mikulovic J, Bui-Xuan G, Dieu O, Blondeau T, Fardy P et al. Comparison of two ActiGraph accelerometer generations in the assessment of physical activity in free living conditions. *BMC Res Notes*. 2012;5:187.
- Freedson P, Pober D, Janz KF. Calibration of accelerometer output for children. *Med Sci Sports Exerc*. 2005;37:523-530.
- Aguilar-Cordero MJ, Sánchez-López AM, Guisado-Barrilao R, Rodríguez-Blanque R, Noack-Segovia J, Pozo-Cano D. Descripción del acelerómetro como método para valorar la actividad física en los diferentes períodos de la vida; revisión sistemática. *Nutr Hosp*. 2014;29(6):1250-61.
- Cain KL, Sallis JF, Conway TL, Van Dyck D, Calhoun L. Using accelerometers in youth physical activity studies: a review of methods. *J Phys Act Health*. 2013;10(3):437-50.
- Currie C, Molcho M, Boyce W, Holstein B, Torsheim T, Richter M. Researching health inequalities in adolescents: the development of the Health Behaviour in School-Aged Children (HBSC) family affluence scale. *Soc Sci Med*. 2008;66(6):1429-36.
- Ravens-Siebert U, Erhart M, Rajmil L, Herdman M, Auquier P, Bruil J et al. Reliability, construct and criterion validity of the KIDSCREEN-10 score: a short measure for children and adolescents' well-being and health-related quality of life. *Qual Life Res*. 2010;19(10):1487-500.
- Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320(7244):1240-3.
- World Health Organization. *Obesity: preventing and managing the global epidemic. Report of a WHO consultation*. WHO Technical Report Series Number 894. 2000. Geneva: World Health Organization.
- American Association on Mental Retardation. *Mental retardation definition, classification, and systems of supports*. 2002. Washington: American Association on Mental Retardation.
- González-Gross M, Castillo MJ, Moreno L, Nova E, González-Lamuño D, Pérez-Llamas F et al. [Feeding and assessment of nutritional status of spanish adolescents (AVENA study). Evaluation of risks and interventional proposal. I. Methodology]. *Nutr Hosp*. 2003;18(1):15-28.
- Evenson KR, Birnbaum AS, Bedimo-Rung AL, Sallis JF, Voorhees CC, Ring K et al. Girls' perception of physical environmental factors and transportation: reliability and association with physical activity and active transport to school. *Int J Behav Nutr Phys Act*. 2006;3:28.
- Rey-López JP, Vicente-Rodríguez G, Répásy J, Mesana MI, Ruiz JR, Ortega FB et al. Food and drink intake during television viewing in adolescents: the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study. *Public Health Nutr*. 2011;14(9):1563-9.
- Rosenberg DE, Sallis JF, Kerr J, Maher J, Norman GJ, Durant N et al. Brief scales to assess physical activity and sedentary equipment in the home. *Int J Behav Nutr Phys Act*. 2010;7:10.
- Sirard JR, Nelson MC, Pereira MA, Lytle LA. Validity and reliability of a home environment inventory for physical activity and media equipment. *Int J Behav Nutr Phys Act*. 2008;5:24.
- García-Cervantes L, Martínez-Gómez D, Rodríguez-Romo G, Cabanas-Sánchez V, Marcos A, Veiga OL. Reliability and validity of an adapted version of the ALPHA environmental questionnaire on physical activity in Spanish youth. *Nutr Hosp*. 2014;30(5):1118-24.
- Van Der Horst K, Paw MJ, Twisk JW, Van Mechelen W. A brief review on correlates of physical activity and sedentariness in youth. *Med Sci Sports Exerc*. 2007;39(8):1241-50.
- Sallis JF. Age-related decline in physical activity: a synthesis of human and animal studies. *Med Sci Sports Exerc*. 2000;32(9):1598-600.

33. Konharn K, Santos MP, Ribeiro JC. Socioeconomic status and objectively measured physical activity in Thai adolescents. *J Phys Act Health*. 2014;11(4):712-20.
34. Kristensen PL, Korsholm L, Møller NC, Wedderkopp N, Andersen LB, Froberg K. Sources of variation in habitual physical activity of children and adolescents: the European youth heart study. *Scand J Med Sci Sports*. 2008;18(3):298-308.
35. Riddoch CJ, Mattocks C, Deere K, Saunders J, Kirkby J, Tilling K et al. Objective measurement of levels and patterns of physical activity. *Arch Dis Child*. 2007;92(11):963-9.
36. Kocak S, Harris MB, Isler AK, Cicek S. Physical activity level, sport participation, and parental education level in Turkish junior high school students. *Pediatr Exerc Sci*. 2002;14:147-154.
37. Hanson MD, Chen E. Socioeconomic status and health behaviors in adolescence: a review of the literature. *J Behav Med*. 2007;30(3):263-85.
38. De Cocker K, Ottevaere C, Sjöström M, Moreno LA, Wärnberg J, Valtueña J et al. Self-reported physical activity in European adolescents: results from the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) study. *Public Health Nutr*. 2011;14(2):246-54.
39. Sterdt E, Liersch S, Walter U. Correlates of physical activity of children and adolescents: a systematic review of reviews. *Health Educ J*. 2013.
40. Edwarson CL, Gorely T. Parental influences on different types and intensities of physical activity in youth: A systematic review. *Psychol Sport Exerc*. 2010;11:522-535.
41. Lin JD, Lin PY, Lin LP, Chang YY, Wu SR, Wu JL. Physical activity and its determinants among adolescents with intellectual disabilities. *Res Dev Disabil*. 2010;31(1):263-9.
42. Biddle SJ, Gorely T, Marshall SJ, Cameron N. The prevalence of sedentary behavior and physical activity in leisure time: A study of Scottish adolescents using ecological momentary assessment. *Prev Med*. 2009;48(2):151-5.
43. Ding D, Sallis JF, Kerr J, Lee S, Rosenberg DE. Neighborhood environment and physical activity among youth a review. *Am J Prev Med*. 2011;41(4):442-55.



Original/Deporte y ejercicio

Efecto de un protocolo de calentamiento en la distancia alcanzada en el test sit-and-reach en alumnos adolescentes

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Resumen

Introducción: los test lineales son frecuentemente utilizados en las clases de educación física para evaluar la extensibilidad isquiosural del alumnado, sin que haya una estandarización del procedimiento para su realización.

Objetivo: analizar la influencia de un protocolo de calentamiento en los resultados obtenidos en el test *sit-and-reach* en estudiantes adolescentes.

Metodología: a 47 adolescentes (17 chicos y 30 chicas) se les midió la distancia alcanzada en el test *sit-and-reach* antes, inmediatamente después de finalizar, así como a los 5 y 10 minutos tras finalizar un protocolo de calentamiento compuesto por una parte de carrera continua, actividades de locomoción y movilidad, además de estiramientos estáticos de cuádriceps, isquiosurales, aductores, psoas ilíaco y gemelos, con una duración total de 8 minutos. Entre las mediciones realizadas tras el calentamiento, los participantes permanecieron en bipedestación sin realizar ejercicio y/o estiramiento alguno.

Resultados y discusión: tras el calentamiento hubo una mejora significativa en la distancia alcanzada en el test *sit-and-reach* (+ 2,15 cm) ($p < 0,001$), siendo ligeramente mayor a los 5 y 10 minutos (+ 2,49 cm a los 5 minutos y + 2,61 cm a los 10 minutos) ($p < 0,001$ respecto al pre-test).

Conclusiones: la realización de un protocolo de calentamiento previo al test *sit-and-reach*, compuesto por locomoción, movilidad y estiramientos, incrementa de manera significativa la distancia alcanzada en este test, que permanece aumentada, al menos, hasta 10 minutos después de finalizar el calentamiento.

(Nutr Hosp. 2015;31:2618-2623)

DOI:10.3305/nh.2015.31.6.8858

Palabras clave: Ejercicio aeróbico. Flexibilidad. Ejercicios de estiramiento muscular. Educación física. Ejercicio de calentamiento.

THE EFFECT OF A WARM-UP PROTOCOL ON THE SIT-AND-REACH TEST SCORE IN ADOLESCENT STUDENTS

Abstract

Introduction: sit-and-reach tests are often used in physical education classes for measurement of hamstring extensibility in students, without a standar protocol to perform it.

Objetive: to analyze the effect of a warm-up protocol based on locomotion activities and stretching in the sit-and-reach scores in adolescent students.

Method: a total of 47 teenagers students (17 boys and 30 girls) performed the sit-and-reach test before, immediately after, and 5 and 10 minutes after completing a structured warm-up. The warm-up consisted on a part of continuous running, dynamic locomotor and mobility activities as well as static stretching of lower limbs (quadriceps, hamstrings, adductors, iliopsoas and gastrocnemius), with a total duration of 8 minutes. Between measurements after warm-up, the participants remained standing without performing any exercise and/or stretching.

Results and discussion: after warm-up there was a significant improvement in the sit-and-reach score (+ 2.15 cm) ($p < 0.001$), being slightly higher at 5 and 10 minutes (+ 2.49 cm at 5 minutes and + 2.61 cm at 10 minutes) ($p < 0.001$ with respect to the pre-test).

Conclusions: a warm-up protocol performed before the sit-and-reach test, comprised by locomotion, dynamic activities and stretching, improves significantly the distance achieved in this test.

(Nutr Hosp. 2015;31:2618-2623)

DOI:10.3305/nh.2015.31.6.8858

Key words: Aerobic exercise. Joint flexibility. Muscle stretching exercises. Physical education. Warm-up exercise.

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Recibido: 17-II-2015.
1.ª Revisión: 8-III-2015.
Aceptado: 10-III-2015.

Introducción

La flexibilidad es un componente de la condición física saludable¹, que se define como la capacidad física de amplitud de movimiento de una articulación². Una adecuada flexibilidad es un elemento importante en las actividades de la vida diaria y, muy especialmente, en las actividades físico-deportivas¹, al permitir un rango de movimiento óptimo.

La flexibilidad está condicionada por diversos factores no modificables tales como el sexo, la edad, o la disposición de ligamentos y tendones, entre otros, así como por otros factores modificables como la temperatura corporal o las actividades previamente realizadas a la aplicación de un estímulo de estiramiento muscular². En este sentido, para aumentar los niveles de temperatura y así mejorar la flexibilidad suelen utilizarse diversas actividades motrices de locomoción, movilidad, y estiramientos de forma aislada o combinadas³.

Entre los diversos grupos musculares del cuerpo humano, la investigación se ha centrado en algunos de ellos debido a la frecuencia de casos con una reducida flexibilidad y a las consecuencias de la misma en el sistema músculo-esquelético. Entre estos, la musculatura isquiosural ha sido extensamente analizada debido a la influencia que tiene su flexibilidad en el ritmo lumbo-pélvico y la disposición sagital del raquis en movimientos de flexión del tronco^{4,5}. Una disminución de la extensibilidad isquiosural reduce la flexión coxofemoral con rodilla extendida, provocando cambios específicos en la disposición sagital del raquis. Una extensibilidad isquiosural reducida se ha relacionado con un mayor riesgo de algias lumbares⁶, desalineaciones raquídeas⁷, lesiones musculares⁸ y cambios en el ritmo lumbo-pélvico^{4,5,9,10}. En jóvenes, una insuficiente extensibilidad isquiosural ha sido asociada con dolor lumbar y cervical¹¹, así como un mayor riesgo de algias lumbares crónicas¹².

En las clases de Educación Física se llevan a cabo, con frecuencia, pruebas para la evaluación de la extensibilidad isquiosural, como parte de los contenidos que se integran en el bloque denominado “Condición Física y Salud” o “Actividad Física y Salud”. Entre los diferentes test descritos para valorar la misma, el test *sit-and-reach* es el más comúnmente utilizado tanto en diferentes baterías de ejercicio físico como en las clases de Educación Física¹³. Puesto que el horario lectivo de esta asignatura es limitado, se suelen utilizar pruebas que sean fáciles de llevar a cabo y que permitan valorar en poco tiempo a un número importante de alumnos¹³. Además, el *sit-and-reach* ha sido un test frecuentemente utilizado en diversas investigaciones que han puesto en práctica, en ámbito escolar, algún programa de intervención basado en estiramientos de la musculatura isquiosural¹³⁻²¹. Así también, este test es frecuentemente utilizado en otros contextos en los que se realiza una valoración de la extensibilidad isquiosural²².

En la actualidad, existe una gran diversidad de protocolos a la hora de llevar a cabo este test en las clases de Educación Física. Esta variabilidad viene condicionada por la presencia o no de un calentamiento previo, el tiempo que pasa desde que finaliza el mismo hasta que se procede a la aplicación del test, la forma de estandarizar la posición de las rodillas y tobillos, o la velocidad en el movimiento de flexión del tronco al intentar alcanzar la máxima distancia. Con frecuencia, por cuestiones de organización y control del grupo de clase, el test se ejecuta tras un calentamiento realizado por todos los alumnos de forma simultánea, pero en función del orden de valoración, algunos alumnos realizan el test inmediatamente después de acabar el calentamiento, mientras otros lo hacen varios minutos después de haberlo finalizado. Estudios previos²³⁻²⁵ han establecido que los efectos logrados tras una actividad previa, basada en estiramientos o en actividades de locomoción, son limitados en el tiempo, con una variabilidad importante en función del estudio (entre 3 y 30 min). No obstante, estos estudios se han realizado en adultos y en contextos diferentes al ámbito educativo.

Por todo ello, los objetivos de este trabajo fueron: 1) analizar la influencia de un protocolo de calentamiento basado en actividades de locomoción y estiramientos en los resultados obtenidos en el test *sit-and-reach* en estudiantes adolescentes, y 2) determinar cómo afecta un período de reposo, tras el calentamiento, en la distancia alcanzada en el test *sit-and-reach*.

Metodología

Participantes

Cuarenta y siete estudiantes adolescentes (17 chicos y 30 chicas), con edades comprendidas entre 16 y 18 años, participaron en este estudio. Los criterios de exclusión fueron haber presentado dolor lumbar agudo, o alguna lesión musculo-esquelética en la región posterior de la pierna y/o cirugía raquídea o abdominal reciente, tener alguna alteración raquídea estructurada diagnosticada o algún tipo de lesión en el momento de las valoraciones. Todas las mediciones fueron realizadas tras dos horas, al menos, desde que los participantes habían estado en posición decúbito. Además, los alumnos fueron instruidos a no realizar ejercicio físico alguno en las 24 horas previas al estudio.

Procedimiento

El estudio fue aprobado por la Comisión de Bioética institucional. Previamente a las mediciones, todos los alumnos y sus tutores legales fueron informados sobre los objetivos y métodos del estudio y firmaron un consentimiento informado.

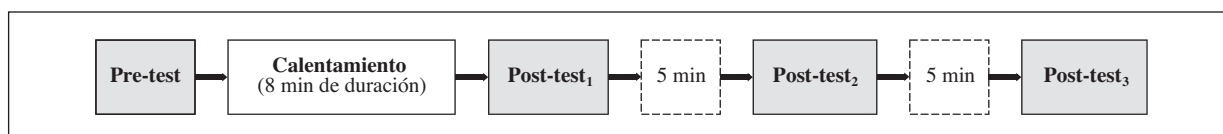


Fig. 1.— Secuencia temporal de la toma de datos.

A todos los participantes se les aplicó el test *sit-and-reach* antes de realizar un protocolo de calentamiento de 8 min de duración (pre-test), así como tres veces más después (post-test₁: inmediatamente tras el calentamiento; post-test₂: pasados 5 min tras el calentamiento; y post-test₃: pasados 10 min tras el calentamiento) (figura 1). Entre las mediciones realizadas tras el calentamiento, los participantes permanecieron en bipedestación sin realizar ejercicio y/o estiramiento alguno.

Para la valoración de la extensibilidad isquiosural se utilizó el test *sit-and-reach*, empleándose un cajón de medición de 30 cm de altura (*Finder Flex-Tester*®) con una regla milimetrada adosada. Para la ejecución del test, el alumno se situó en sedentación, con las rodillas extendidas, los pies separados a la anchura de sus caderas y las plantas de los pies situadas perpendiculares al suelo, en contacto con el cajón de medición y con las puntas de los pies dirigidas hacia arriba. A todos los participantes se les dieron las siguientes instrucciones: “Con una mano sobre la otra, las palmas de las manos hacia abajo, con los dedos y los codos estirados y manteniendo las rodillas estiradas en todo momento, flexiona lentamente el tronco tanto como puedas, empujando la regla con las puntas de los dedos de las manos hasta alcanzar la máxima distancia posible, y mantén la posición durante 3 segundos”. Durante la medición, el investigador principal se encargó de sujetar las rodillas de los estudiantes manteniéndolas extendidas. La distancia alcanzada se midió en centímetros. El valor 0 cm correspondió a la tangente de las plantas de los pies, siendo positivos los valores cuando las falanges distales del carpo superaban la tangente y negativos cuando no la alcanzaban. La realización del test se llevó a cabo con ropa deportiva y descalzos. La temperatura del laboratorio se estandarizó a 24° C.

El protocolo de calentamiento, de 8 min de duración, consistió en la realización de 4 min de carrera continua, seguido de la realización de ejercicios de locomoción y movilidad articular haciendo recorridos de 20 metros de distancia: 1º) skipping; 2º) talones a glúteos; 3º) carrera lateral (ida por un lado y vuelta hacia el otro); 4º) desplazamiento andando realizando movimientos de abducción coxofemoral con cadera y rodilla flexionada a 90º; 5º) desplazamiento andando realizando movimientos de adducción coxofemoral con cadera y rodilla flexionada a 90º; 6º) flexión coxofemoral unilateral con rodilla extendida, alternando ambas piernas; y 7º) extensión coxofemoral unilateral con rodilla extendida, alternando ambas piernas. Tras finalizar, realizaron un estiramiento estático-pasivo de

los músculos cuádriceps, aductores, psoas ilíaco, isquiosurales y gemelos, ejecutados de forma unilateral y con ambas extremidades, manteniendo la posición de estiramiento 15 seg. Todo el protocolo de calentamiento estuvo dirigido por el investigador principal.

Análisis estadístico

La distribución de los datos fue inicialmente valorada mediante el test de normalidad de Shapiro-Wilks. Puesto que las variables seguían una distribución normal, se realizó un análisis estadístico en base a pruebas paramétricas. Para la obtención de los resultados se realizó una estadística descriptiva con la obtención de los valores medios y desviación típica. Un análisis de varianza (ANOVA) de medidas repetidas fue realizado para establecer las diferencias en la distancia alcanzada en el test *sit-and-reach* entre las diferentes repeticiones. La significación del análisis multivariado de medidas repetidas fue confirmada mediante los test de Traza de Pillai, Lambda de Wilk, traza de Hotelling y raíz mayor de Ro, los cuales arrojaron resultados similares. La esfericidad fue analizada mediante la prueba de Mauchly. La corrección de Greenhouse-Geisser fue aplicada si la esfericidad no era asumida. Un valor $p < 0,05$ fue establecido para determinar la significación estadística a priori. Si se encontraban diferencias significativas en la distancia alcanzada entre las diferentes medidas se realizó una comparación por pares (*post hoc*) usando la corrección de Bonferroni para comparaciones múltiples, ajustando el criterio de significación a un valor de 0,0125 (0,05 dividido entre 4). El análisis estadístico fue realizado mediante el *software* SPSS (versión 19,0; SPSS Inc., IL).

Resultados

La distancia alcanzada en el test *sit-and-reach* por los participantes fue de $5,59 \pm 8,12$ cm en el pre-test, $7,74 \pm 7,16$ cm en el post-test₁, $8,06 \pm 7,06$ cm en el post-test₂ y $8,52 \pm 6,70$ cm en el post-test₃. El ANOVA mostró un efecto significativo en la comparación de la distancia alcanzada en el test *sit-and-reach* ($F = 51,29$; $p < 0,001$). El análisis *post hoc* con ajuste de Bonferroni mostró diferencias significativas entre el pre-test y todos los post-test ($p < 0,001$). No obstante, no se encontraron diferencias estadísticamente significativas entre las diferentes mediciones realizadas después del calentamiento ($p > 0,05$) (Tabla I).

Tabla I
Significación estadística (valor de p) en la comparación por pares entre las diferentes repeticiones del test *sit-and-reach*.

	<i>Pre-test</i>	<i>Post-test₁</i>	<i>Post-test₂</i>	<i>Post-test₃</i>
Pre-test	-	0,000	0,000	0,000
Post-test ₁	-	-	0,628	0,016
Post-test ₂	-	-	-	0,163

Discusión

Los objetivos del presente estudio fueron analizar los efectos de un calentamiento basado en actividades de locomoción, movilidad y estiramientos, en los resultados obtenidos en el test *sit-and-reach* en alumnos adolescentes, así como determinar si un período de recuperación sin realizar ejercicio físico alguno afecta a la distancia alcanzada en este test. El principal hallazgo fue que, tras un protocolo de calentamiento basado en actividades de locomoción y estiramientos estáticos del tren inferior, los alumnos mostraron un aumento significativo de la distancia alcanzada en este test, que se mantuvo, al menos, hasta 10 minutos después de finalizar el calentamiento.

Estudios previos han analizado el efecto agudo de diversos protocolos de calentamiento basados en estiramientos sobre la extensibilidad isquiosural, encontrando mejoras similares. Zakas²⁶ en un estudio realizado en jugadores de fútbol adolescentes, encontró un aumento semejante de la extensibilidad isquiosural tras realizar un protocolo de estiramientos estáticos de 30 segundos basado en diferentes estructuras de series y tiempo (1x30s, 2x15s o 6x5s). En otro estudio que comparó los efectos de estirar de forma estática respecto a realizarlo con una técnica dinámica, no se encontraron diferencias significativas en la distancia alcanzada en el *sit-and-reach* entre ambas, induciendo ambos calentamientos a un incremento significativo de la flexibilidad²⁷. Si se incluye una parte de locomoción compuesta por actividades aeróbicas submáximas en el protocolo de calentamiento, se produce un aumento de la temperatura del músculo esquelético^{3,28} que podría aumentar, aún más, el rango de movimiento articular. En esta línea, Wenos y Konin²⁸ encontraron que un calentamiento aeróbico de 4 minutos previo a la realización de estiramientos aumentó la temperatura muscular y el rango de movimiento articular.

Puesto que tanto un calentamiento basado exclusivamente en estiramientos o en actividades aeróbicas se ha relacionado con un aumento del rango de movimiento articular, algunos estudios han analizado la influencia de un protocolo de calentamiento combinando ambas actividades. En esta línea, Rosario y Folletto²⁹ mostraron que un calentamiento compuesto por 20 minutos andando y 30 segundos de estiramientos de los músculos isquiosurales aumentaba considerablemente la flexibilidad de los mismos en comparación

a un grupo que no había sido sometido a un calentamiento previo. Zakas et al.³⁰, en jugadores de fútbol adolescentes, analizaron el efecto sobre la extensibilidad de varios protocolos de calentamiento (carrera continua, estiramientos pasivos del tren inferior, o una combinación de ambos). Sus resultados mostraron que todos los protocolos de calentamiento generaron mejoras similares del rango de movimiento. Aguilar et al.³¹ compararon diversos protocolos de calentamiento (protocolo basado en actividades de locomoción y estiramientos dinámicos vs estiramientos estáticos), encontrando una mejora de 6,5° en el test de extensión activa de rodilla en el grupo que realizó el protocolo más dinámico. Por el contrario, no encontraron cambios significativos en el grupo que solo realizó estiramientos estáticos de la musculatura de los miembros inferiores. En concordancia con el presente estudio, un protocolo de calentamiento basado en la combinación de tareas aeróbicas y estiramientos pasivos aumenta significativamente los valores alcanzados en diversos test que valoran la extensibilidad de la musculatura isquiosural³¹.

El aumento del rango de movimiento se ha explicado bien por un incremento de la tolerancia al estiramiento^{32,33} o bien por cambios mecánicos/estructurales en las características viscoelásticas de la musculatura³⁴. El aumento de la distancia alcanzada en el presente estudio podría explicarse más por un incremento en la tolerancia al estiramiento, que se considera como la causa primaria de las mejoras en la extensibilidad muscular a corto plazo³⁵.

Un aspecto importante al realizar un protocolo de calentamiento es el tiempo que permanecen sus efectos una vez ha finalizado el mismo. En este sentido, otro de los principales hallazgos del presente estudio fue que la mejora de la distancia alcanzada en el test *sit-and-reach* se mantuvo hasta 10 minutos después de haber finalizado el calentamiento. No es posible establecer hasta qué momento permanecen dichos efectos, ya que no se realizaron mediciones posteriores. Otros estudios también han analizado el tiempo que permanecen las mejoras logradas en el rango de movimiento tras la aplicación de alguna intervención. Spornoga et al.²³ concluyeron que, tras una secuencia de estiramientos realizada en adultos jóvenes, aumentaba significativamente el rango de movimiento en el test de extensión activa de la rodilla, y el efecto se mantenía hasta 6 minutos después de haberlo terminado. Por

otro lado, DePino et al.²⁴, tras 4 estiramientos estáticos de 30 segundos, encontraron que las mejoras alcanzadas en la extensibilidad isquiosural se mantenían hasta 3 minutos después de finalizarlo. Murphy et al.³ encontraron, tras aplicar un protocolo de calentamiento basado en la combinación de locomoción aeróbica seguido de estiramientos estático-pasivos, un aumento del rango de movimiento articular hasta 30 minutos después de la intervención. Del mismo modo, procedimientos que incluían un calentamiento aeróbico de 4 minutos de duración obtuvieron un efecto mantenido en el tiempo respecto al rango de movimiento de al menos 15 minutos tras la intervención²⁷.

La distancia alcanzada en el test *sit-and-reach* supone una medida indirecta de la extensibilidad isquiosural, y está condicionada por diversos factores, tales como la amplitud de movimiento de flexión anterior de la pelvis, la disposición angular del raquis torácico y lumbar, así como la relación de parámetros antropométricos y la antepulsión escapulo-humeral^{36,37}. El aumento de la distancia en el test *sit-and-reach* tras la aplicación de actividades de locomoción y/o estiramientos de forma aislada o combinada podría deberse a cambios en la posición de la pelvis y/o el raquis, ya que los parámetros antropométricos de los participantes son los mismos en todas las mediciones. En este sentido, López-Miñarro et al.³⁸ encontraron que tras un protocolo de estiramientos estáticos de 8 min de duración en adultos jóvenes, se produjo un aumento significativo de la distancia alcanzada en el *sit-and-reach*, que se relacionaba con una mayor inclinación pélvica y flexión lumbar, junto a una reducción de la cifosis torácica. Dichos cambios son consistentes con otros estudios de corte transversal que comparan la disposición sagital del raquis en función de la extensibilidad isquiosural^{4,5,9}.

La principal aportación práctica del presente estudio está contextualizada en la aplicación de estos test en el ámbito educativo. En base a los resultados encontrados en el mismo, en el caso de valorar la extensibilidad isquiosural mediante este test en ámbito educativo tras la aplicación de un calentamiento basado en actividades de locomoción, movilidad y estiramientos, el profesorado debe intentar valorar a todo el grupo en los 10 minutos siguientes a finalizar el mismo, ya que así se asegura no generar un agravio comparativo si usa esta prueba como elemento de evaluación.

Otra variable que debería ser analizada en futuros estudios es la variabilidad que se produce entre la distancia alcanzada en el test *sit-and-reach* cuando se realizan dos o más repeticiones del mismo, en función de haber realizado o no un protocolo de calentamiento previo. Por ejemplo, existen estudios que realizan dos veces el test y eligen la mejor marca de ambas³⁹, por lo que sería interesante valorar cómo evoluciona la diferencia entre ambas mediciones en función de incluir o no una actividad previa.

La principal limitación del estudio fue que se usó un test lineal para valorar la extensibilidad isquiosural. En

este sentido, se eligió utilizar el test *sit-and-reach* para valorar la extensibilidad isquiosural por ser uno de los más frecuentemente usados para medir la flexibilidad en ámbito educativo, ya que es simple de realizar, fácil de organizar y no requiere unas destrezas especiales por parte de los alumnos ni de los docentes a la hora de llevarlo a cabo¹³. Este test presenta una validez de baja a moderada como criterio de extensibilidad isquiosural en adolescentes⁴⁰ y es frecuentemente utilizado en pruebas de campo a gran escala. Además, la validez del test *sit-and-reach* está condicionada por el propio nivel de extensibilidad de la persona, de modo que ésta es menor en aquellas personas con una extensibilidad más reducida⁴¹. Los test angulares proporcionan medidas más válidas de la extensibilidad isquiosural de una persona. No obstante, el uso de un test angular en ámbito educativo es poco funcional, ya que requiere mucho más tiempo para medir, más formación y entrenamiento por parte del evaluador y un material específico más difícil de usar y económicamente más costoso. En este sentido, Mayorga-Vega et al.⁴² a partir de un meta-análisis plantean que si no se pueden usar test angulares, el *sit-and-reach* es una alternativa válida para estimar la extensibilidad isquiosural.

Conclusión

La realización de un protocolo de calentamiento, compuesto por una parte de locomoción con movilidad articular y otra parte de estiramientos estáticos, incrementa la distancia alcanzada en el test *sit-and-reach*. En el caso de que tras finalizar el calentamiento haya un tiempo de espera hasta realizar el test hay que tener en cuenta que las mejoras obtenidas por el efecto del calentamiento se mantienen, al menos, durante 10 minutos.

Referencias

1. Delgado M, Tercedor P. *Estrategias de intervención en educación para la salud desde la educación física*. Inde Publicaciones, Barcelona, 2002.
2. NSCA National Strength and Conditioning Association. *Principios del entrenamiento de la fuerza y del acondicionamiento físico*. Editorial Médica Panamericana, Madrid (2007).
3. Murphy JR, Di Santo MC, Alkanani T, Behm DG. Aerobic activity before and following short-duration static stretching improves range of motion and performance vs. a traditional warm-up. *Appl Physiol Nutr Metab* 2010; 35 (5): 679-90.
4. Muyor JM, Alacid F, Rodríguez-García PL, López-Miñarro PA. Influencia de la extensibilidad isquiosural en la morfología sagital del raquis e inclinación pélvica en deportistas. *Int J Morphol* 2012; 30 (1): 176-81.
5. López-Miñarro PA, Alacid F. Influence of hamstring muscle extensibility on spinal curvatures in young athletes. *Sci Sports* 2010; 25 (4): 188-93.
6. Jones MA, Stratton G, Reilly T, Unnithan VB. Biological risk indicators for recurrent non-specific low back pain in adolescents. *Br J Sports Med* 2005; 39 (3): 137-40.
7. Handrakis JP, Friel K, Hoeffner F, Akinkunle O, Genova V, Isakov E, Mathew J, Vitulli F. Key characteristics of low back

- pain and disability in college-aged adults: a pilot study. *Arch Phys Med Rehabil* 2012; 93 (7): 1217-24.
8. Cabry J, Shiple BJ. Increasing hamstring flexibility decreases hamstring injuries in high school athletes. *Clin J Sport Med* 2000; 10 (4): 311-2.
 9. López-Miñarro PA, Muyor JM, Alacid F. Influence of hamstring extensibility on sagittal spinal curvatures and pelvic tilt in high-trained young kayakers. *Eur J Sports Sci* 2012; 12 (6): 469-74.
 10. López-Miñarro PA, Muyor JM, Alacid F, Vaquero-Cristóbal R, López-Plaza D, Isorna M. Comparison of hamstring extensibility and spinal posture between kayakers and canoeists. *Kinesiology* 2013; 45 (2): 163-70.
 11. Mikkelsen LO, Nuppenon H, Kaprio J, Kautiainen H, Mikkelsen M, Kujala U. Adolescent flexibility, endurance strength, and physical activity as predictors of adult tension neck, low back pain, and knee injury: A 25 year follow up study. *Br J Sports Med* 2006; 40 (2): 107-13.
 12. Hestbaek L, Leboeuf-Yde C, Kyvik KO, Manniche C. The course of low back pain from adolescence to adulthood. Eight year follow up of 9600 twins. *Spine* 2006; 31 (4): 468-72.
 13. Rodríguez PL, Santonja F, López-Miñarro PA, Sáinz de Baranda P, Yuste JL. Effect of physical education stretching programme on sit-and-reach score in schoolchildren. *Sci Sport* 2008; 23 (3): 170-5.
 14. Mayorga-Vega D, Merino-Marban R, Garrido FJ, Viciano J. Comparison between warm-up and cool-down stretching programs on hamstring extensibility gains in primary schoolchildren. *Phys Act Rev* 2014; 1: 16-24.
 15. Sánchez Rivas E, Mayorga-Vega D, Fernández Rodríguez E, Merino-Marbán R. Efecto de un programa de estiramiento de la musculatura isquiosural en las clases de educación física en Educación Primaria. *J Sport Health Res* 2014; 6 (2): 159-68.
 16. Merino-Marban R, Mayorga-Vega D, Fernandez-Rodriguez E, Vera Estrada F, Viciano J. Effect of a physical education-based stretching programme on sit-and-reach score and its posterior reduction in elementary schoolchildren. *Eur Phys Edu Rev* 2015; 21 (1): 83-92.
 17. Mayorga-Vega D, Merino-Marban R, Vera Estrada F, Viciano J. Effect of a short-term physical education-based flexibility program on hamstring and lumbar extensibility and its posterior reduction in Primary schoolchildren. *Kinesiology* 2014; 46 (2): 227-33.
 18. Mayorga-Vega D, Merino-Marban R, Sánchez-Rivas E, Viciano J. Effect of a short-term static stretching training program followed by five weeks of detraining on hamstring extensibility in children aged 9-10 years. *J Phys Edu Sport* 2014; 14 (3): 355-9.
 19. Moreira RFC, Akagia FH, Wuna PYL, Moriguchia CS, Satoa TO. Effects of a school based exercise program on children's resistance and flexibility. *Work* 2012; 41 (suppl 1): 922-8.
 20. González-Gálvez N, Carrasco Poyatos M, Marcos Pardo PJ, Feito Y. The effect of pilates method in scholar's trunk strength and hamstring flexibility: gender differences. *International J Med Health Pharmaceut Biomed Eng* 2014; 8 (6): 348-51.
 21. Mayorga-Vega D, Merino-Marban R, Garrido FJ, Viciano J. Comparison between warm-up and cool-down stretching programs on hamstring extensibility gains in primary schoolchildren. *Phys Act Review* 2014; 2: 16-24.
 22. Monleón C, Pablos A, Carnide F, Martín M, Pablos C. Effects of a rhythmic and choreographic program in obese and overweight participants. *Nutr Hosp* 2014; 30(3): 622-8.
 23. Spornoga SG, Uhl TL, Arnold BL, Gansneder BM. Duration of maintained hamstring flexibility after a one-time, modified hold-relax stretching protocol. *J Athl Train* 2001; 36 (1): 44-8.
 24. DePino GM, Webright WG, Arnold BL. Duration of maintained hamstring flexibility after cessation of an acute static stretching protocol. *J Athl Train* 2000; 35 (1): 56-9.
 25. O'Sullivan K, Murray E, Sainsbury D. The effect of warm-up, static stretching and dynamic stretching on hamstring flexibility in previously injured subjects. *BMC Musculoskelet Disord* 2009; 10: 37.
 26. Zakas A. The effect of stretching duration on the lower-extremity flexibility of adolescent soccer players. *J Bodyw Mov Ther* 2005; 9 (3): 220-5.
 27. Perrier ET, Pavol MJ, Hoffman MA. The acute effects of a warm-up including static or dynamic stretching on countermovement jump height, reaction time, and flexibility. *J Strength Cond Res* 2011; 25 (7): 1925-31.
 28. Wenos DL, Konin JG. Controlled warm-up intensity enhances hip range of motion. *J Strength Cond Res* 2004; 18 (3): 529-33.
 29. Rosario JL, Foletto, A. Comparative study of stretching modalities in healthy women: Heating and application time. *J Bodyw Mov Ther* 2015; 19 (1): 3-7.
 30. Zakas A, Grammatikopoulou M, Zakas N, Zahariadis P, Vamvakoudis E. The effect of active warm-up and stretching on the flexibility of adolescent soccer players. *J Sports Med Phys Fitness* 2006; 46 (1): 57-61.
 31. Aguilar AJ, DiStefano LJ, Brown CN, Herman DC, Guskiewicz KM, Padua DA. A dynamic warm-up model increases quadriceps strength and hamstring flexibility. *J Strength Cond Res* 2012; 26 (4): 1130-41.
 32. Halbertsma JPK, Goeken LNH. Stretching exercises: effect on passive extensibility and stiffness in short hamstrings of healthy subjects. *Arch Phys Med Rehabil* 1994; 75 (9): 976-81.
 33. Reid DA, McNair PJ. Passive force, angle, and stiffness changes after stretching of hamstring muscles. *Med Sci Sports Exerc* 2004; 36 (11): 1944-8.
 34. Aquino CF, Fonseca ST, Gonçalves GG, Silva PL, Ocarino JM, Mancini MC. Stretching versus strength training in lengthened position in subjects with tight hamstring muscles: a randomized controlled trial. *Man Ther* 2010; 15 (1): 26-31.
 35. LaRoche DP, Connolly DA. Effects of stretching on passive muscle tension and response to eccentric exercise. *Am J Sports Med* 2006; 34 (6): 1000-7.
 36. López-Miñarro PA, García A, Rodríguez PL. Comparación entre diferentes test lineales de medición de la extensibilidad isquiosural. *Apunts. Educación Física y Deporte* 2010; 99: 56-64.
 37. López-Miñarro PA, Sáinz de Baranda P, García R, Toro O. A comparison of the spine posture among several sit-and-reach test protocols. *J Sci Med Sport* 2007; 10 (6): 456-62.
 38. López-Miñarro PA, Muyor JM, Belmonte F, Alacid F. Acute effects of hamstring stretching on sagittal spinal curvatures and pelvic tilt. *J Hum Kinet* 2012; 31: 69-78.
 39. Arriscado D, Muros JJ, Zabala M, Dalmau JM. Relación entre condición física y composición corporal en escolares de primaria del norte de España (Logroño). *Nutr Hosp* 2014; 30 (2): 385-94.
 40. Castro-Piñero J, Chillón P, Ortega FB, Montesinos JL, Sjöström M, Ruiz JR. Criterion-related validity of sit-and-reach and modified sit-and-reach test for estimating hamstring flexibility in children and adolescents aged 6-17 years. *Int J Sports Med* 2009; 30 (9): 658-62.
 41. López-Miñarro PA, Rodríguez PL. Hamstring muscle extensibility influences the criterion-related validity of sit-and-reach and toe-touch tests. *J Strength Cond Res* 2010; 24 (4): 1013-8.
 42. Mayorga-Vega D, Merino-Marban R, Viciano J. Criterion-Related Validity of Sit-and-R reach Tests for Estimating Hamstring and Lumbar Extensibility: a Meta-Analysis. *J Sports Sci Med* 2014; 13 (1): 1-14.



Original/Deporte y ejercicio

Physical fitness, adiposity and testosterone concentrations are associated to playing position in professional basketballers

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Abstract

The effects of basketball on basal concentrations of testosterone and cortisol and its associations to body composition and physical performance remain to be determined.

Aim: the main aim of this study was to determine the effects of playing position on physical fitness, percentage of body fat and hormonal profile in professional basketball players (BP).

Method: jump performance (SJ, CMJ and ABK), 30 m running speed and treadmill $\text{VO}_{2\text{max}}$ tests were conducted in 12 male BP (24.1 years) from the first division league of Spain (ACB). The percentage of body fat was determined from anthropometry, and hemoglobin, glucose, testosterone and cortisol concentrations were measured from fasting blood samples. BP were divided into 3 groups depending on playing positions: guards (GU), forwards (FW) and centers (CE) ($n = 4$ in each group).

Results: GU had greater percentage of body fat (%BF) than CE ($p < 0.05$). CE developed greater positive mechanical impulse than GU in all jump types ($p < 0.05$) and achieved higher maximal instantaneous power than GU and FW in the SJ and ABK ($p < 0.05$). Centers had more plasma testosterone than guards ($p < 0.05$). All groups a similar relative $\text{VO}_{2\text{max}}$.

Conclusion: center position was associated to lower adiposity and higher jumping performance than playing as guards. All playing positions induced a similar effect on aerobic power.

(Nutr Hosp. 2015;31:2624-2632)

DOI:10.3305/nh.2015.31.6.8977

Key words: Basketball. Fat. $\text{VO}_{2\text{max}}$. Testosterone. Cortisol.

CONDICIÓN FÍSICA, ADIPOSIDAD Y CONCENTRACIONES DE TESTOSTERONA ESTÁN ASOCIADAS A LA POSICIÓN DE JUEGO EN BALONCESTISTAS PROFESIONALES

Resumen

Los efectos de jugar al baloncesto sobre las concentraciones basales de testosterona y cortisol, así como su asociación a la composición corporal y el rendimiento físico aún están por determinarse.

Objetivo: el principal objetivo de este estudio fue determinar los efectos de la posición de juego sobre la condición física, el porcentaje de grasa corporal y el perfil hormonal en jugadores de baloncesto profesionales (BP).

Metodología: la capacidad de salto (SJ, CMJ y ABK), la velocidad en 30 m y el $\text{VO}_{2\text{max}}$ en tapiz rodante se midió en 12 varones BP (24,1 años) pertenecientes a la primera división de la liga de España (ACB). El porcentaje de grasa corporal se determinó a partir de la antropometría, y las concentraciones de hemoglobina, glucosa, testosterona y cortisol se midieron a partir de muestras de sangre en ayunas. Los baloncestistas se dividieron en tres grupos en función de las posiciones de juego: bases (GU), aleros (FW) y pivots (CE). Resultados: GU tuvo mayor porcentaje de grasa corporal (% GC) que CE ($p < 0,05$). CE desarrolló mayor impulso positivo mecánico que GU en todos los tipos de saltos ($p < 0,05$) y logró mayor potencia instantánea máxima que GU y FW en el SJ y ABK ($p < 0,05$). Los pivots tenían más testosterona plasmática que los bases ($p < 0,05$). Todos los grupos mostraron similar $\text{VO}_{2\text{max}}$.

Conclusión: la posición de pivots fue asociada a una menor adiposidad y a una mayor capacidad de salto en comparación con los bases. Todas las posiciones de juego indujeron un efecto similar sobre la potencia aeróbica.

(Nutr Hosp. 2015;31:2624-2632)

DOI:10.3305/nh.2015.31.6.8977

Palabras clave: Baloncesto. Grasa. $\text{VO}_{2\text{max}}$. Testosterona. Cortisol.

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Recibido: 16-III-2015.
Aceptado: 23-IV-2015.

Abbreviations

ABK: Abalakov.
ACB: First division league of Spain.
BP: Basketball players.
CE: Centers.
CMJ: Counter movement jump.
FW: Forwards.
GU: Guards.
IUA: Use of arm-swing.
M: Normalized for body size.
MIP: The maximal instantaneous power.
MIV: The maximal instantaneous vertical velocity.
MP: The mean power.
NBA: National basketball association league of United States.
PI: The positive mechanical impulse.
RFD: The mean rate of force development.
S: Power.
SJ: Squat jump.
VCO₂: CO₂ production.
VE L/min, VO₂ L/min: Ventilation.
VHJ: The vertical height jump.
VO₂: Measure oxygen uptake.
VO₂max: Maximal oxygen uptake.
VT: Vertical velocity at takeoff.
VT₂: Ventilatory threshold.
Hemoglobin (Hb) and hematocrit (Hct) were measured by microcentrifugation (Allegra™ 25R Centrifuge, Beckman Coulter, California, USA) and cyanometHb (Boehringer Mannheim GmbH test combination, Mannheim, Germany), respectively.
SD: Mean value ± standard deviation.
LSD: Fisher's least significant difference.
BMI: Bodymassindex.
RSA: Repeated Sprint Ability.

Introduction

Basketball is one of the most popular sports throughout the world. The first division of the Spanish basketball league [Basketball Clubs Association (ACB)] is considered the best league in the world by most coaches and players, after the NBA (National Basketball Association league of United States)¹. Physical characteristics of professional basketball players have been reported in players enrolled in different basketball leagues^{1,2}, but limited data is available with ACB or NBA players^{3,4}. However it remains to be determined the influence of playing position on physical fitness and fat mass in professional basketball players.

Basketball requires the combination of low and high-intensity actions⁵. Also the RSA relevance as determinant of ability to reproduce high intensity efforts thought the entire basketball game should not be omitted⁶. A major part of these actions are high-intensity and recruits the anaerobic metabolism^{5,7}, among them the jumps and sprints are the most frequent^{2,5,8}. Together

with jumping and sprinting, aerobic power has been recently associated to performance in Tunisian basketball players². These impairments in performance highlight that coaches should plan conditioning programs based on repeated sprint and repeated jump ability, strength, sprint and jump capacities following specific sessions⁹. In this population maximum oxygen consumption (VO₂max) positively correlated to the time spent in high-intensity actions during a basketball match⁸. Low-intensity running or walking during the short periods of time between high-intensity actions stimulates aerobic metabolism and accelerates the recovery^{2,10,11}, which allows maintaining anaerobic power and capacity during the basketball game¹². It remains to be determined whether jumping, sprinting performance and VO₂max is associated to playing position in ACB players.

Testosterone is an anabolic hormone which regulates body composition. High blood concentrations of testosterone are associated to increased muscle mass and strength in humans¹³ and decreased fat mass¹⁴. In contrast, cortisol is a catabolic hormone with opposite effects. A decrease in the testosterone/cortisol ratio can lead to overtraining syndrome, characterized by a decreased sport-specific physical performance¹⁵. Little information exists about the physiological profiles of professional basketball players^{4,5}. The effects of basketball on basal concentrations of testosterone and cortisol and its associations to body composition and physical performance remain to be determined. This information could be very useful to develop more specific training programs for basketball players.

The main aim of this study was to determine physical fitness, fat mass accumulation and hormonal profile of professional basketball players from the ACB league. A secondary aim was to test the hypothesis that playing position is associated to differences these variables.

Methods and Participants

Participants

Twelve male basketball players (24.1 ± 4.9 years) from a first division team of the ACB in a selective n agreed to enroll in the study. All players had been participating in the last 6 final stages (Play-offs) of the ACB and in the Eurocup Basketball (Union of European Basketball Leagues, ULEB Eurocup). Their current dedication to competitions, sport specific and physical conditioning training sessions was 24 hours per week. All participants performed a similar physical conditioning training program and used the same relative loads during the resistance training sessions. Players were assigned to 3 groups depending on their playing positions, guards (n=4), forwards (n=4), and centers (n=4). Each participant, as well as the basketball club were informed about the aims and procedures of the study and gave their informed written consent. Our selection of highly trained

and motivated basketballers. This study was based on our experience that competitive athletes are generally willing and able to withstand considerable discomfort. The coaches were informed carefully about the experimental procedures and the possible risk and benefits of the project with the approval of the local committee of ethics of the University of Las Palmas de Gran Canaria and gave written consent to participate in this study, which conformed to the Declaration of Helsinki.

The tests were conducted in two different days during the preparation phase of the season. The first day, subjects were asked to attend to the laboratory in fasting conditions for blood collection, anthropometrics determinations, and to perform an incremental exercise test on treadmill to measure $\text{VO}_{2\text{max}}$. At least 72 h later, the participants performed the jump tests and the 30 m running speed test.

Dynamic force

The forces generated during vertical jumps were measured with a force plate (Kistler, Winterthur, Switzerland) and were used to determine the jumping height as previously reported¹⁶. Each participant performed three kinds of maximal jumps following the protocol proposed by Bosco et al¹⁷. The squat jump (SJ): starting with knees bent at 90° and without previous counter movement, the counter movement jump (CMJ): starting from a standing position that allows counter movement to be able to reach knee bending angles of around 90° just before impulsion, and the “Abalakov jump” (ABK), same protocol than the CMJ but with arms free to help the subject to jump up.

The vertical height jump (VHJ), vertical velocity at takeoff (VT), the mean rate of force development (RFD), the positive mechanical impulse (PI), the mean power (MP), the maximal instantaneous power (MIP) and the maximal instantaneous vertical velocity (MIV) were determined by the best of three trials in all kinds of jumps, SJ, CMJ and ABK.

The RFD was obtained by linear regression of the force time relationship during the impulse phase of the SJ, CMJ and ABK between 25% and 75% of the peak force¹⁶. The “index of elasticity” was determined by calculating the difference between the CMJ and SJ vertical jump height, multiplied by one hundred and divided by SJ vertical jump height¹⁸.

$$IE = \frac{(CMJ - SJ) * 100}{SJ}$$

In addition, the index “Use of Arm-swing” (IUA) was calculated for the SJ and CMJ with the following formula¹⁸.

$$IUA_{sj} = \frac{(ABK - SJ) * 100}{SJ}$$

$$IUA_{cmj} = \frac{(ABK - CMJ) * 100}{CMJ}$$

Parameters related to the strength and power (S) were normalized for body size (M) through an allometric scaling model ($S = a \cdot M^b$) based on the simple theory of geometric similarity proposed by Markovic and Jaric¹⁹.

$$S_n = \frac{S}{M^{0.67}}$$

Running speed test

A 30-m sprint, starting in a stationary position, was performed on the basketball court. Time was recorded by 7 photocells prepared every 5 meters (Multicellular Equipment General ASDE, Valencia). The timer was automatically activated upon crossing the first cell and corresponding records were collected at distances of 5 and 30 meters. To perform this test subjects were encouraged to run as fast as possible the 30 meters. Each subject performed 3 trials and the fastest was taken as the representative value of the test.

Percentage of body fat

The protocol “O-Scale System” was used to determine the anthropometric measurements²⁰, which includes a body mass, height, skinfolds and circumferences measurements. The values the percentage of body fat were determined according to athlete-specific equation of Jackson and Pollock²¹. All skinfolds were measured using a skinfold caliper (Holtain, Ltd., Crymych, United Kingdom) which exerts a constant pressure of 10 g/mm² and has an accuracy of 0.1 mm, as described by Ara et al²².

Treadmill $\text{VO}_{2\text{max}}$ Test

To perform the incremental test, the EKG electrodes were placed to monitor the heart rate response (Schiller AT12). Then a face mask was connected to the gas analyzer (Vmax N29; Sormedics, California, USA) to measure oxygen uptake (VO_2) and CO_2 production (VCO_2). When subjects were ready, they started the exercise test on a treadmill (Power-Jog M30) with a constant slope of 1%, starting with a warming up of 3 minutes at a constant speed of 6 km/h, over a distance of 300 meters. Then a ramp incremental speed exercise was started at 8 km/h, and the speed was increased by 0.5 km/h every 30 seconds to exhaustion. Ventilation (VE) (L/min), VO_2 (L/min), heart rate (bpm) and the second ventilatory threshold have been determined as has been described by Lucia et al²³. The second ventilatory threshold (VT_2) have been defined as the point before a second exponential increase in VE and the O_2 equivalent accompanied by a non-linear increase in the CO_2 equivalent as described by Reinhard et al²⁴.

During the test, the values of the gas analyzer were captured breath by breath and averaged every 20 s.

Blood samples

The subjects reported to the laboratory at 8.00 after an overnight fast and an antecubital vein was catheterized. After 10 min rest in the supine position a 20 ml blood sample was withdrawn. Serum glucose was measured by the hexokinase method using Gluco-quant reagents (Roche/Hitachi, 11876899216, Indianapolis, USA). Circulating concentrations of total testosterone and cortisol were determined using commercially available enzyme-linked immunosorbent assay (ELISA) kits (DRG Diagnostics, DRG Instruments GmbH, Marburg, Germany). Hemoglobin (Hb) and hematocrit (Hct) were measured by microcentrifugation (Allegra™ 25R Centrifuge, Beckman Coulter, California, USA) and cyanomet Hb (Boehringer Mannheim GmbH test combination, Mannheim, Germany), respectively.

Statistical Analyses

The data are presented as mean value $\pm$ standard deviation (SD). Differences between groups were tested using ANOVA with the Fisher's least significant difference (LSD) post hoc test. In addition, to determine if differences in physical fitness between playing positions could be accounted for height or weight, analy-

ses of covariance were performed with the body mass index (BMI) as covariate. Pearson correlation coefficients were calculated to determine the relationships between variables. Analysis were considered statistically significant when $P < 0.05$. The data were analysed using the statistical package SPSS, PC program, version 19. (SPSS Inc., USA).

Results

Physical characteristics

Physical characteristics of all basketball players are summarized in table I. Centers were taller than guards and forwards ($P < 0.05$), and heavier than guards ($P < 0.05$). The percentage of body fat was greater in guards than in centers ($P < 0.05$).

Physical fitness

Guards were faster than forwards, and centers, in the 5 first meters of the 30m running speed test ($P < 0.05$). This result in the 5 first meters was maintained after accounting by BMI. Moreover, guards were faster than centers at the end of 30 meters ($P < 0.05$). Guards were faster than forwards and center at the end of 30 meters after accounting by BMI ($P < 0.05$). In turn, forwards were faster than centers at the end of 30 meters ($P < 0.05$), and this result was maintained after accounting by BMI. Positive correlations were found

Table I
*Characteristics of professional basketball players belonging to the ACB league**

Variables	All players (n = 12)	Guards (n = 4)	Forwards (n = 4)	Center (n = 4)	Perimeter players (n = 7)	Inside players (n = 5)
Age (year)	24.1 $\pm$ 4.9	24.1 $\pm$ 7.3	24.4 $\pm$ 5.6	23.7 $\pm$ 1.7	25.2 $\pm$ 5.9	22.5 $\pm$ 3.0
Height (cm)	196.4 $\pm$ 10.1	186.8 $\pm$ 4.4†	195.5 $\pm$ 7.4‡	206.9 $\pm$ 5.6	189.3 $\pm$ 5.6&	206.3 $\pm$ 5.0
Weight (kg)	91.8 $\pm$ 10.6	83.2 $\pm$ 4.9†	90.4 $\pm$ 8.2	101.7 $\pm$ 9.6	86.9 $\pm$ 7.9	98.6 $\pm$ 10.9
Body fat (%)	10.3 $\pm$ 1.0	10.9 $\pm$ 0.7†	10.3 $\pm$ 1.2	9.5 $\pm$ 0.6	10.7 $\pm$ 0.9&	9.5 $\pm$ 0.5
Hemoglobin (mmol·L ⁻¹)	14.5 $\pm$ 0.9	14.8 $\pm$ 1.2	14.7 $\pm$ 0.5	14.0 $\pm$ 0.9	14.7 $\pm$ 0.9	14.3 $\pm$ 0.9
Hematocrit (%)	43.4 $\pm$ 2.3	44.2 $\pm$ 2.2	43.9 $\pm$ 2.5	41.8 $\pm$ 2.0	43.7 $\pm$ 2.1	42.9 $\pm$ 2.7
Testosterone (ng/mL)	6.8 $\pm$ 1.7	6.0 $\pm$ 0.5†	7.0 $\pm$ 2.5	7.8 $\pm$ 1.2	6.0 $\pm$ 1.3&	8.3 $\pm$ 1.3
Cortisol (μ g/dL)	18.0 $\pm$ 7.8	20.8 $\pm$ 4.8	18.4 $\pm$ 8.6	13.7 $\pm$ 10.9	19.0 $\pm$ 6.9	16.1 $\pm$ 10.2
VO ₂ max (mL/kg/min)	57.7 $\pm$ 5.5	58.0 $\pm$ 5.0	57.5 $\pm$ 4.6	57.5 $\pm$ 8.7	57.0 $\pm$ 4.3	58.7 $\pm$ 7.5
HRmax (b·min ⁻¹)	188.9 $\pm$ 6.8	191.8 $\pm$ 10.3	188.7 $\pm$ 1.5	185.3 $\pm$ 3.2	190.7 $\pm$ 8.2	186.3 $\pm$ 3.2
VT ₂ (% VO ₂ max)	90.4 $\pm$ 4.8	90.9 $\pm$ 5.3	89.4 $\pm$ 7.1	90.8 $\pm$ 2.9	89.6 $\pm$ 5.9	91.6 $\pm$ 2.9
HR _{VT2} (b·min ⁻¹)	178.2 $\pm$ 8.6	177.8 $\pm$ 11.4	177.0 $\pm$ 5.2	180.0 $\pm$ 10.1	177.0 $\pm$ 9.4	180.0 $\pm$ 8.3

* Values are expressed as mean $\pm$ SD; HR max = maximal heart rate obtained in the treadmill VO₂max test; VT₂ = 2nd ventilatory threshold

† Statistically significant at $p < 0.05$ for guards vs. center

‡ Statistically significant at $p < 0.05$ for forwards vs. center

& Statistically significant at $p < 0.05$ for perimeters vs. inside players

between height and the first 5 meters and 30 meters running time ($r = 0.77$, $P < 0.01$ and $r = 0.78$, $P < 0.01$; respectively). These correlations were maintained after accounting by BMI ($r = 0.79$, $P < 0.01$ and $r = 0.76$, $P < 0.01$; respectively).

The jumping height during SJ, CMJ and ABK was similar in guards, forwards and centers; even when it was adjusted by BMI. In all type of jumps, the positive mechanical impulse and the maximal instantaneous power were higher in centers than in guards (all $P < 0.05$), and mean power was also higher during CMJ and ABK ($P < 0.05$). The positive mechanical impulse remained increased in centers than in guards in all type of jumps when the results were adjusted by BMI ($P < 0.05$). In turn, when the maximal instantaneous power was adjusted by BMI showed significant higher values in centers than in guards in SJ ($P < 0.05$), and it showed a trend in CMJ and ABK ($P = 0.06$ and $P = 0.06$; respectively). However, the mean power was similar after accounting by BMI.

Maximal instantaneous power was greater in centers than in forwards during SJ ($P < 0.05$). However, when the differences between centers and forwards were performed after accounting by BMI, the results showed that center had higher positive mechanical impulse in CMJ ($P < 0.05$), and it showed a trend in SJ and ABK ($P = 0.08$ and $P = 0.07$; respectively). Moreover, the maximal instantaneous power showed a trend in SJ after accounting by BMI ($P = 0.06$).

When all players were considered together, the IE was positively correlated with the IUA_{sj} ($r = 0.94$, $p < 0.05$) and inversely correlated with height ($r = -0.67$, $p < 0.05$); even when the results were accounted by BMI.

No significant differences by playing positions were found in VO_{2max} , second ventilatory threshold and HR_{max} .

Hormones and blood measurements

Table I summarizes the hormonal profile of the basketball players. Plasma testosterone was higher in centers than in guards ($P < 0.05$). No differences between groups were observed Hb, Hct, glucose and cortisol (Table I).

When all subjects were considered together an inverse correlation was observed between plasma testosterone and the percentage of body fat ($r = -0.79$; $P < 0.05$) (Fig. 1).

Discussion

To our knowledge, this is the first study that has examined the differences between playing positions in anthropometry measurements, maximum speed, explosive power of lower limbs, maximal oxygen consumption and the second ventilatory threshold in

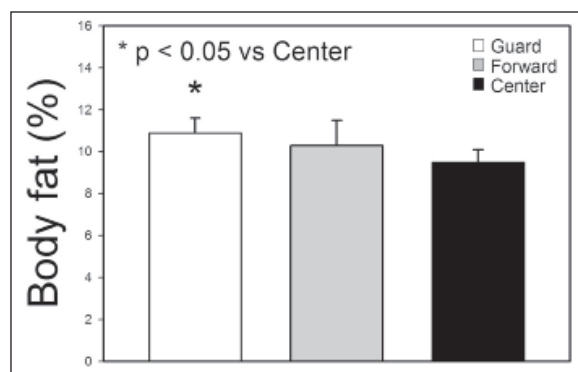


Fig. 1.—Percentage of body fat divided by playing position. Guards had more percentage of body fat when were compared with centers ($p < 0.05$).

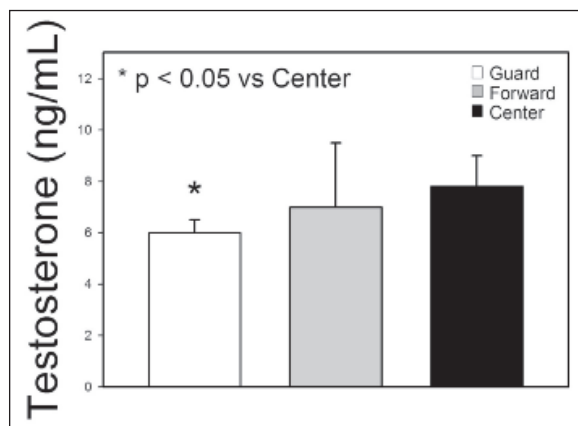


Figure 2. Plasma testosterone level divided by playing position. Plasma testosterone was higher in centers than guards ($p < 0.05$).

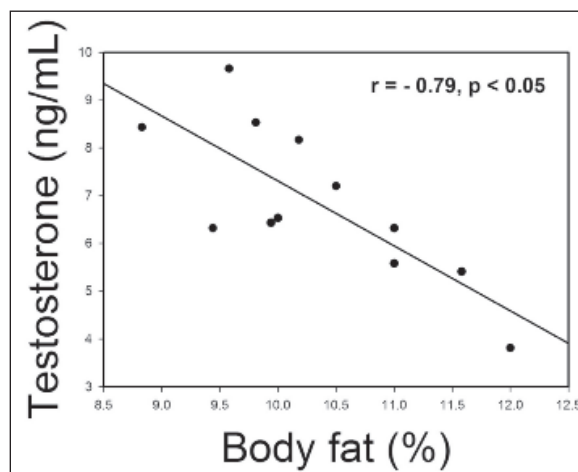


Figure 3. Correlation between Plasma testosterone and percentage of body fat. Our results showed that plasma testosterone had a negative correlation with percentage of body fat ($r = -0.79$; $p < 0.05$).

elite basketball players from ACB league. In agreement with previous studies our results show that, players who used to play close to the ring (inside players) where taller and heavier than the others^{1,25}. The height

Table II
Lower limbs explosive power and biomechanical performance of professional players belonging to the ACB league*

Variable	All players (n = 12)	Guards (n = 4)	Forwards (n = 4)	Center (n = 4)	Perimeter players (n = 7)	Inside players (n = 5)
VHJ (cm)	30.6 ± 5.5	30.1 ± 5.7	28.5 ± 3.2	33.2 ± 7.3	29.6 ± 4.6	31.9 ± 6.8
VT (m/s)	2.5 ± 0.3	2.5 ± 0.4	2.4 ± 0.1	2.5 ± 0.3	2.5 ± 0.3	2.5 ± 0.3
RFD (kgf·s ⁻¹)	690.7 ± 415.4	610.0 ± 370.0	703.7 ± 435.2	758.4 ± 539.8	669.2 ± 405.7	720.8 ± 475.0
PI (kgf·s ⁻¹)	23.1 ± 3.7	20.6 ± 2.1†	22.1 ± 3.0	26.7 ± 3.2	21.4 ± 2.7	25.5 ± 3.9
MIV (m/s)	2.5 ± 0.2	2.5 ± 0.2	2.5 ± 0.1	2.6 ± 0.3	2.5 ± 0.2	2.6 ± 0.3
MP (W)	1742.2 ± 310.6	1623.4 ± 362.8	1667.2 ± 217.0	1935.9 ± 314.2	1683.9 ± 275.7	1823.7 ± 370.2
MIP (W)	4242.4 ± 745.8	3639.4 ± 413.0††	4033.8 ± 389.9‡	5053.9 ± 543.9	3872.0 ± 448.8&	4760.9 ± 807.0
MPn (W/kg)	84.3 ± 12.6	83.9 ± 17.9	81.5 ± 8.1	87.6 ± 13.0	84.6 ± 12.7	84.0 ± 13.9
MIPn (W/kg)	204.7 ± 24.5	188.4 ± 21.3†	197.2 ± 10.8‡	228.6 ± 20.9	194.4 ± 16.9	219.2 ± 27.8
VHJ (cm)	36.8 ± 4.1	37.7 ± 3.8	35.6 ± 4.6	37.2 ± 4.9	37.4 ± 3.8	36.1 ± 4.9
VT (m/s)	2.7 ± 0.1	2.7 ± 0.1	2.6 ± 0.2	2.7 ± 0.2	2.7 ± 0.1	2.7 ± 0.2
RFD (kgf·s ⁻¹)	1159.8 ± 812.7	1345.4 ± 925.8	847.4 ± 249.3	1286.7 ± 1142.3	1106.1 ± 735.8	1235.1 ± 996.0
PI (kgf·s ⁻¹)	25.2 ± 3.3	22.9 ± 1.0††	24.6 ± 3.4	28.2 ± 2.8	23.9 ± 2.6	27.0 ± 3.5
MIV (m/s)	2.8 ± 0.1	2.8 ± 0.2	2.8 ± 0.1	2.8 ± 0.2	2.8 ± 0.1	2.8 ± 0.1
MP (W)	2689.9 ± 337.4	2472.9 ± 265.2†	2625.7 ± 330.9	2971.2 ± 252.7	2545.7 ± 312.4	2891.9 ± 281.7
MIP (W)	4706.6 ± 675.7	4159.2 ± 218.3††	4607.3 ± 605.9	5353.2 ± 537.6	4399.4 ± 521.4	5136.6 ± 671.8
MPn (W/kg)	130.1 ± 9.5	127.7 ± 8.8	128.5 ± 13.7	134.3 ± 5.6	127.7 ± 11.5	133.5 ± 5.2
MIPn (W/kg)	227.5 ± 19.8	215.1 ± 4.6†	225.1 ± 21.9	242.2 ± 20.8	220.7 ± 16.7	237.0 ± 21.5
IE (%)	22.6 ± 17.5	27.0 ± 13.0	26.1 ± 23.5	14.6 ± 16.7	28.0 ± 18.5	15.0 ± 14.5
VHJ (cm)	44.2 ± 4.4	43.7 ± 1.8	43.9 ± 4.3	45.0 ± 7.0	44.4 ± 2.8	43.9 ± 6.5
VT (m/s)	2.9 ± 0.1	2.9 ± 0.1	2.9 ± 0.1	3.0 ± 0.2	2.9 ± 0.1	2.9 ± 0.2
RFD (kgf·s ⁻¹)	639.7 ± 481.3	541.7 ± 235.5	680.1 ± 444.5	697.2 ± 759.6	556.9 ± 325.0	755.6 ± 670.7
PI (kgf·s ⁻¹)	27.7 ± 3.8	25.1 ± 1.7†	27.2 ± 3.4	30.9 ± 3.9	26.3 ± 2.9	29.7 ± 4.2
MIV (m/s)	3.0 ± 0.1	3.0 ± 0.1	3.0 ± 0.1	3.0 ± 0.2	3.0 ± 0.1	3.0 ± 0.2
MP (W)	2873.4 ± 448.1	2491.8 ± 276.9††	2847.3 ± 371.5	3281.2 ± 323.6	2666.6 ± 386.5&	3162.9 ± 385.3
MIP (W)	5753.2 ± 932.1	4991.7 ± 546.4††	5566.8 ± 605.8‡	6701.0 ± 709.2	5299.5 ± 662.7&	6388.3 ± 930.8
MPn (W/kg)	139.1 ± 17.4	128.7 ± 10.6	139.7 ± 19.5	148.9 ± 18.7	133.9 ± 16.9	146.4 ± 17.2
MIPn (W/kg)	277.6 ± 28.2	257.7 ± 19.1†	272.0 ± 17.7	303.2 ± 28.3	265.6 ± 20.0	294.6 ± 31.2
IUA _(SJ) (%)	47.4 ± 22.7	48.5 ± 23.8	55.4 ± 25.5	38.3 ± 21.5	52.7 ± 24.9	40.0 ± 19.0
IUA _(CMJ) (%)	20.2 ± 6.6	16.4 ± 7.7	23.6 ± 3.9	20.7 ± 7.2	19.2 ± 6.9	21.7 ± 6.7

* Values are expressed as mean ± SD; VHJ = vertical height jump; RFD = mean rate of force development; PI = positive mechanical impulse; MPn = mean power normalized by weight; MIPn = maximal instantaneous power normalized by weight; IE = index of elasticity; IUA = index of use of arm-swing.

† Statistically significant at p<0.05 and †† at p<0.01 for guards vs. center.

‡ Statistically significant at p<0.05 for forwards vs. center.

& Statistically significant at p<0.05 for perimeters vs inside players.

and heavy build of centers is useful in their physical low-post battles, in their responsibility at rebounds and to shoot near to basket²⁶.

In agreement with Parr *et al.*²⁷, the percentage of body fat was lower in centers than guards. In contrast to our findings, several studies have reported higher percentage of body fat in centers than in guards^{1,25}. It is known that there is an inverse correlation between fat mass and plasma testosterone. In support, in our study plasma testosterone was inversely correlated with percentage of body fat. In addition, a high plasma testosterone level in centers could facilitate the hypertrophic response to strength training¹³.

Basketball rules were changed by the “Fédération Internationale de Basketball” (FIBA) in the year 2000. Both the aerobic and anaerobic capacity has been measured in elite basketball players during the period before (1994-2000) and after (2001-2004). Cormery *et al.* have suggested that this change in rules is responsible for an increase in VO_2max , aerobic and anaerobic threshold of 7.8%, 12.8% and 7.3%, respectively. Furthermore, this increase was gradual between 2001 and 2004, while no difference was found between 1994 and 2000. Therefore, it may have been an increasing trend in VO_2max and anaerobic threshold along these last years, but no data exist in the literature to prove this hypothesis. However, our study showed normal values of VO_2max ($57.7 \pm 5.5 \text{ mL} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) similar to previous studies negating the possibility of such an increase in VO_2max with the change in rules, at least in the ACB players.

The second ventilatory threshold may reach values between 80-95% of VO_2max in well-trained athletes^{28,29}. In our players the second ventilatory threshold was reached at $90.5 \pm 5.4\%$ VO_2max with 178.2 ± 8.6 of HR_{VT} ($\text{b} \cdot \text{min}^{-1}$). This slight increase can be caused by rule changes that occurred in the year 2000 and also by changes in training routines mimicking much of the play style of the NBA, with higher physical demands. For example, centers are required to be faster because they need to play on the perimeter, the game speed is becoming higher and defenses are turning more aggressive.

On the other hand, it is important to analyze the lower limbs explosive power and maximal speed in 30 meter as McInnes *et al.*⁵ showed that basketball player performs (mean $\pm$ SD) 997 ± 183 movements during a match, of which 46 ± 12 were vertical jump shares and 105 ± 52 were short sprints^{5,30}. Similar values were found by Ben Abdelkrim *et al.*¹³ (mean $\pm$ SD) 1050 ± 51 movements during a match, where 44 ± 7 were vertical jump actions, 55 ± 11 sprints and 97 ± 14 medium-high intensity run. In the latest study, they note that the actions of high intensity (sprints, jumps and high-specific movements), 22.8% belong to pure actions of jumps, to which we would have to add a percentage belong to the 48.7% of high-specific movements, because it includes shot actions and lay-ups that require jumping. The remaining 28.5% belongs to the movements during a match are performed in sprint actions³¹.

Performance of 27-m sprint test was significantly correlated with playing time in NCAA Division I male basketball players³² nevertheless performance of 20-m sprint test was not significantly correlated to playing position in women basketball players from the English National League Division II³³. However, in our study we found that guards and forwards were faster than centers in 30 meters. In addition, player's height and 30-m speed (m/s) were inversely correlated ($r = -0.77$; $p \leq 0.05$). The differences found among playing positions in the 30-m sprint test showed that height may be a limiting factor on the maximum speed in basketball players.

No significant differences between playing position were found in other studies in 20-m sprint performance³³. In addition, we found that guards were faster than centers in the first 5 meters of the 30-m sprint test. Thus, the velocity of the first meters with the ball domain may be a limiting factor to make a successful penetration.

The vertical height jump CMJ was assessed by Ostojic *et al.*¹ on using a force platform (Newtest Power-timer Testing System, Oulu, Finland), resulting in average 54.4 ± 7.7 cm, 59.7 ± 9.6 cm (Guards), 57.8 ± 6.5 cm (Forwards) and 54.6 ± 6.9 cm (Centers). Average vertical jump height was not statistically different between different positional roles, although vertical jump power was significantly higher in centers ($p < 0.01$) than in guards. Estimated percentage of fast muscle fibers (fast twitch) was similar in all positional roles.

Several authors have reported that the mean of vertical height jump (VHJ) in male basketball players was more than 60 cm in contrast with our results 30.6 ± 5.5 cm for SJ, 36.8 ± 4.1 cm for CMJ and 44.2 ± 4.4 cm for ABK^{1,5}, however the jumps were not performed on a force platform or was measured trough the center of gravity. Our results agree with a recent research in elite Italian male players³³. For vertical height jumps (VHJ), we found similar results among different positional roles as previously reported¹. Furthermore, we obtained higher values in centers than the other players, similar to male basketball players of NCAA division I²⁵.

The measurement of index of elasticity (IE) is critical in sports where jumping ability plays an important role³⁴ and therefore it is advisable to carry out tests to assess this capability. However, no differences between playing position were found in our study. The correlation between IE and $\text{IUA}_{(\text{sj})}$ showed the importance of muscle elasticity in the countermovement jump and arms swing. On the other hand, the strong inverse correlations between $\text{VHJ}_{(\text{sj})}$ with IE and $\text{IUA}_{(\text{sj})}$ showed that players who jump less than others, they get to optimize their jump performance with the countermovement and the arms swing.

Some studies have compared performance during jump and sprint tests between playing positions players of different competitive levels and age^{1,2,25,33,36}. A pioneer study conducted in players of the National Collegiate Athletic Association (NCAA, United Sta-

tes) showed that vertical jump power was significantly higher in forwards and centers than in guards²⁵. Ostojic et. al.¹ obtained similar results in Serbian first national league players and found no differences in jumping height between playing positions. Futures studies should be analyze these differences between men and women.

Conclusion

In summary, this study shows that centers are heavier, taller and are able to develop greater power during vertical jumps compared to guards and forwards. Inside players have a higher basal plasma testosterone concentration and lower percentage of body fat than perimeter players. However, perimeter player are faster than inside players. Finally, our study shows that VO_2max in ACB players is similar to other European leagues players. The values obtained in this study might be useful for coaches and physical trainers, as it provides the necessary information to focus on the importance of physical fitness according to the playing position of professional basketball players.

Acknowledgments

The study was supported by Ministerio de Educación y Ciencia (DEP2006-56076-C06-04/ACTI) and FEDER, Consejería de Educación, Cultura y Deportes del Gobierno de Canarias (2006/179 0001 and FEDER).

The authors thank José A.L. Calbet for his critical review of the manuscript, José Navarro de Tuero for his excellent technical assistance, all professional basketball players who volunteered in this study and the ACB team for their collaboration.

Conflict of Interest

The authors have no conflicts of interest with regard to this research or its funding.

References

- Ostojic SM, Mazic S, Dikic N. Profiling in basketball: physical and physiological characteristics of elite players. *J Strength Cond Res.* 2006; 20: 740-44.
- Ben Abdelkrim N, Chaouachi A, Chamari K, et al. Positional role and competitive-level differences in elite-level men's basketball players. *J Strength Cond Res.* 2010; 24: 1346-55.
- Gomez MA, Lorenzo A, Barakat R, et al. Differences in game-related statistics of basketball performance by game location for men's winning and losing teams. *Percept Mot Skills.* 2008; 106: 43-50.
- Shelling X, Calleja-González J, Terrados N. Hormonal analysis in elite basketball during a season. *Rev Psicol Deporte.* 2009; v 18: 363-67.
- McInnes SE, Carlson JS, Jones CJ, et al. The physiological load imposed on basketball players during competition. *J Sports Sci.* 1995; 13: 387-97.
- Stojanovic Md, Ostojic Sm, Calleja-González J, et al. Correlation Between Explosive Strength, Aerobic Power And Repeated Sprint Ability In Elite Basketball Players. *J Sports Med Phys Fitness.* 2012; Aug;52(4): 375-81.
- Graham JE, Douglas Boatwright J, Hunsford MJ, et al. Effect of active vs. passive recovery on repeat suicide run time. *J Strength Cond Res.* 2003; 17: 338-41.
- Ben Abdelkrim N, El Fazaa S, El Ati J. Time-motion analysis and physiological data of elite under-19-year-old basketball players during competition. *Br J Sports Med.* 2007; 41: 69-75.
- Delextrat A, Trochym J, Calleja-González J. Effect Of A Typical In-Season Week On Strength Jump And Sprint Performances In National Level Female Basketball Players. *J Sports Med Phys Fitness.* 2012; Apr;52(2):128-36.
- Delextrat A, Calleja-González J, Hippocrate A, Clarke ND. (2013). Effects of sports massage and intermittent cold-water immersion on recovery from matches by basketball players. *J Sports Sci* 2013; Jan;31(1):11-9.
- Dorado C, Sanchis-Moysi J, Calbet JA. Effects of recovery mode on performance, O_2 uptake, and O_2 deficit during high-intensity intermittent exercise. *Canadian J Appl Phys.* 2004; 29: 227-44.
- Cormery B, Marcil M, Bouvard M. Rule change incidence on physiological characteristics of elite basketball players: a 10-year-period investigation. *Br J Sports Med.* 2008; 42: 25-30.
- Ahtiainen JP, Pakarinen A, Alen M, et al. Muscle hypertrophy, hormonal adaptations and strength development during strength training in strength-trained and untrained men. *Eur J Appl Phys.* 2003; 89: 555-63.
- Rosenfield RL, Bordini B. Evidence that obesity and androgens have independent and opposing effects on gonadotropin production from puberty to maturity. *Brain Res.* 2010; 1364: 186-97.
- Adlercreutz H, Harkonen M, Kuoppasalmi K, et al. Effect of training on plasma anabolic and catabolic steroid hormones and their response during physical exercise. *Int J Sports Med.* 1986; 7 Suppl 1: 27-8.
- Perez-Gomez J, Olmedillas H, Delgado-Guerra S, et al. Effects of weight lifting training combined with plyometric exercises on physical fitness, body composition, and knee extension velocity during kicking in football. *Appl Physiol Nutr Metab.* 2008a; 33: 501-10.
- Bosco C, Luhtanen P, Komi PV. A simple method for measurement of mechanical power in jumping. *Eur J Appl Phys Occ Phys.* 1983; 50: 273-82.
- Hara M, Shibayama A, Takeshita D, et al. A comparison of the mechanical effect of arm swing and countermovement on the lower extremities in vertical jumping. *Hum Movement Sci.* 2008; 27: 636-48.
- Markovic G, Jaric S. Is vertical jump height a body size-independent measure of muscle power? *J Sports Sci.* 2007; 25: 1355-63.
- Ward RR, WD, Leyland AJ, Selbie S. The Advanced O-Scale Physique Assessment System. Kinematrix: Bumaby; 1989.
- Jackson AS, Pollock ML. Generalized equations for predicting body density of men. *Br J Nutr.* 1978; 40: 497-504.
- Ara I, Vicente-Rodríguez G, Perez-Gómez J, et al. Influence of extracurricular sport activities on body composition and physical fitness in boys: a 3-year longitudinal study. *Int J Obesity.* 2006; 30: 1062-71.
- Lucia A, Hoyos J, Perez M, et al. Heart rate and performance parameters in elite cyclists: a longitudinal study. *Med Sci Sports Exerc.* 2000; 32: 1777-82.
- Reinhard U, Muller PH, Schmulling RM. Determination of anaerobic threshold by the ventilation equivalent in normal individuals. *Respiration.* 1979; 38: 36-42.
- Latin RW, Berg K, Baechle T. Physical and Performance Characteristics of NCAA Division I Male Basketball Players. *J Strength Cond Res.* 1994; 8: 214-18.

26. Ziv G, Lidor R. Physical attributes, physiological characteristics, on-court performances and nutritional strategies of female and male basketball players. *Sports Med.* 2009a; 39: 547-68.
27. Parr R, Hoover R, Wilmore J, al. E. Professional basketball players: athletic profiles. *Physician Sportsmed.* 1978; 6: 77-9.
28. Luhtanen P, Rahkila P, Rusko H, et al. Mechanical work and efficiency in treadmill running at aerobic and anaerobic thresholds. *Acta Physiol Scand.* 1990; 139: 153-59.
29. Urhausen A, Coen B, Weiler B, et al. Individual anaerobic threshold and maximum lactate steady state. *Int J Sports Med.* 1993; 14: 134-39.
30. Ziv G, Lidor R. Vertical jump in female and male basketball players-A review of observational and experimental studies. *J Sports Sci Med.* 2010; May,13(3): 332-39.
31. Ben Abdelkrim N, Castagna C, El Fazaa S, et al. Blood metabolites during basketball competitions. *J Strength Cond Res.* 2009; 23: 765-73.
32. Hoffman JR, Tenenbaum G, Maresh CM, et al. Relationship Between Athletic Performance Tests and Playing Time in Elite College Basketball Players. *J Strength Cond Res.* 1996; 10: 67-71.
33. Delextrat A, Cohen D. Strength, power, speed, and agility of women basketball players according to playing position. *J Strength Cond Res.* 2009; 23: 1974-81.
34. Castagna C, Chaouachi A, Rampinini E, et al. Aerobic and explosive power performance of elite italian regional-level basketball players. *J Strength Cond Res.* 2009; 23: 1982-87.
35. Anderson FC, Pandy MG. Storage and utilization of elastic strain energy during jumping. *J Biomechanics.* 1993; 26: 1413-27.
36. Mielgo-Ayuso J, Calleja-González J, Clemente-Suárez VJ, Zourdos MC. Influence of anthropometric profile on physical performance in elite female volleyballers in relation to playing position. *Nutr Hosp.* 2014; 31(2):849-57.



Original/Deporte y ejercicio

Effects of exercise on inflammation in cardiac rehabilitation

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Abstract

Background: programs of weight loss and a healthy diet are recommended for patients with cardiovascular risk but the effectiveness of these programs in decreasing cardiovascular mortality is controversial.

Aim: to examine the acute and long-term effects of a 2-month cardiac rehabilitation program on chemokines related to inflammation in subjects with cardiovascular disease.

Design: prospective cohort study.

Methods: twenty-six patients with cardiovascular disease enrolled in a cardiac rehabilitation program based on nutritional and exercise interventions were studied. Lifestyle and clinical, metabolic and inflammatory variables were analysed.

Results: 88.5% were men and the mean age was 54.9 ± 7.8 years. At the end of the cardiac rehabilitation program the levels of carbohydrate and lipid metabolism were lower, except for high density lipoprotein cholesterol which was higher. The levels of uric acid, interleukin-6, interleukin-1Beta, adiponectin and leptin remained stable. Interleukin-6 correlated positively with levels of C-reactive protein and negatively with blood glucose. Interleukin-1Beta correlated positively with C-reactive protein levels and negatively with blood pressure figures. Significant correlations were seen between the changes in levels of interleukin-6 and interleukin-1Beta and changes in metabolic equivalents, and in C-reactive protein levels before and after the cardiac rehabilitation program. No significant correlations were observed with weight, waist circumference or fat mass.

Conclusions: a cardiac rehabilitation program decreased anthropometric variables and blood pressure figures.

EFFECTOS DEL EJERCICIO SOBRE LA INFLAMACIÓN EN REHABILITACIÓN CARDÍACA

Resumen

Introducción: a los pacientes con riesgo cardiovascular se les recomiendan programas de pérdida de peso y dieta saludable, pero la eficacia de estos programas a la hora de reducir la mortalidad es controvertida.

Objetivo: examinar los efectos agudos y a largo plazo de un programa de rehabilitación cardíaca de dos meses de duración sobre las quimocinas relacionadas con la inflamación en pacientes con enfermedad cardiovascular.

Diseño: estudio de cohortes prospectivo.

Métodos: se estudiaron 26 pacientes con enfermedad cardiovascular inscritos en un programa de rehabilitación cardíaca basado en intervenciones nutricionales y de ejercicio. Se analizaron el estilo de vida y variables clínicas, metabólicas e inflamatorias.

Resultados: 88,5% eran hombres y la edad media fue de $54,9 \pm 7,8$ años. Al final del programa de rehabilitación cardíaca las variables del perfil glucémico y lipídico descendieron, excepto el colesterol de lipoproteínas de alta densidad, que aumentó. Ácido úrico, interleucina-6, interleucina-1 beta, adiponectina y leptina se mantuvieron estables. Interleucina-6 correlacionó positivamente con proteína C reactiva y negativamente con glucosa en sangre. Interleucina-1 beta correlacionó positivamente con proteína C-reactiva y negativamente con las cifras de presión arterial. Encontramos correlaciones significativas entre los cambios en interleucina-6 e interleucina-1 beta y los cambios en los equivalentes metabólicos y proteína C-reactiva, antes y después del programa de rehabilitación cardíaca. No se observaron correlaciones significativas con peso, circunferencia de cintura o masa grasa.

Conclusiones: la rehabilitación cardíaca mejora las variables antropométricas, las cifras de presión arterial,

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Recibido: 18-II-2015.

Aceptado: 14-III-2015.

res, and improved lipid metabolism and ergometry data. However, no changes regarding the inflammatory state were observed.

(*Nutr Hosp.* 2015;31:2633-2640)

DOI:10.3305/nh.2015.31.6.8868

Key words: *Cardiovascular disease. Weight loss. Healthy diet. Cardiac rehabilitation program. Chemokines.*

Abbreviations

AMI: acute myocardial infarction.
BMI: body mass index.
CVD: cardiovascular disease.
HbA1c: glycated haemoglobin.
HDL: high density lipoprotein.
IL-6: interleukin 6.
IL-1 β : interleukin 1 β .
IPAQ: International Physical Activity Questionnaire.
LDL: low density lipoprotein.
MCP-1: monocyte chemoattractant protein-1.
METs: metabolic equivalents.
PVD: peripheral vascular disease.
SD: standard deviation.
TNF- α : tumour necrosis factor- α .
VCAM-1: vascular cell adhesion molecular-1.
WC: waist circumference.

Background

A progressive distancing from Mediterranean diet has been observed with more overweight and obesity and, therefore, higher risk of cardiovascular disease (CVD)¹. Events arising from CVD are caused by an atherosclerotic process. It is well known that the addition of physical exercise to hypocaloric treatments produced greater fat mass and weight loss than dieting alone². Exercise is known to prevent plaque development and induce the regression of vascular stenosis. Exercise asserts this atheroprotective role by reducing or preventing oxidative stress and inflammation through various pathways³. In addition, exercise improves insulin action in the immediate post-exercise period, though the mechanism is unclear⁴. Low muscle condition has been associated with less healthy clinical, lipid and metabolic profile revealing the importance of training as indicator of cardiovascular health⁵. Research has suggested that changes in diet and exercise, even if only modest weight loss is reached, improve insulin sensitivity and decrease blood pressure, lipids and inflammatory cytokines levels⁶. Nevertheless, a recent study found that an intensive lifestyle intervention based on reduced calorie intake and increased physical activity for 10 years did not reduce the risk of cardiovascular morbidity or mortality, as compared with a control program of diabetes support and education, among overweight or obese patients with type 2 diabetes⁷.

así como el perfil de lípidos y los resultados de la ergometría. Sin embargo, no se observaron cambios con respecto al estado inflamatorio.

(*Nutr Hosp.* 2015;31:2633-2640)

DOI:10.3305/nh.2015.31.6.8868

Palabras clave: *Enfermedad cardiovascular. Pérdida de peso. Dieta sana. Programa de rehabilitación cardíaca. Quemocinas.*

There are pro-inflammatory factors linked to atherosclerosis such as interleukin 6 (IL-6)³. Recently, IL-6 has been recognized as the predominant exercise cytokine. It is released by the muscle in response to contractions⁸. The pathological versus beneficial role of IL-6 remains unclear. On one hand, increased IL-6 in obesity is associated with the physiopathology of type 2 diabetes, while on the other hand muscle-derived IL-6 seems to increase glucose uptake and fat oxidation in skeletal muscle and improve glucose tolerance and insulin sensitivity⁴. Ellingsgaard *et al.*⁹ found that IL-6, released from either contracting skeletal muscle or white adipose tissue, enhances insulin secretion by increasing glucagon-like peptide-1 secretion from intestinal L cells and pancreatic alpha cells. Other authors have suggested that IL-6 could exert modulatory effects during exercise¹⁰. Interleukin 1 β (IL-1 β) is another inflammation chemokine related to the metabolic syndrome¹¹.

The purpose of this study was to examine the effects of a 2-month cardiac rehabilitation program on chemokines related to inflammation in subjects with CVD.

Materials and methods

Study Population

We conducted a longitudinal prospective study, involving 26 patients enrolled in a cardiac rehabilitation program after an acute cardiac event during 2010. The candidates were informed of the characteristics and objectives of the study before they signed an informed consent. The inclusion criteria were: provision of informed consent, suitable cardiac diagnosis, clinically stable patients, and a life expectancy of at least one year. Exclusion criteria included: age less than 18 or more than 80 years, and the presence of acute or chronic inflammatory disease, infectious disease, metastatic disease, or psychological disease.

Cardiac rehabilitation program

The program was carried out according to the protocol approved by the Ethics Committee of our Hospital and conformed to the guidelines of the Helsinki protocol.

Rehabilitation intervention: The program included early mobilization, respiratory exercises, prevention of complications and basic information about heart disease. Two months after hospital discharge, we checked for clinical and risk factors at a specialized outpatient office and physical training for 8 weeks, psychological treatment by relaxation techniques, and a health education program were carried out. The health education program consisted of talks about theoretical and practical aspects of CVD. The exercises were performed 3 times a week. The physical training consisted of warming up, aerobic exercise and cooling down / relaxation phases. Stretching and exercises with free weights (1-2 kg) were performed in the warming-up phase for 20 minutes. Then, treadmill or bicycle aerobic exercise was performed for 30 minutes. Finally, walking and breathing exercises were performed in the cooling-down phase for 10 minutes. An ergometry test was performed before and after the cardiac rehabilitation program.

Nutritional intervention: A Mediterranean diet was recommended, encouraging a low calorie and fat diet, and higher consumption of oleic and omega-3 acids, which are associated with a better cardiovascular profile. The dietary intervention included a reduction of 500-600 kilocalories per day with 50% carbohydrates, 30% fats and 15-20% proteins. In addition, a review of the diabetes education of the patients with diabetes was performed.

Study variables

At the first (baseline) visit we reviewed the inclusion and exclusion criteria and obtained demographic data as well as information about the main diagnosis, associated disorders, pharmacological treatment and physical activity using the International Physical Activity Questionnaire (IPAQ)¹². Eating habits were recorded using an adaptation of the Trichopoulou scale, a validated extensive semi-quantitative questionnaire on food intake, which indicates the degree of adherence to the traditional Mediterranean diet¹³. The physical examination included data for weight, height, body mass index (BMI), waist circumference (WC) and single frequency impedance (Bio-medica®). We collected the data before the acute cardiac event (retrospectively), and before and at the end of the cardiac rehabilitation program, as well as 12 months later.

Laboratory determinations

Following a minimum 8-h fast venous blood samples were drawn for biochemical analyses at three times: before and at the end of the cardiac rehabilitation program, as well as 12 months later. Samples were centrifuged at 4000 rpm for 15 minutes at 4 C°. Plasma and serum were aliquotted and stored at -80 C° until

analysis. The biochemical variables were measured using standard enzymatic methods. The plasma adipokine levels were measured using manual commercial kits. Human IL-6 Quantikine ELISA Kit from R&D Systems (Abingdon, United Kingdom) for IL-6 levels, Human IL-1 beta/IL-1F2 Quantikine HS ELISA Kit from R&D Systems (Abingdon, United Kingdom) for IL-1 β levels, ELISA kits (DRG Diagnostics, Marburg, Germany) for adiponectin levels, and ELISA kit from Mediagnost (Reutlingen, Germany) for leptin levels, according to the manufacturer's instructions, respectively.

Statistical analysis

Descriptive statistics included mean, standard deviation (SD), and ranges for quantitative variables, and percentages for qualitative variables. Information from each visit was compared by the Mann Whitney U and the Friedman test for non-parametric variables. The Wilcoxon test for paired samples was used to compare different times (Bonferroni correction was applied). A level of $p < 0.05$ was accepted as being statistically significant.

Results

We studied 26 patients, 88.5% men and with a mean age of 54.9 ± 7.8 years. The most frequent cardiac event leading to inclusion in the cardiac rehabilitation program was acute myocardial infarction (AMI) with stent implantation (47.1%). Other cardiac events included angina with stent 24.1%, coronary bypass 20.2% and AMI without stent 8.6%. A previous cardiac event was present in 42.3% of the patients.

Ergometry data before and after the rehabilitation program were obtained (Table I). Significant differences were found in tolerated exercise time (6.1 ± 2.3 vs. 7.3 ± 3 minutes; $p = 0.006$), metabolic equivalents (METs) (7.4 ± 2.3 vs. 8.2 ± 2.8 ; $p = 0.045$), and Börg's perceived exertion scale (11.7 ± 1.5 vs. 13.6 ± 1.3 ; $p < 0.001$), which improved after the rehabilitation program.

Demographic and clinical variables at the beginning, at the end, and 12 months after the cardiac rehabilitation program are shown in table II and figures 1 and 2. Anthropometric variables, fat mass, and blood pressure decreased at the end of the cardiac rehabilitation program but then increased close to baseline levels 12 months later. The changes in waist circumference, fat mass, and systolic blood pressure were significant. The results of the Trichopoulou questionnaire improved after the cardiac rehabilitation program and remained stable later. After their cardiac event, most patients stopped smoking (Fig. 1a) and significantly reduced the grams of alcohol consumption (Table II). After 12 months, alcohol consumption increased again, though mainly with meals (Fig. 1b). Other significant changes

were also noted concerning physical activity quantified by IPAQ (Fig. 1c), hypertension drugs (Fig. 2a), treatment with metformin (Fig. 2b) and treatment with

Table I
Ergometry results before and after the cardiac rehabilitation program

	<i>Ergometry before CRP</i>	<i>Ergometry after CRP</i>	<i>P</i>
Baseline HR (bpm)	69.2 ± 8.6	69.3 ± 11.1	0.300
Submax HR (bpm)	123.9 ± 16.9	122 ± 15.6	0.897
Baseline SBP (mmHg)	114.2 ± 18.6	112.3 ± 18.8	0.899
Submax SBP (mmHg)	148 ± 25	147.1 ± 22.4	0.896
Baseline DBP (mmHg)	71.3 ± 7.9	67.5 ± 8.8	0.357
Submax DBP (mmHg)	73 ± 9.5	71.4 ± 9.5	0.205
Time (min)	6.1 ± 2.3	7.3 ± 3	0.006
METs	7.4 ± 2.3	8.2 ± 2.8	0.045
Börg	11.7 ± 1.5	13.6 ± 1.3	<0.001

Notes to Table : Data expressed as means ± SD. CRP: cardiac rehabilitation program; Submax HR: submaximum heart rate; bpm: beats per minute; Submax SBP: submaximum systolic blood pressure; mmHg: millimetres of mercury; min: minutes; METs: metabolic equivalents.

statins (Fig. 2c) between the initial state and the visits after the acute cardiac event.

The analytical variables pre and post exercise at the beginning, at the end, and 12 months after the cardiac rehabilitation program are shown in table III (only a pre-exercise evaluation was performed at the 12-month visit). At the end of the cardiac rehabilitation program, we observed lower levels of all the study variables except for high density lipoprotein (HDL) cholesterol, which increased, and levels of uric acid, IL-6, IL-1β, adiponectin, and leptin, which remained stable. After 12 months, levels of insulin, peptide C, total cholesterol, HDL cholesterol, triglycerides, IL-6 and leptin worsened close to baseline levels whereas glucose, glycated haemoglobin (HbA1c), low density lipoprotein (LDL) cholesterol, uric acid, C-reactive protein, IL-1β, and adiponectin remained stable. Only changes in levels of total cholesterol and LDL cholesterol reached statistical significance.

Significant correlations were found between levels of IL-6, positively with C-reactive protein, HDL cholesterol, adiponectin, total cholesterol and LDL cholesterol; and negatively with levels of glucose and HbA1c. In addition, levels of IL-1β correlated positively with levels of glucose, leptin and C-reactive protein and the consumption of alcohol in grams per day, and negatively with blood pressure figures (data not shown).

Table II
Clinical and anthropometric characteristics

	<i>Before CRP</i>	<i>After CRP</i>	<i>12 months</i>	<i>P</i>
Weight (kg)	83.8 ± 16.6	80.7 ± 14.2	83.6 ± 18.9	0.053
BMI (kg/m ²)	29.5 ± 4.9	28.5 ± 4.4	29.3 ± 5.9	0.081
WC (cm)	103.7 ± 11.4	101.2 ± 8.4	104.9 ± 13.5	0.035
Fat mass (kg)	31.4 ± 8.8	26.8 ± 6.1	30.4 ± 10.9	0.042
Lean mass (kg)	52.4 ± 7.8	53.9 ± 8.1	53.2 ± 8	0.100
Basal metabolism (Kcal)	1682.1 ± 282.2	1618.9 ± 231.4	1684.9 ± 307.5	0.329
Trichopoulou questionnaire	7.4 ± 2.6	10.8 ± 1.6	10.3 ± 2.1	<0.001
IPAQ ≥ 150 min/week (%)	73.1	96.2	88.5	0.014
SBP (mmHg)	126.7 ± 14.6	119 ± 15.6	126.6 ± 18.4	0.002
DBP (mmHg)	78 ± 10.5	74.2 ± 10.8	78.6 ± 8.1	0.091
Cigarettes per day	0.3 ± 1.2	0.5 ± 1.9	0.6 ± 2	<0.001
Grams of alcohol	10.3 ± 11.5	9.9 ± 10.3	16.5 ± 12.2	<0.001
Insulin units/kg	0.01 ± 0.01	0.1 ± 0.1	0.1 ± 0.03	0.154
Nap (%)	50	57.7	53.8	0.519
Stroke (%)	0	0	7.7	0.480
PVD (%)	3.8	7.7	3.8	0.392

Notes to Table 2: Data expressed as means ± SD and %. CRP: cardiac rehabilitation program; BMI: body mass index; WC: waist circumference; SBP: systolic blood pressure; DBP: diastolic blood pressure; IPAQ: International Physical Activity Questionnaire; PVD: peripheral vascular disease.

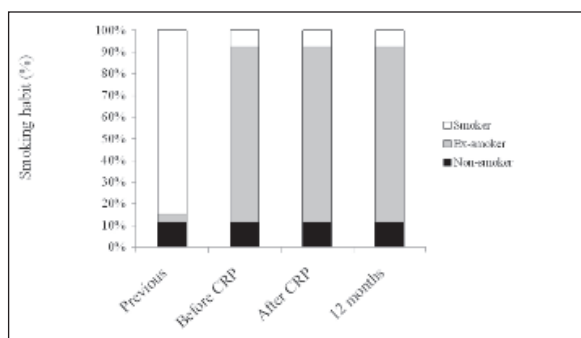


Fig. 1a: Prevalence of smoking habit.

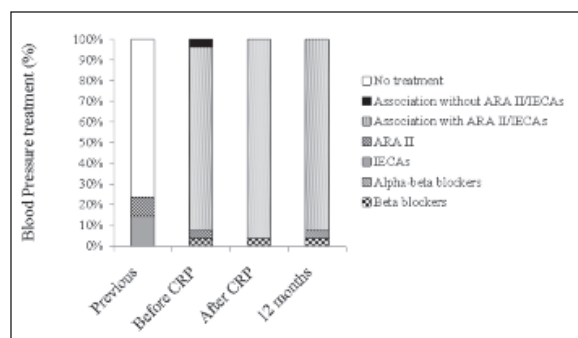


Fig. 2a: Prevalence of different blood pressure treatments.

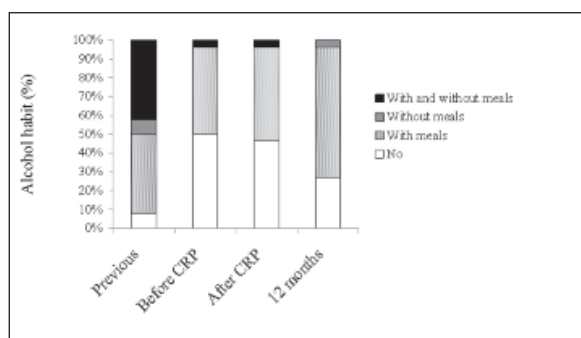


Fig. 1b: Prevalence of alcohol habit.

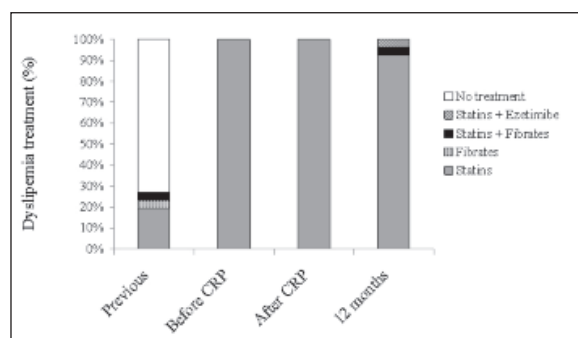


Fig. 2b: Prevalence of different dyslipidemia treatments.

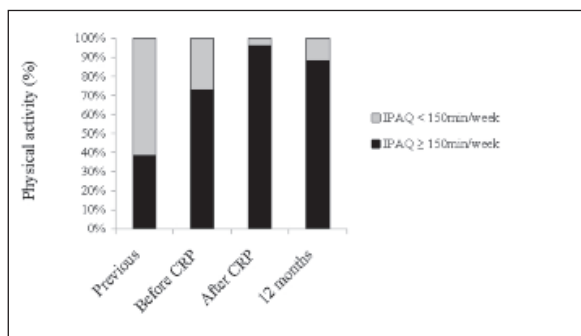


Fig. 1c: Prevalence of physical activity based on the IPAQ questionnaire.

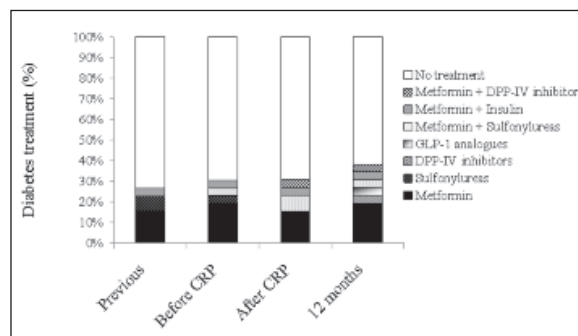


Fig. 2c: Prevalence of different diabetes treatments

Fig. 1.—Toxic habits and physical activity questionnaire.

Fig. 2.—Blood pressure, dyslipidemia and diabetes treatments.

The possible relationships between changes in body composition and changes in levels of IL-6 and IL-1 β after the cardiac rehabilitation program were analyzed. No significant correlations were found for weight, WC or fat mass. Notably, we found a significant negative correlation between the change in levels of IL-1 β prior to exercise and the change in METs ($r = -0.600$; $p = 0.03$) and a significant positive correlation between the change in levels of IL-6 prior to exercise and the change in levels of C-reactive protein ($r = 0.604$; $p = 0.01$), before and after the cardiac rehabilitation program.

Discussion

Short-term studies have shown that cardiac rehabilitation programs improve the clinical, metabolic and inflammatory profile of patients with CVD and lead to a reduction in cardiac and overall mortality^{14,15}. Our results concerning smoking cessation agree with those already published¹⁶. However, we have found no relevant data about alcohol consumption with which to compare our results. We found that the anthropometric variables and blood pressure figures decreased at the end of the cardiac rehabilitation program but increased

Table III
Pre-exercise and post-exercise analytical variables before the CRP, after the CRP and 12 months later

	<i>Before CRP pre-exercise</i>	<i>Before CRP post-exercise</i>	<i>After CRP pre-exercise</i>	<i>After CRP post-exercise</i>	<i>12 months</i>
Glucose; mg/dl (mmol/L)	116.3 ± 28.8 (6.4 ± 1.6)	122.2 ± 23.9 (6.7 ± 1.3)	113.5 ± 15.1 (6.3 ± 0.8)	124.6 ± 45.2 (6.9 ± 2.5)	112.0 ± 19 (6.2 ± 1.1)
HbA1c; % (mmol/mol)	6.4 ± 0.7 (41.9 ± 4.6)	-	6.1 ± 0.6 (39.9 ± 3.9)	-	6 ± 0.7 (39.3 ± 4.6)
Insulin; mcU/ml (pmol/L)	14.6 ± 11.8 (104.8 ± 84.7)	49.9 ± 26.7 (358 ± 191.6) ^a	11.9 ± 8 (85.4 ± 57.4)	25.9 ± 19.4 (185.8 ± 139.2) ^b	16.1 ± 15.2 (115.5 ± 109.1)
Peptide C; ng/ml (=mcg/L)	3.2 ± 1.4	-	3.1 ± 1.1	-	3.8 ± 2.3
Total chol; mg/dl (mmol/L)	172.8 ± 34.5 (4.5 ± 0.9)	138.2 ± 26.9 (3.6 ± 0.7)	155.9 ± 30.8 (4 ± 0.8)	133.2 ± 38.2 (3.5 ± 1) ^b	158.2 ± 34.3 (4.1 ± 0.9) ^c
HDL chol; mg/dl (mmol/L)	40.3 ± 10.4 (1 ± 0.3)	47.2 ± 10.9 (1.2 ± 0.3)	42.9 ± 11.2 (1.1 ± 0.3)	44.3 ± 12.2 (1.2 ± 0.3)	40.7 ± 10.9 (1.1 ± 0.3)
LDL chol; mg/dl (mmol/L)	101.7 ± 24.1 (2.6 ± 0.6)	80 ± 17.2 (2.1 ± 0.4)	87.5 ± 22.1 (2.3 ± 0.6)	78.1 ± 16.5 (2 ± 0.4) ^b	88.8 ± 29.9 (2.3 ± 0.8) ^c
TG; mg/dl (mmol/L)	166.5 ± 73.5 (1.9 ± 0.8)	122 ± 44.1 (1.4 ± 0.5)	162.2 ± 91.5 (1.8 ± 1)	141.1 ± 79.7 (1.6 ± 0.9)	167.8 ± 115.6 (1.9 ± 1.3)
Uric acid; mg/dl (mmol/L)	6 ± 1.1 (0.4 ± 0.1)	-	5.9 ± 1.7 (0.4 ± 0.1)	-	6.1 ± 1.3 (0.4 ± 0.1)
C-reactive protein; mg/L (= mcg/ml)	10.7 ± 20.6	3.2 ± 0.3	4.5 ± 4.4	3.5 ± 1.3	4.7 ± 3.7
IL-6; pg/ml	4.3 ± 2.9	4.7 ± 2.1	4.2 ± 2.4	4.4 ± 1.7	4.9 ± 3.7
IL-1β; pg/mL	0.3 ± 0.2	0.2 ± 0.03 ^a	0.3 ± 0.4	0.4 ± 0.3 ^b	0.2 ± 0.02
Adiponectin; ng/ml	5.8 ± 3.9	-	5.7 ± 3.5	-	6.2 ± 3.7
Leptin; pg/ml	14.8 ± 13.1	-	14.4 ± 12.8	-	20.5 ± 27.8

Notes to Table 3: Data expressed as means ± SD and %. CRP: cardiac rehabilitation program; HbA1c: glycated hemoglobin; Total chol: total cholesterol; LDL chol: low density lipoprotein cholesterol; HDL chol: high density lipoprotein cholesterol; TG: triglycerides; IL-6: interleukin 6; IL-1β: Interleukin 1β.

^aSignificant differences between preexercise and postexercise times before CRP (p<0.05).

^bSignificant differences between preexercise and postexercise times after CRP (p<0.05).

^cSignificant differences between preexercise before CRP, after CRP and 12 months later (p<0.05).

almost back to baseline levels 12 months later, against López Frías et al.¹⁵ whose patients kept the achieved positive changes in body composition after 12 months. Even if our results were modest, though still in agreement with previous data¹⁷. No significant changes were observed in carbohydrate metabolism, unlike the results described by Singh et al.¹⁸ in a 3-year randomized controlled study based on moderate exercise and diet with a high quantity of fruit and vegetables. A significant decrease was found in levels of total cholesterol and LDL cholesterol in our study, though this may have been as a result of treatment with statins. Similar results were described by Brochu et al.¹² and Schuler et al.¹⁹ after diet and exercise programs, though both studies also found improved levels of triglycerides.

Cytokine changes related to exercise are less well studied. Over recent years some authors have studied regular exercise as a natural anti-atherogenic activity and its effects on oxidative stress and inflammatory

pathways³. Our results showed that levels of C-reactive protein decreased, though not significantly, following the 2-month cardiac rehabilitation program and remained stable 12 months later. Other studies, too, have shown that aerobic exercise training induces a reduction in levels of C-reactive protein²⁰.

At present, the role of IL-6 as a pro-inflammatory or anti-inflammatory cytokine is controversial. The release of IL-6 during exercise induces inhibition of TNF-α production and a release of other anti-inflammatory cytokines such as the IL-1 receptor antagonist and IL-10³. The patients in our study showed no significantly higher levels of IL-6 after acute exercise, in line with studies in mice²¹ and in humans⁹.

Concerning CVD patients, Pereira et al.²² compared the response of IL-6 after two submaximal intensities of exercise in individuals with heart failure and found no differences after low intensity and a significant increase after moderate intensity. After our cardiac

rehabilitation program there was a non-significant reduction in levels of pre-exercise IL-6. Results, though, are controversial. On one hand, some authors have found that pre-exercise levels of IL-6 decreased after different exercise programs in patients with heart failure^{23,24}. On the other hand, others observed no changes in pre-exercise levels of IL-6 after 12 months of follow-up²⁵, similar to our results.

Regarding the type of exercise, an eccentric exercise program in pre and postmenopausal women increased levels of IL-6 72h post-exercise²⁶. No changes were observed after 6 weeks of moderate or high intensity resistance training in healthy young men²³ or after 16 weeks of moderate to high intensity resistance and concurrent training in middle-aged men²⁷. The various exercise programs in the different studies lasted between 6 and 16 weeks.

These results are important because a significant inverse relationship has been described between physical capacity and IL-6 in patients with stable CVD²⁸. We found significant correlations between IL-6 and certain variables. Notable among these was the positive correlation between pre-exercise IL-6 and post-exercise C-reactive protein levels at baseline. This is in agreement with Naghii et al.²⁹ who examined the effects of regular physical activity on non-lipid cardiovascular risk factors in healthy military recruits. We found a negative correlation between IL-6 and pre and post-exercise glucose levels at baseline, unlike Mitchell et al.³⁰, who concluded that a resistance and aerobic exercise in young obese men did not influence glucose tolerance as evaluated by an oral glucose tolerance test. We also observed significant correlations in levels of IL-6 with lipid fractions, though no relevant published data were found. Hamer et al.³¹ described a significant positive correlation between IL-6 and systolic blood pressure after acute exercise, though we did not observe this significant correlation. Unlike our results, Karch et al.³² found that IL-6 levels correlated negatively with the IPAQ score.

IL-1 β has emerged as a new inflammatory chemokine related to the metabolic syndrome. Previous studies have described a significant increase in levels of IL-1 β in intestinal lymphocytes in mice after acute exercise¹⁷. In other study, IL-1 β was measured at baseline, and at 3 and 6 months in Korean women with metabolic syndrome enrolled in an exercise and diet program, with no significant changes¹¹, similar to our results. We observed significant correlations of IL-1 β , positive with levels of C-reactive protein and negative with blood pressure figures. To our knowledge, no similar data have been published.

Assessing changes in body composition and changes in levels of IL-6 and IL-1 β after the cardiac rehabilitation program showed no significant correlations concerning weight, WC or fat mass. Some ergometry data showed significant correlations with changes in levels of IL-6 and IL-1 β before and after the program. As far as we are aware, no similar data have been published either.

Regarding other cytokines, some authors have found a decrease in plasma levels of adiponectin¹⁹ and leptin²⁰ after acute exercise, but these data were not available in our study.

We recognize several limitations in our study. As only a few heterogeneous studies have evaluated the effects of exercise on inflammation markers in patients with CVD comparison of results is difficult, especially regarding IL-1 β . Our patient population sample was small and our follow-up period was short if we consider the long natural history of CVD and the heterogeneity of the intervention programs published. In addition, after 12 months, patients were only evaluated pre-exercise because the gym and patient monitoring facilities were not available during and after exercise.

Conclusion

Our patients experienced a decrease in anthropometric variables and blood pressure figures, and an improvement in lipid metabolism as a result of the cardiac rehabilitation program. However, 12 months later these variables had increased close to baseline values. Although data fail to agree, a systematic review³³ and a meta-analysis³⁴ conducted in patients with CVD concluded that exercise training reduced levels of IL-6. Thus, IL-6 could explain the anti-inflammatory effect of regular exercise in patients with CVD. However, our study found no significant changes in levels of IL-6 or IL-1 β and a non-significant decline in levels of C-reactive protein after the cardiac rehabilitation program. In addition, no association was found between changes in levels of IL-6 or IL-1 β and weight, WC or fat mass. Hence and in accordance with the recent results of the Look AHEAD study⁷, the absence of significant changes regarding the inflammatory status after a cardiac rehabilitation program could explain the lack of improvement in cardiovascular morbidity or mortality observed in that study, although not all of the patients were diabetic and all of them already had CVD. Further research will be needed to elucidate the effects of exercise and diet on inflammatory pathways.

Conflict of interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Funding

L. Garrido-Sánchez is supported by a fellowship from the Fondo de Investigación Sanitaria (FIS) "Miguel Servet I" CP 13/00188.

Acknowledgements

The authors wish to thank all the patients and IMABIS. We also gratefully acknowledge Ian Johnstone for his contribution to the English version of this manuscript.

References

- Ruiz-Cabello Turmo P, García-Molina VA, Fernández Martínez MM, Moratalla Cecilia N, Gregorio Arenas E, Aranda Ramírez P. Los países mediterráneos ante la Dieta Mediterránea, ¿Seguimos en el buen camino? El ejemplo de las mujeres de mediana edad del sur de España. *Nutr Hosp.* 2015;31(6).
- Bonfanti N, Marcelo Fernández J, Gomez-Delgado F, Pérez-Jiménez F. Efecto de dos dietas hipocalóricas y su combinación con ejercicio físico sobre la tasa metabólica basal y la composición corporal. *Nutr Hosp.* 2014;29(3):635-43.
- Szostak J, Laurant P. The forgotten face of regular physical exercise: a 'natural' anti-atherogenic activity. *Clin Sci* 2011; 121:91-106.
- Allen TL, Whitham M, Febbraio MA. IL-6 muscles in on the gut and pancreas to enhance insulin secretion. *Cell Metab* 2012; 15:8-9.
- Ramírez-Vélez R, Meneses-Echavez JF, González-Ruiz K, Correa JE. Fitness muscular y riesgo cardio-metabólico en adultos jóvenes colombianos. *Nutr Hosp.* 2014;30:769-75.
- Demarco VG, Johnson MS, Whaley-Connell AT, Sowers JR. Cytokine abnormalities in the etiology of the cardiometabolic syndrome. *Current Hypertension Reports* 2010; 12:93-8.
- Look AHEAD Research Group, Wing RR, Bolin P, Brancati FL, Bray GA, Clark JM, Coday M, et al. Cardiovascular Effects of Intensive Lifestyle Intervention in Type 2 Diabetes. *N Engl J Med* 2013; 369:145-54.
- Plomgaard P, Halban PA, Bouzakri K. Bimodal impact of skeletal muscle on pancreatic β -cell function in health and disease. *Diabetes Obes Metab* 2012; 14:78-84.
- Ellingsgaard H, Hauselmann I, Schuler B, Habib AM, Baggio LL, Meier DT, et al. Interleukin-6 enhances insulin secretion by increasing glucagon-like peptide-1 secretion from L cells and alpha cells. *Nat Med* 2011; 17:1481-9.
- Reihmane D, Jurka A, Tretjakovs P. The relationship between maximal exercise-induced increases in serum IL-6, MPO and MMP-9 concentrations. *Scand J Immunol* 2012; 76:188-92.
- Eui Geum Oh, So Youn Bang, Soo Hyun Kim, Sa Saeng Hyun, Sang Hui Chu, Justin YJ, et al. Therapeutic Lifestyle Modification Program Reduces Plasma Levels of the Chemokines CRP and MCP-1 in Subjects With Metabolic Syndrome. *Biological Research for Nursing* 2013; 15:48-55.
- Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) – Short and Long Forms. November 2005; [www.ipaq.ki.se/scoring.pdf]
- Trichopoulos A, Costacou T, Bamia C, Trichopoulos D. Adherence to a Mediterranean diet and survival in a Greek population. *N Engl J Med* 2003; 348: 2599-608.
- Taylor RS, Brown A, Ebrahim S, Jolliffe J, Noorani H, Rees K, et al. Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *Am J Med* 2004; 116:682-92.
- López Frías M, Gómez Martínez M, Ramírez López Frías M, De Teresa Galván C, Díaz Castro J, Nestares T. Beneficio del seguimiento de un programa de rehabilitación cardíaca sobre algunos parámetros de la composición corporal. *Nutr Hosp.* 2014;30(6):1366-74.
- A Chatziefstratiou A, Giakoumidakis K, Brokalaki H. Cardiac rehabilitation outcomes: modifiable risk factors. *Br J Nurs.* 2013; 22:200-7.
- Savage PD, Brochu M, Poehlman ET, Ades PA. Reduction in obesity and coronary risk factors after high caloric exercise training in overweight coronary patients. *Am Heart J* 2003; 146:317-23.
- Singh RB, Rastogi V, Rastogi SS, Niaz MA, Beegom R. Effect of diet and moderate exercise on central obesity and associated disturbances, myocardial infarction and mortality in patients with and without coronary artery disease. *J Am Coll Nutr* 1996; 15:592-601.
- Schuler G, Hambrecht R, Schlierf G, Niebauer J, Hauer K, Neumann J, et al. Regular physical exercise and low-fat diet. Effects on progression of coronary artery disease. *Circulation* 1992; 86:1-11.
- Stavropoulos-Kalinoglou A, Metsios GS, Veldhuijzen van Zanten JJ, Nightingale P, Kitas GD, Koutedakis Y. Individualised aerobic and resistance exercise training improves cardiorespiratory fitness and reduces cardiovascular risk in patients with rheumatoid arthritis. *Ann Rheum Dis.* 2013; 72:1819-25.
- Pervaiz N, Hoffman-Goetz L. Immune cell inflammatory cytokine responses differ between central and systemic compartments in response to acute exercise in mice. *Exerc Immunol Rev* 2012; 18:142-57.
- Pereira DA, Ribeiro-Samora GA, Vieira DS, Pereira LS, Coelho FM, Parreira VF, et al. Evaluation of the inflammatory response to two different intensities of exercise in individuals with heart failure. *Inflammation* 2012; 35:509-15.
- Pil-Byung C, Shin-Hwan Y, Il-Gyu K, Gwang-Suk H, Jae-Hyun Y, Han-Joon L, et al. Effects of exercise program on appetite-regulating hormones, inflammatory mediators, lipid profiles, and body composition in healthy men. *J Sports Med Phys Fitness* 2011; 51:654-63.
- Fu TC, Wang CH, Lin PS, Hsu CC, Cherng WJ, Huang SC, et al. Aerobic interval training improves oxygen uptake efficiency by enhancing cerebral and muscular hemodynamics in patients with heart failure. *Int J Cardiol* 2013; 167:41-50.
- Lindgärde F, Gottsäter A, Åhrén B. Positive correlation between tumor necrosis factor (TNF)- α and cardiorespiratory fitness after six-months of regular aerobic exercise in Peruvian Amerindian women. *Rev Med Chil* 2011; 139:998-1005.
- Conceição MS, Libardi CA, Nogueira FR, Bonghanha V, Gáspari AF, Chacon-Mikahil MP, et al. Effects of eccentric exercise on systemic concentrations of pro- and anti-inflammatory cytokines and prostaglandin (E2): comparison between young and postmenopausal women. *Eur J Appl Physiol* 2012; 112:3205-13.
- Libardi CA, De Souza GV, Cavaglieri CR, Madruga VA, Chacon-Mikahil MP. Effect of resistance, endurance, and concurrent training on TNF- α , IL-6, and CRP. *Med Sci Sports Exerc* 2012; 44:50-6.
- Byrkjeland R, Nilsson BB, Westheim AS, Arnesen H, Seljeflot I. Inflammatory markers as related to disease severity in patients with chronic heart failure: limited effects of exercise training. *Scand J Clin Lab Invest* 2011; 71:598-605.
- Naghii MR, Aref MA, Almadadi M, Hedayati M. Effect of regular physical activity on non-lipid (novel) cardiovascular risk factors. *Int J Occup Med Environ Health* 2011; 24:380-90.
- Mitchell JB, Phillips MD, Yellott RC, Currie LM. Resistance and aerobic exercise: the influence of mode on the relationship between IL-6 and glucose tolerance in young men who are obese. *J Strength Cond Res* 2011; 25:1529-37.
- Hamer M, Steptoe A. Vascular inflammation and blood pressure response to acute exercise. *Eur J Appl Physiol* 2012; 112:2375-9.
- Karch I, Olszowska M, Tomkiewicz Pająk L, Drapisz S, Łuszczak J, Podolec P. The effect of physical activity on serum levels of selected biomarkers of atherosclerosis. *Kardiol Pol* 2013; 71:55-60.
- Smart NA, Steele M. The effect of physical training on systemic proinflammatory cytokine expression in heart failure patients: a systematic review. *Congest Heart Fail* 2011; 17:110-4.
- Swardfager W, Herrmann N, Cornish S, Mazereeuw G, Marzolini S, Sham L, et al. Exercise intervention and inflammatory markers in coronary artery disease: a meta-analysis. *Am Heart J* 2012; 163:666-76.



Original/*Diabetes*

Consumo de frutos secos y aceites vegetales en personas con diabetes mellitus tipo 1

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Resumen

Introducción: estudios recientes han demostrado los beneficios cardiovasculares de la dieta mediterránea enriquecida con aceite de oliva y frutos secos. Las personas con diabetes, que tienen un mayor riesgo de complicaciones cardiovasculares, podrían beneficiarse en gran medida de seguir ese tipo de patrón alimentario.

Objetivos: análisis de la ingesta de grasas vegetales procedentes de frutos secos y aceites vegetales en pacientes con diabetes mellitus tipo 1 (DM1).

Métodos: estudio transversal descriptivo que compara 60 personas con DM1 y 60 sujetos sanos. Se recoge la frecuencia de consumo de aceites vegetales y de frutos secos y se calcula el aporte procedente de estos alimentos en ácidos grasos mono y poliinsaturados (ácido oleico, linoleico y α -linolénico). Se utilizó un cuestionario de frecuencia de consumo diseñado de forma específica. Se recogen variables antropométricas, factores de riesgo cardiovascular y variables relacionadas con la diabetes.

Resultados: el consumo total de grasa vegetal procedente de aceites vegetales fue similar en los pacientes con DM1 frente a los sujetos control ($3,02 \pm 1,14$ vs. $3,07 \pm 1,27$ Raciones (R)/día, $P = 0,822$) y de frutos secos ($1,35 \pm 2,24$ vs. $1,60 \pm 2,44$ R/semana, $P = 0,560$). El grupo DM1 consumió menos aceite de oliva que el grupo control ($2,55 \pm 1,17$ vs. $3,02 \pm 1,34$ R/día, $P = 0,046$). Se detectó un menor consumo de ácido α -linolénico respecto al grupo control ($1,13 \pm 2,06$ vs. $2,64 \pm 4,37$ g/día, $P = 0,018$), mientras que no hubo diferencias en el resto de ácidos grasos (oleico $28,30 \pm 18,13$ vs. $29,53 \pm 16,90$ g/día, $P = 0,703$; linoleico $13,70 \pm 16,80$ vs. $15,45 \pm 19,90$ g/día, $P = 0,605$). En los DM1 no se demostró una influencia del consumo de las grasas vegetales procedentes de aceites y frutos secos en los parámetros antropométricos, metabólicos y variables específicas de la diabetes.

CONSUMPTION OF NUTS AND VEGETAL OIL IN PEOPLE WITH TYPE 1 DIABETES MELLITUS

Abstract

Introduction: recent studies have demonstrated the cardiovascular benefits of the Mediterranean Diet, enriched with olive oil and nuts. People with diabetes, who have an increased risk of cardiovascular complications, could benefit greatly from following this type of eating pattern.

Objective: analysis of vegetable fats intake from nuts and olive oil in patients with 1 Diabetes Mellitus type (DM1).

Methods: transverse descriptive study comparing 60 people with type 1 Diabetes Mellitus (DM1) with 60 healthy individuals. We collect the frequency of consumption of vegetable oils and nuts and calculate the contribution of these foods in mono and polyunsaturated fatty acids (oleic acid, linoleic acid and α -linolenic acid). For data collection we designed a food frequency questionnaire specifically. We also collect anthropometric variables, cardiovascular risk factors and diabetes-related variables.

Results: vegetable fat intake from vegetable oils (3.02 ± 1.14 vs 3.07 ± 1.27 portions/day, $P = 0.822$) and nuts (1.35 ± 2.24 vs 1.60 ± 2.44 portions/week, $P = 0.560$), was similar in both groups. The DM1 group consumed fewer portions of olive oil daily than the control group (2.55 ± 1.17 vs 3.02 ± 1.34 portions/day, $P = 0.046$). We detected a significantly lower intake of α -linolenic acid in the control group (1.13 ± 2.06 versus 2.64 ± 4.37 g/day, $p = 0.018$) while there were not differences in the rest of fatty acids (oleic acid 28.30 ± 18.13 vs 29.53 ± 16.90 g/day, $P = 0.703$; linoleic 13.70 ± 16.80 vs 15.45 ± 19.90 g/day, $P = 0.605$). In DM1, it not demonstrated an influence of the intake of vegetable fats and oils from nuts in the anthropometric, metabolic and diabetes-specific variables.

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Recibido: 22-I-2015.
1.ª Revisión: 17-II-2015.
Aceptado: 5-III-2015.

Conclusiones: en las personas con DM1 el consumo total de aceites vegetales y frutos secos no difiere de la población general. Sin embargo, el consumo de aceite de oliva y el aporte del ácido graso α -linolénico es ligeramente inferior al de la población general. Aunque el consumo de aceites vegetales y frutos secos en las personas DM tipo 1 no se relaciona con parámetros metabólicos, o evolución de las complicaciones de la diabetes, es razonable incidir en incrementar su consumo, dados los beneficios reconocidos de este tipo de alimentos.

(Nutr Hosp. 2015;31:2641-2647)

DOI:10.3305/nh.2015.31.6.8671

Palabras clave: *Diabetes mellitus tipo 1. Ácidos grasos insaturados. Dieta mediterránea. Grasas vegetales. Frutos secos.*

Conclusions: in people with DM1, total intake of vegetable oils and nuts do not differ from the general population. However, the consumption of olive oil and the contribution of α -linolenic fatty acid derived from such fats are slightly lower than the general population. Although intake of vegetable oils and nuts in people with DM1 is not related to metabolic parameters, or progression of complications of diabetes, it is reasonable to increase their intake, given the recognized benefits of this type of food.

(Nutr Hosp. 2015;31:2641-2647)

DOI:10.3305/nh.2015.31.6.8671

Key words: *Type 1 Diabetes Mellitus. Unsaturated fatty acids. Mediterranean diet. Vegetable fats. Nuts.*

Abreviaturas

DM1: Diabetes Mellitus tipo 1.
ADA: American Diabetes Association.
SENC: Sociedad Española de Nutrición Comunitaria.
MUFA: Monounsaturated Fatty Acid (Ácido graso monoinsaturado).
PUFA: Polyunsaturated Fatty Acid (Ácido graso poliinsaturado).
FRCV: Factores de Riesgo cardiovascular.
CT: Colesterol total.
HDLc: High Density Lipoprotein.
LDLc: Low Density Lipoprotein.
TG: Triglicéridos.
HbA1c: Hemoglobina glucosilada..
TAS: Tensión arterial sistólica.
TAD: Tensión arterial diastólica.
IMC: Índice de Masa Corporal.
%G: % Grasa corporal.
%M: % Músculo esquelético.
Gv: Grasa visceral.
MB: Metabolismo Basal.
R: Raciones.
SEEDO: Sociedad Española de Estudio de la Obesidad.
AGE: Ácido graso esencial.
EFSA: European Food Safety Authority.
FNB-IOM: Food and Nutrition Board – Institute of Medicine.
AI: Ingestas adecuadas.
GEB: Gasto Energético Basal.
FA: Factor de actividad.

Introducción

La diabetes mellitus es un grupo de enfermedades metabólicas caracterizadas por hiperglucemia secundaria a un defecto absoluto o relativo en la secreción de insulina. Como consecuencia de la hiperglucemia se pueden producir complicaciones micro y macrovas-

culares que afectan a diferentes órganos como ojos, riñón, nervios, corazón y cerebro. En la diabetes tipo 1 (DM1), la destrucción de las células β del páncreas por un proceso específico autoinmune, conduce a una deficiencia absoluta de insulina¹.

En la actualidad, la terapia de las personas con DM1 se divide en cuatro apartados: tratamiento médico con insulina, terapia nutricional, ejercicio físico y autocontrol de la glucemia². La educación terapéutica en diabetes integra estos cuatro pilares y se considera fundamental para conseguir los objetivos marcados.

Es importante mantener en la dieta una distribución proporcional de los distintos principios inmediatos, de tal manera que el paciente tenga asegurado un aporte completo de todos los nutrientes indispensables. La DM1 requiere un horario de comidas adecuado al perfil de acción de la insulina y la medición frecuente de glucemia para realizar ajustes en la dosis de insulina prandial, en el tiempo de inyección previo a la ingesta y en la cantidad y composición de la comida⁶.

Algunos estudios han analizado el efecto de la alimentación sobre el riesgo cardiovascular (RCV) aumentado que presentan los pacientes con DM1³⁻⁶. Aquellos que evaluaron los efectos de la dieta mediterránea durante al menos un año⁶, junto con el control adecuado de los niveles de HbA_{1c}^{4,5}, demostraron que reduce el RCV en pacientes con DM1.

El estudio PREDIMED (Prevención Primaria de la enfermedad cardiovascular con la Dieta Mediterránea)⁷, realizado en personas con un alto riesgo cardiovascular, mostró que la dieta mediterránea suplementada con aceite de oliva virgen extra o frutos secos reduce la incidencia de complicaciones cardiovasculares mayores.

El objetivo principal de este estudio fue analizar la ingesta de grasas vegetales procedentes de frutos secos y aceite de oliva en pacientes con diabetes mellitus tipo 1.

Métodos

Estudio transversal observacional de carácter cuantitativo desarrollado en la Unidad de Diabetes del Ser-

vicio de Endocrinología y Nutrición del Consorcio Hospital General Universitario de Valencia y en oficinas de Farmacia del área metropolitana de Valencia y Castellón. El reclutamiento se llevó a cabo desde octubre de 2013 hasta abril de 2014.

El estudio incluyó 120 personas divididas en 2 grupos, un grupo de 60 pacientes con DM tipo 1 y un grupo control de 60 sujetos sanos. El reclutamiento se realizó de modo consecutivo. En el grupo de DM1 según asistían los pacientes a la consulta médica por su diabetes. Para el grupo control, según asistían a una oficina de Farmacia. Los criterios de inclusión para el grupo de pacientes con DM1 fueron: tener diagnóstico de DM1 desde hace al menos 1 año y recibir tratamiento con insulina, edad entre los 18 y 60 años. Ambos grupos debían dar su consentimiento para participar en el estudio tras ser informados del propósito del mismo. Como criterios de exclusión, la presencia de comorbilidades graves y no tener la capacidad intelectual suficiente para responder a las preguntas del cuestionario. El estudio fue realizado siguiendo las normas éticas del Comité de Investigación del centro y las de la Declaración de Helsinki vigente.

Recogida de datos

Se diseñó un formulario específico para la recogida de datos de las variables de estudio, utilizando frecuencia y cantidad de ingesta para raciones de frutos secos y aceites vegetales. El cuestionario se resume en

el Anexo 1. Se utilizó el programa DIAL, programa para la evaluación de dietas y gestión de datos de alimentación, desarrollado por el departamento de Nutrición y Bromatología de la Universidad Complutense de Madrid, para obtener la composición en ácidos grasos mono (MUFA) y poliinsaturados (PUFA) de los aceites y frutos secos consumidos: ácido oleico (C18:1 n-9), ácido linoleico (C18:2 n-6) y ácido α -linolénico (C18:3 n-3)⁸. El examen bioquímico incluyó perfil lipídico, colesterol total (CT), LDL colesterol (LDLc), HDL colesterol (HDLc), triglicéridos (TG) (mg/dL), control glucémico mediante hemoglobina glicosilada (HbA1c) en los pacientes del grupo DM1. Se recogieron además niveles de presión arterial (PA) en mmHg, mediante un sistema automático digital OMRON M6 COMFORT HEM-7221-E, impedanciometría mediante báscula-monitor de composición corporal OMRON BF511), hábito tabáquico, y práctica de ejercicio físico (por grupos: no practica actividad física, menos de 3,75 horas/semana más de 3,75 horas/semana).

En el grupo de paciente con DM1 se recogió también el tiempo desde el diagnóstico y las complicaciones crónicas asociadas a la enfermedad.

Análisis estadístico

Para el análisis univariante de variables categóricas se empleó una distribución de frecuencia absoluta. Para el análisis univariante de variables numéricas

CONSUMO ACEITE

- ✎ Tipo de aceite que utiliza para cocina: ☐ Oliva ☐ Girasol ☐ Otros
- ✎ Tipo de aceite que utiliza en crudo: ☐ Oliva ☐ Girasol ☐ Otros
- ✎ Frecuencia de consumo diario (nº cucharadas soperas):
[*1 R = 1 cucharada sopera = 10 mL; 3-6 R/día]

CONSUMO FRUTOS SECOS

- ✎ Tipo de frutos secos que consume:
☐ Nueces ☐ Almendras ☐ Pipas ☐ Cacahuets ☐ Pistachos ☐ Otros
- ✎ Frecuencia de consumo semanal
[*1R = 1 puñado= 20-30 g; 3-7 R/sem]

Anexo 1.—Cuestionario resumido de consumo de grasas vegetales.

continuas que presentaran distribución normal los resultados se expresaron como media $\pm$ desviación estándar y se empleó el test de la *t* de Student. En las personas con DM1, para analizar las diferencias por consumo de grasas vegetales en parámetros metabólicos, antropométricos y frecuencia de complicaciones de la diabetes se emplea también la prueba *t* de Student o la prueba Chi cuadrado según proceda. Se utilizó un análisis de regresión lineal para establecer una relación entre la ingesta de grasa vegetal y los niveles de HbA1c, PA, perfil lipídico y complicaciones de la diabetes. El nivel de significación se estableció en el 95% ($p < 0,05$). Para realizar el análisis estadístico, se exportó la base de datos al programa informático SPSS 15.0.

Resultados

Las características clínicas de ambos grupos de pacientes se muestran en la tabla I. En el grupo de DM1, la HbA1c media fue de $7,92 \pm 4,1$ %, el tiempo desde el diagnóstico fue de $19,22 \pm 5,88$ años y el 31,70% (N=19) tenían complicaciones crónicas microvasculares.

Tabla I
Características clínicas basales de los grupos de estudio

	Grupo control	DM 1	P
N	60	60	n.s.
Hombres	25	29	
Talla (m)	$1,66 \pm 0,08$	$1,68 \pm 0,10$	0,223
Peso (Kg)	$73,54 \pm 16,87$	$70,80 \pm 14,98$	0,348
IMC (Kg/m ²)	$26,38 \pm 4,78$	$24,91 \pm 4,12$	0,072
% G	$32,76 \pm 8,95$	$28,53 \pm 9,49$	0,014
% M	$29,13 \pm 4,80$	$31,99 \pm 6,22$	0,007
Gv	$9,16 \pm 5,68$	$7,25 \pm 4,04$	0,040
MB (Kcal/día)	$1532,53 \pm 269,90$	$1534,44 \pm 266,65$	0,970
CT (mg/dL)	$201,06 \pm 40,05$	$177,03 \pm 33,86$	0,001
HDLc (mg/dL)	$55,92 \pm 14,97$	$57,68 \pm 14,35$	0,564
LDLc (mg/dL)	$120,89 \pm 34,04$	$102,49 \pm 26,13$	0,006
TG (mg/dL)	$125,96 \pm 74,77$	$85 \pm 34,97$	0,001
PAS (mmHg)	$119,77 \pm 15,93$	$132,42 \pm 17,27$	0,000
PAD (mmHg)	$75,27 \pm 10,41$	$76,57 \pm 9,36$	0,473
Sedentarismo	N=26 (43,33%)	N=29 (48,33%)	0,164
Tabaquismo	N=17 (28,33%)	N=15 (25%)	0,680

IMC: índice de masa corporal; G: compartimento graso por impedanciometría; M: compartimento muscular por impedanciometría; Gv: Grasa visceral; MB: Metabolismo Basal; CT: Colesterol total; TG: Triglicéridos; PAS: presión arterial sistólica; PAD: presión arterial diastólica.

Datos relacionados con el consumo de los MUFA y PUFA

Frecuencia de consumo de aceite y frutos secos:

Los pacientes con DM1 consumieron menos aceite de oliva que el grupo control. No hubo diferencias significativas entre grupos en el consumo de aceite de girasol ni en el total de aceite consumido. No hubo diferencias significativas entre grupos en Raciones/semana de frutos secos consumidos. Los resultados se expresan en la tabla II.

En el grupo control 51 personas (85%) consumieron aceite de oliva frente a 43 en el grupo de DM1 (71,66%). El consumo exclusivo de aceite de girasol se presentó en 2 personas (3,33%) del grupo control y 1 (1,87%) del grupo de DM1. En el grupo control 7 personas consumían ambos aceites (11,67%) frente a 16 personas (26,67%) en el grupo DM1. Las preferencias de uso no variaron entre grupos, siendo el aceite de oliva el más empleado para alimentos en crudo y el aceite de girasol para cocinar.

En el grupo de DM1, 36 personas (60%) no consumen ningún tipo de fruto seco, exactamente igual que en grupo control. De las 24 personas (40%) que sí consumen, el fruto seco más consumido en el grupo control son las nueces (51,16%, N=22) y en DM1 son las almendras (32,65%, N=16)

Influencia del consumo de frutos secos sobre parámetros relacionados con DM1

El consumo de frutos secos no mostró asociación con ninguno de los parámetros de la impedanciometría, perfil lipídico, HbA1c, complicaciones crónicas y años de evolución de la enfermedad.

Cantidades totales consumidas de MUFA y PUFA

El grupo de DM1 mostró un menor consumo de ácido α -linolénico frente al grupo control (grupo DM1 $1,13 \pm 0,06$ vs. Grupo control $2,64 \pm 0,37$, $p=0,021$).

Tabla II
Resultados frecuencia de consumo de aceite y frutos secos en raciones diarias

R aceites y frutos secos	Grupo control	Diabéticos tipo 1	P
R/día aceite de oliva	$3,02 \pm 0,34$	$2,55 \pm 0,17$	0,046
R/día de aceite de girasol	$0,60 \pm 0,21$	$0,47 \pm 0,15$	0,565
R total/día aceites	$3,07 \pm 0,37$	$3,02 \pm 0,34$	0,822
R total/semana frutos secos	$1,60 \pm 0,14$	$1,35 \pm 0,14$	0,560

R: raciones.

No hubo diferencias significativas entre grupos en el consumo de ácido oleico (grupo control $29,53 \pm 8,90$ vs DM1 $28,30 \pm 8,13$, $p=0,834$) y ácido linoleico (grupo control $15,45 \pm 7,90$ vs DM1 $13,71 \pm 6,80$; $p=0,641$) (fig. 1).

Influencia de las cantidades totales consumidas de MUFA y PUFA sobre parámetros relacionados con la DM1

Las cantidades totales consumidas de ácido oleico, ácido linoleico y α -ácido linolénico no se asociaron con ninguno de los parámetros de la impedanciometría, perfil lipídico, HbA1c, complicaciones crónicas y años de evolución de la enfermedad.

Discusión

En la DM1 la dieta es un factor al que se le da una importancia capital, si bien en los últimos años hemos pasados de regímenes estrictos a recomendaciones más flexibles e individualizadas (ADA). Sin embargo son escasos todavía los estudios que comparen los hábitos nutricionales de nuestros pacientes con DM1 con respecto a la población general. Dado que en la DM1 está especialmente recomendada la prevención primaria de la enfermedad cardiovascular, sería conveniente reconducir los programas de educación nutricional en estos pacientes y seguirlos con el tiempo para ver la evolución de posibles complicaciones cardiovasculares en un futuro. Particularmente la población con DM1 podría beneficiarse de modo especial del consumo de grasas vegetales procedentes de aceites y frutos secos.

Los hábitos nutricionales en personas con DM1 se han asociado a marcadores de riesgo cardiovascular. El estudio EURO-DIAB demostró que una ingesta pobre en fibra, grasa poliinsaturada y proteína vegetal, junto con un mayor consumo de colesterol se relacionaba con mayor disfunción endotelial e inflamación en estos pacientes⁹. Aunque no se ha podido demostrar que la ingesta de grasa saturada conlleve una mayor mortalidad cardiovascular¹⁰, los resultados del estudio PREDIMED ofrecen una nueva perspectiva en lo que se refiere al consumo de grasas vegetales ricas en ácidos grasos insaturados. En dicho estudio se demostró que en personas con alto riesgo cardiovascular, la Dieta Mediterránea suplementada con aceite de oliva extra y frutos secos reducía la incidencia de complicaciones cardiovasculares mayores⁷.

La ingesta de PUFA se ha asociado también a una menor progresión de nefropatía diabética en un estudio realizado en España¹¹.

En nuestro estudio hemos analizado la frecuencia de consumo de grasas vegetales consideradas cardiosaludables en personas con DM1 frente a un grupo control sano. Los dos tipos de aceite consumidos por ambos grupos son el aceite de oliva y el aceite de girasol, reflejo de la tradición en la dieta que aparece en los países mediterráneos. El consumo de aceite de oliva en el grupo de DM1 fue significativamente inferior al grupo control, no habiendo diferencias en el caso del aceite de girasol ni en las raciones de aceite totales consumidas diariamente. En el grupo DM1, las raciones totales de aceite consumidas diariamente están por debajo de las recomendaciones de la SENC (2004)¹², que establece la frecuencia de consumo 3-6 R/día (1 ración = 10 mL). El grupo control cumplió con dichas recomendaciones manteniéndose en el rango más bajo de las mismas.

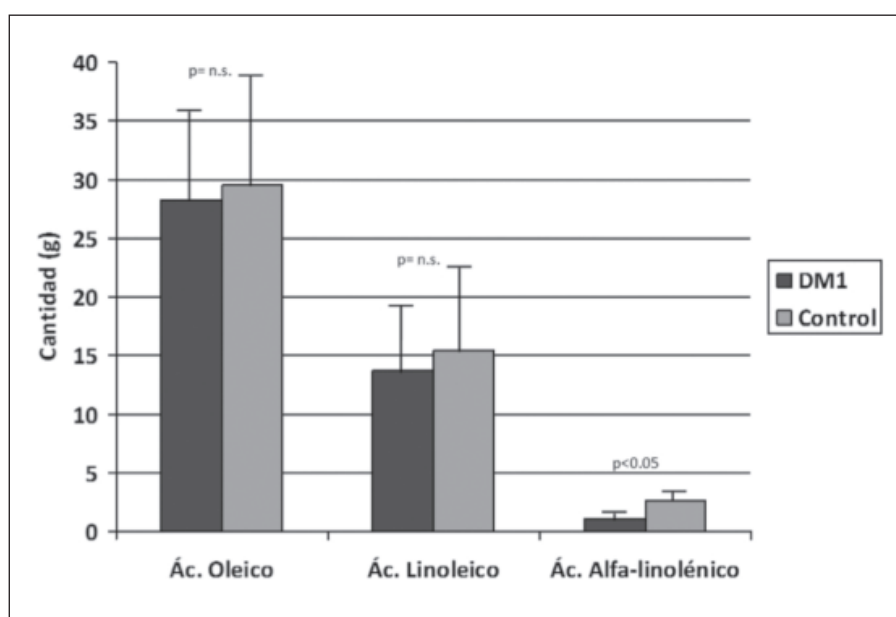


Fig. 1.—Cantidades totales consumidas de ácidos grasos mono y poliinsaturados.

La Asociación Americana de Diabetes no establece diferencias en el consumo de grasas mono y polinsaturadas para las personas con DM1 frente a la población sana y únicamente hace referencia a la dieta mediterránea para promover su uso en la diabetes tipo 2. Por otro lado, los suplementos de ácidos grasos así como de diferentes tipos de antioxidantes no han conseguido demostrar efectos beneficiosos en la diabetes¹. Por tanto, las modificaciones en la dieta son las que pueden aportar beneficios para la salud.

Los frutos secos son ricos en grasas saludables, proteínas, fibra, magnesio y algunos antioxidantes como vitamina E, fitolaxina y resveratrol¹³. Algunos estudios han demostrado un peor estado de antioxidación en los pacientes con DM1 incluso desde la infancia¹⁴, lo que permite establecer la hipótesis de los beneficios de los frutos secos en esta población. En nuestro estudio no hubo diferencias significativas en el consumo de frutos secos, entre los pacientes con DM1 y el grupo control, pero se observó en ambos grupos una frecuencia de consumo por debajo de las recomendaciones de la SENC (2004)¹², que la establece 3-7 R/semana (1 ración = 20 y 30 g). Nos parece especialmente reseñable que un 60% de sujetos de ambos grupos no consuma ningún tipo de fruto seco.

Los ácidos grasos α -linolénico y linoleico son ácidos grasos esenciales ya que los mamíferos no pueden sintetizarlos, por lo que deben estar presentes en la dieta. El ácido oleico no es un ácido graso esencial, ya que puede ser formado a partir de ácido esteárico (C18:0)¹⁵. Con el programa DIAL, se obtuvo la composición en ácidos grasos mono y poliinsaturados de los aceites y frutos secos consumidos por los dos grupos de población. No hubo diferencias entre grupos en cuanto al consumo de ácido oleico y ácido linoleico, sin embargo, el grupo de DM1 consumió significativamente menos ácido α -linolénico que el grupo control.

Según la SENC, los PUFA deben ser representar 6-7% del aporte energético diario (aproximadamente el 5% ácido linoleico y 1% ácido α -linolénico). La relación n-6/n-3 no debe ser superior a 5:1, aunque puede llegar a 10:1 si se cubre con aceites vegetales ricos en n-6 en la dieta. La European Food Safety Authority (EFSA) coincide con estas recomendaciones en el Reglamento (UE) n° 432/2012 en el que establece la lista de declaraciones de propiedades saludables autorizadas¹⁶. Tanto el ácido linoleico como el ácido α -linolénico, contribuyen a mantener niveles normales de colesterol sanguíneo, el primero con una ingesta mínima de 10-12 g/día, y el segundo con una ingesta de 2 g/día. Las recomendaciones americanas establecidas por el Food and Nutrition Board-Institute of Medicine (FNB-IOM) son superiores a las europeas 37,38. Para los PUFA n-6 y n-3 indica unas AI de PUFA n-6 para las mujeres de 9 a >70 años de 10 a 12 g/día y para los hombres de 12 a 17 g/día, y unas AI de PUFA n-3 para las mujeres de 9 a >70 años de 1-1,1 g/día y para los hombres de 1,2 a 1,6 g/día, de manera que la proporción $\omega 6/\omega 3$ americana

oscila entre 9:1-11:1¹⁷. En nuestro estudio respecto a los PUFA, el consumo de ácido linoleico, tanto en DM1 como en el grupo control, sobrepasa los 10 g/día declarados adecuados por la EFSA y también está dentro de las AI americanas. En cuanto al ácido α -linolénico, los resultados son dispares, por un lado los DM1 no alcanzan los 2g/día declarados por la EFSA, aunque sí que estarían dentro de la AI americanas, sin embargo el grupo control sobrepasa tanto los 2g/día declarados por la EFSA como las AI americanas. La relación $\omega 6/\omega 3$ en DM1 sobrepasa el valor de 10:1 (12,12), sin embargo en el grupo control estaría dentro de los recomendado 5:1-10:1 (5,85). Por tanto, sería importante, una vez más, incidir en los pacientes con DM1 sobre la importancia del consumo de PUFA. Una dieta mediterránea rica en ácido α -linolénico ha demostrado ser beneficiosa en la prevención secundaria de enfermedades coronarias¹⁸.

El ácido oleico, como se ha dicho anteriormente, no es un ácido graso esencial, por lo que la SENC recomienda que represente 15-20% del aporte energético diario. Para nuestra población, supondría unas necesidades de 40-60 g/día, considerando el género y la actividad física. No hubo diferencias entre grupos pero en ninguno se alcanzaron los mínimos de ingesta recomendados.

El ácido oleico ha demostrado tener efectos beneficiosos en modelos de diabetes tipo 2, mejorando la producción de la insulina y reduciendo la respuesta inflamatoria en forma de citoquinas como el factor de necrosis tumoral alfa (TNF- α)¹⁹.

El consumo de ácidos grasos vegetales ha demostrado beneficios sobre el control de la glucosa, la presión arterial y el perfil lipídico^{20,21}. En este estudio se evaluó si existía alguna asociación entre el consumo de aceites vegetales en pacientes DM1 y los parámetros de impedanciometría, el perfil lipídico, la HbA1c y complicaciones crónicas de la enfermedad siendo el resultado negativo. No obstante, el pequeño tamaño de la muestra y, sobre todo, la baja frecuencia de consumo no permite extraer conclusiones en este punto.

Entre otras limitaciones del estudio se encuentra, como ocurre en este tipo de análisis de frecuencia de consumo, la subjetividad a la hora de indicar la cantidad real de alimento consumido, puesto que los modelos de cuestionarios no dejan de alcanzar sólo una aproximación y dejan al sujeto la responsabilidad final de los resultados.

En conclusión, se evidencia un consumo insuficiente de frutos secos y aceite de oliva en los pacientes con DM1. Deben realizarse esfuerzos por modificar los hábitos nutricionales de los pacientes con DM1, más allá de las recomendaciones sobre hidratos de carbono y grasas saturadas, e insistir en incrementar el consumo de aceites vegetales ricos en MUFA y PUFA y frutos secos, que no sólo no empeoran el control glucémico sino que además tienen otros beneficios en cuanto a la prevención de complicaciones cardiovasculares.

Referencias

1. American Diabetes Association. Standards of Medical Care in Diabetes-2014. *Diabetes Care* 2014; 37 (Supl. 1):S14-S80.
2. McCarthy M. American Diabetes Association issues new guidelines for type 1 diabetes. *BMJ* 2014; 18;348:g4119.
3. Nathan DM, Cleary PA, Backlund JY, Genuth SM, Lachin JM, Orchard TJ, et al. Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. *N Engl J Med* 2005; 353: 2643-53.
4. Orchard TJ, Forrest KY, Kuller LH, Becker DJ. Lipid and blood pressure treatment goals for type 1 diabetes: 10 years incidence data from the Pittsburgh Epidemiology of Diabetes Complications Study. *Diabetes Care* 2001; 24: 1053-9.
5. Mukamal KJ, Nesto RW, Cohen MC, Muller JE, Maclure M, Sherwood JB, et al. Impact of diabetes on long-term survival after acute myocardial infarction: comparability of risk with prior myocardial infarction. *Diabetes Care* 2001; 24: 1422-7.
6. Faulkner MS, Chao WH, Kamath SK, Quinn L, Fritsch C, Maggioro JA, et al. Total homocysteine, diet, and lipid profiles in type 1 and type 2 diabetic and nondiabetic adolescents. *J Cardiovasc Nurs* 2006; 21: 47-55.
7. Estruch R, Ros E, Salas-Salvadó J, et al for the PREDIMED Study Investigators. Primary Prevention of Cardiovascular Disease with a Mediterranean Diet. *N Engl J Med* 2013; 368: 1279-90.
8. Ortega RM, López-Sobaler AM, Andrés P, Requejo AM, Aparicio Vizuete A, Molinero LM. DIAL software for assessing diets and food calculations. Departamento de Nutrición (UCM) y Alce Ingeniería S.L. Current version 2.16 2012. <http://www.alceingenieria.net/nutricion.htm>
9. van Bussel BC, Soedamah-Muthu SS, Henry RM, Schalkwijk CG, Ferreira I, Chaturvedi N, Toeller M, Fuller JH, Stehouwer CD; EURODIAB Prospective Complications Study Group. Unhealthy dietary patterns associated with inflammation and endothelial dysfunction in type 1 diabetes: the EURODIAB study. *Nutr Metab Cardiovasc Dis* 2013;23:758-64.
10. Schoenaker DA1, Toeller M, Chaturvedi N, Fuller JH, Soedamah-Muthu SS; EURODIAB Prospective Complications Study Group. Dietary saturated fat and fibre and risk of cardiovascular disease and all-cause mortality among type 1 diabetic patients: the EURODIAB Prospective Complications Study. *Diabetologia* 2012;55:2132-41.
11. Cárdenas C, Bordiu E, Bagazgoitia J, Calle-Pascual AL; Diabetes and Nutrition Study Group, Spanish Diabetes Association. Polyunsaturated fatty acid consumption may play a role in the onset and regression of microalbuminuria in well-controlled type 1 and type 2 diabetic people: a 7-year, prospective, population-based, observational multicenter study. *Diabetes Care* 2004;27:1454-7.
12. Dapcich V, Salvador Castell G, Ribas Barba L, Pérez Rodrigo C, Aranceta Bartrina J, Serra Majem L. En: Guía de la alimentación saludable. Madrid: Editorial Sociedad Española de Nutrición Comunitaria; 2010. p. 84-91.
13. Vassiliou EK1, Gonzalez A, Garcia C, Tadros JH, Chakraborty G, Toney JH. Oleic acid and peanut oil high in oleic acid reverse the inhibitory effect of insulin production of the inflammatory cytokine TNF-alpha both in vitro and in vivo systems. *Lipids Health Dis* 2009; 26: 8-25.
14. Varvarovská J, Racek J, Stozický F, Soucek J, Trefil L, Poma-hacová R: Parameters of oxidative stress in children with type 1 diabetes mellitus and their relatives. *J Diabetes Complications* 2003; 17: 7-10.
15. Chilton FH, Murphy RC, Wilson BA, Sergeant S, Ainsworth H, Seeds MC, Mathias RA. Diet-gene interactions and PUFA metabolism: a potential contributor to health disparities and human diseases. *Nutrients* 2014;6(5):1993-2022.
16. <http://www.boe.es/doue/2012/136/L00001-00040.pdf>
17. Food and Nutrition Board (FNB), Institute of Medicine (IOM). Dietary Reference Intakes for energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. National Academy Press Washington DC. 2005.
18. de Lorgeril M, Salen P. Dietary prevention of coronary heart disease: focus on omega-6/omega-3 essential fatty acid balance. *World Rev Nutr Diet* 2003;92:57-7.
19. Vassiliou EK1, Gonzalez A, Garcia C, Tadros JH, Chakraborty G, Toney JH. Oleic acid and peanut oil high in oleic acid reverse the inhibitory effect of insulin production of the inflammatory cytokine TNF-alpha both in vitro and in vivo systems. *Lipids Health Dis* 2009; 26: 8-25.
20. Viguiouk E, Kendall CW, Blanco Mejia S, Cozma AI, Ha V, Mirrahimi A, Jayalath VH, Augustin LS, Chiavaroli L, Leiter LA, de Souza RJ, Jenkins DJ, Sievenpiper JL. Effect of tree nuts on glycemic control in diabetes: a systematic review and meta-analysis of randomized controlled dietary trials. *PLoS One* 2014; 9(7): e103376.
21. Salas-Salvadó J. Quinta Lección Jesús Culebras; los frutos secos: efectos sobre la salud, la obesidad y el síndrome metabólico. *Nutr Hosp* 2015; 31 (2): 519-27.



Original/Intensivos

Evaluación del test paracetamol en suero como indicador predictivo del vaciado gástrico

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Resumen

Introducción: la iniciación temprana de la nutrición en pacientes intervenidos quirúrgicamente es fundamental.

Objetivos: analizar las técnicas disponibles para evaluar el vaciado gástrico de los pacientes críticos sometidos a cirugía, y que apoyan la decisión de introducirles un tipo de alimentación u otro.

Resultados: los test estándar son la medida del volumen residual gástrico y la auscultación, pero no han demostrado gran eficacia. El test de paracetamol parece una buena herramienta predictiva. Permitiría en una hora saber si el vaciado gástrico es adecuado y con ello seleccionar el tipo de nutrición más conveniente (enteral, parenteral) o evaluar el uso de procinéticos.

Discusión: el test de paracetamol es una alternativa económica de alto valor predictivo. Existen estudios cuyo objetivo final es valorar el test como indicador de la tolerancia de la nutrición enteral, pero es necesario ampliar y estandarizar su uso para poder incluirlo en los protocolos de actuación hospitalarios.

(Nutr Hosp. 2015;31:2648-2650)

DOI:10.3305/nh.2015.31.6.8039

Palabras clave: Test de paracetamol. Test de paracetamol simplificado. Vaciado gástrico. Volumen residual gástrico.

STUDY OF PARACETAMOL LEVELS IN SERUM SAMPLES AS PREDICTIVE INDICATOR OF GASTRIC EMPTYING

Abstract

Introduction: according to numerous studies, early initiation of nutrition in patients who have undergone surgery is essential.

Objectives: we analyzed the available techniques to assess gastric emptying in critically ill patients undergoing surgery, and holding the decision to introduce the type of feeding route.

Results: the measurement of gastric residual volume and auscultation are the standard tests used, but they have not shown great effectiveness. The acetaminophen absorption test seems to be a good predictive tool, that allows in 1 hour whether gastric emptying is right and thus, support the idea of continue with enteral nutrition, change to parenteral nutrition or evaluate the use of prokinetics drugs.

Discussion: although there are studies whose final objective is the evaluation of the test as an indicator of tolerance of enteral nutrition, it is necessary to expand and standardize its use in order to include it in protocols for clinical practice.

(Nutr Hosp. 2015;31:2648-2650)

DOI:10.3305/nh.2015.31.6.8039

Key words: Paracetamol test. Simplified paracetamol test. Gastric emptying. Gastric residual volume.

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Recibido: 4-IX-2014.

1.ª Revisión: 20-X-2014.

2.ª Revisión: 5-II-2015.

Aceptado: 7-III-2015.

Introducción

Según numerosos estudios la iniciación temprana de la nutrición en pacientes intervenidos quirúrgicamente es fundamental¹. El catabolismo acelerado y el ayuno pueden ser deletéreos en estos pacientes². Empezar con nutrición oral convencional o enteral de forma temprana mejora el sistema inmune y reduce la permeabilidad de la mucosa gastrointestinal. Como consecuencia, se disminuyen las complicaciones por sepsis, se reduce la tasa de mortalidad, la estancia en UCI y por tanto, los costes^{3,4}. Sin embargo, en un 30-50% de los pacientes al introducir la nutrición enteral, aparece alguna complicación gastrointestinal⁵. Entre las complicaciones, destacan el aumento del residuo gástrico, el estreñimiento, la diarrea, la distensión abdominal y la disfunción del esfínter esofágico inferior con la aparición de regurgitación de la dieta, y/o vómitos que incrementa el riesgo del desarrollo de broncoaspiración y neumonía secundaria⁶. Actualmente, la medida del volumen residual gástrico (VRG) y la auscultación del peristaltismo son los test estándar utilizados en la valoración del tipo de soporte nutricional (oral, enteral, mixta, o parenteral) en los pacientes críticos intervenidos quirúrgicamente.

Objetivos

Analizar las técnicas disponibles para evaluar el vaciado gástrico de los pacientes críticos sometidos a cirugía, y las evidencias encontradas sobre el potencial del test de paracetamol en suero como indicador del vaciado gástrico.

Métodos

Se ha realizado una búsqueda bibliográfica en: Biblioteca Cochrane Plus (Update Software), Cochrane Library (John Wiley & Sons, Inc.), Embase (Elsevier), ERIC (USDE), Biblioteca, MEDLINE, PubMed, SciELO (Scientific Electronic Library Online). Se ha realizado una búsqueda de ensayos clínicos registrados a nivel mundial en clinicaltrials.gov.

Resultados

Hay escasas publicaciones donde se utilice el test del paracetamol como medida del volumen residual gástrico (VRS) en pacientes críticos postquirúrgicos⁷, sin embargo aparece con alto valor predictivo (valor predictivo positivo y negativo del 100%)⁵. Sin embargo, sí existen diversos estudios, especialmente del efecto en la motilidad del uso de procinéticos, que utilizan este test para la medición del vaciado gástrico^{8,9,10,11}. En la búsqueda realizada en Clinical Trial se han encontrado sólo siete estudios donde se aplica el test

con este fin, se trata de 5 ensayos clínicos aleatorizados y dos estudios observacionales caso-control.

En el ensayo clínico “*The effect of oxybutynin chloride topical gel administration of gastric emptying*”¹² que finalizó en octubre de 2012, se busca analizar el efecto de la oxibutinina gel tópico en el vaciado gástrico, y para ello lo compara con la dosis biodisponibilidad relativa del paracetamol. “*Methylnaltrexone vs Erythromycin for Facilitating Gastric Emptying Time in Critically Ill Patients*”¹³ finalizado en marzo 2011, es un ensayo clínico ya finalizado, aleatorizado simple ciego en paralelo donde participaron 42 personas y donde se utilizó la prueba de absorción de paracetamol para medir el tiempo de vaciado gástrico tras la administración de eritromicina intravenosa y metilnaltrexona subcutánea para compararlas.

En los ensayos clínicos “*Liraglutide in the Treatment of Type 1 Diabetes Mellitus*”¹⁴ y “*Liraglutide in type 1 Diabetes*”¹⁵, actualmente activos, se investiga el efecto de liraglutida 1,8 mg una vez al día en comparación con el placebo durante 24 semanas sobre el cambio en los niveles de glucagón postprandial, el vaciado gástrico, EVA para el apetito, y para ello se compara con la absorción de paracetamol. Se trata de estudios aleatorizados, doble ciego y en paralelo.

En febrero del 2015 finalizó el ensayo clínico “*A study of the effect of Taspoglutide on gastric emptying in patients with type 2 Diabetes*”¹⁶ que ha incluido a 60 pacientes. Se trata de un estudio controlado con placebo 3 brazos que investiga el efecto de taspoglutida en el vaciado gástrico en pacientes con diabetes tipo 2. Los pacientes se han asignado al azar a uno de 3 grupos para recibir a) 10 mg taspoglutida subcutánea semanalmente durante 12 semanas b) 10 mg taspoglutida subcutánea semanalmente durante 4 semanas, seguido de 20 mg subcutáneos de taspoglutida semanalmente durante 8 semanas o c) dosis subcutánea de placebo a la semana durante 12 semanas. El efecto de esta medicación sobre el vaciado gástrico de estos pacientes se evalúa mediante una prueba de paracetamol a intervalos a lo largo del estudio.

Los dos estudios observacionales donde se utiliza el test de paracetamol son “*Quantification of the Incretin Effect in Healthy Subjects and Patients With Type 2 Diabetes*”¹⁷ e “*Incretin Physiology and Beta-cell Function Before and After Weight-loss*”¹⁸. El trabajo “*Quantification of the Incretin Effect in Healthy Subjects and Patients With Type 2 Diabetes*” tiene como objetivo la cuantificación del efecto incretina en sujetos sanos y en pacientes con diabetes tipo 2 durante cantidades crecientes de sobrecargas orales de glucosa y la correspondiente sobrecargas de glucosa intravenosas isoglucémicas. El estudio “*Incretin Physiology and Beta-cell Function Before and After Remission of Type 2 Diabetes*”, aún en activo, evalúa el impacto de la banda gástrica ajustable laparoscópica (BGAL) sobre la función de las células beta, sensibilidad a la insulina, la función de la incretina, secreción postprandial de las hormonas incretinas (péptido similar al

glucagón-1 (GLP-1) y dependiente de glucosa (GIP) en los pacientes con obesidad mórbida y describe los mecanismos fisiopatológicos implicados en la mejora de la homeostasis de la glucosa durante la pérdida de peso a largo plazo. En ambos estudios se incluye el test de paracetamol en su diseño como medio de calcular la curva de absorción intestinal de los sujetos participantes.

Discusión

La medida del volumen residual gástrico (VRG) y la auscultación del peristaltismo son los test estándar utilizados en la valoración del tipo de soporte nutricional (oral, enteral, mixta, o parenteral) en los pacientes críticos intervenidos quirúrgicamente. La medida del VRG se realiza por conexión periódica de la sonda a una bolsa de drenaje, o mediante aspiración con jeringa. Si éste supera 200 ml en varias mediciones seriadas en un intervalo aproximado de 6 horas, la nutrición parenteral sería la vía más adecuada⁵. A pesar de su uso, su baja precisión y el tiempo transcurrido entre comprobaciones, hacen que no resulte adecuado para evaluar la eficacia del aporte nutricional¹⁹. El paracetamol es un analgésico cuya absorción tiene lugar en la región proximal del intestino delgado y, usualmente, es completa una hora después de su administración. Dado que la tasa de absorción depende del vaciado gástrico, administrando una dosis conocida de paracetamol por sonda nasogástrica y midiendo sus valores plasmáticos en tiempos conocidos, se construye una curva cuya área sería un indicador del vaciado gástrico. También existe una variante, el test de paracetamol simplificado, en la que se realiza una única medición en el pico de absorción, a los 30 minutos de la administración. Esto permitiría en un tiempo de aproximadamente 1 hora saber si el vaciado gástrico es adecuado, ayudando a la toma de decisiones de forma precoz. Además, el paracetamol por sí solo no afecta a la motilidad gástrica, es barato y las posibles contraindicaciones y efectos adversos son ampliamente conocidos y predecibles.

La decisión de retirada del sondaje nasogástrico es una decisión muy difícil e importante en la evolución del paciente. No se dispone de herramientas cuantitativas ni cualitativas con eficacia demostrada que soporten la decisión clínica de comenzar / continuar con un tipo de nutrición u otro en pacientes críticos tras intervención quirúrgica. Por todo lo expuesto, el test de paracetamol parece una buena alternativa para la medición del vaciado gástrico y la toma de decisiones. Este test ha demostrado su eficacia como medición del vaciado gástrico^{5,20,21}, pero aún es necesario demostrar su utilidad en la toma de decisión en estos pacientes con los ensayos clínicos adecuados. También sería interesante incluir en estos estudios la utilización o no de la versión simplificada del test, dada que ésta es más eficiente y menos invasiva.

Referencias

1. García B., Grau T. La nutrición enteral precoz en el enfermo grave. *Nutr Hosp*. 2005; 20: 93-100.
2. Mallampalli A., McClave SA., Snider HL. Defining tolerance to enteral feeding in the intensive care unit. *Clin Nutr* 2000; 19(4): 213-215.
3. Cerra FB, Benitez MR, Blackburn GL, Irwin RS, Jeejeebhoy K, Katz DP, et al. Applied nutrition in ICU patients. A consensus statement of the American College of Chest Physicians. *Chest* 1997; 111(3): 769-78.
4. Moore FA, Feliciano DV, Andrassy RJ, McArdle AH, Booth FV, Morgenstein-Wagner TB, et al. Early enteral feeding compared with parenteral reduces septic complication: The results of meta-analysis. *Ann Surg* 1992; 216(2): 172-84.
5. Gordo Vidal F., Núñez Reiz, A., Calvo Herranz, Ruiz de Luna R., Temprano Vázquez S. Test de paracetamol simplificado en la valoración de la tolerancia a la nutrición enteral. *Med Intensiva* 2003; 27(6): 385-90.
6. Mondejar JC, Jiménez J., Ordóñez J., Caparrós T., García A., Ortiz C., López J. Gastrointestinal complications of enteral nutrition in critically-ill patients. *Med Intensiva*. 2001; 25(4): 152-60.
7. Moreira TV, McQuiggan M. Methods for the assessment of gastric emptying in critically ill, enterally fed adults. *Nutr Clin Pract* 2009;24(2):261-73.
8. Landzinski J, Kiser TH, Fish DN, Wischmeyer PE, MacLaren R. Gastric motility function in critically ill patients tolerant vs intolerant to gastric nutrition. *JPEN J Parenter Enteral Nutr* 2008; 32(1): 45-50.
9. MacLaren RP, Kuhl DA, Gervasio JM, Brown R, Dickerson RN, Livingston TN, et al. Sequential single doses of cisapride, erythromycin, and metoclopramide in critically ill patients intolerant to enteral nutrition: a randomized, placebo-controlled, crossover study. *Crit Care Med* 2000; 28: 438-444.
10. MacLaren R, Pharm D, Ward DP, et al. Comparison of Cisapride and Metoclopramide for facilitating gastric emptying an improving tolerance to intragastric enteral nutrition in critically ill, mechanically ventilated adults. *Clin Ther* 2001; 23(11): 1855-66. <http://acnp.unibo.it/cgi-ser/start/it/cnr/df-.tcl?issn=01492918&m040=ACNP&m040=TEMP&language=ITALIANO&libre=%7B%7D>
11. Nieto JE. In vivo and in vitro evaluation of the effects of domperidone on the gastrointestinal tract of healthy horses. *Am J Vet Res*. 2013; 74(8):1103-10.
12. <https://clinicaltrials.gov/ct2/show/NCT00926926>.
13. <https://clinicaltrials.gov/ct2/show/NCT01117376?term=Methylnaltrexone+vs+Erythromycin+for+Facilitating+Gastric+Emptying+Time+in+Critically+Ill+Patients&rank=1>.
14. <https://clinicaltrials.gov/ct2/show/NCT01722266?term=Liraglutide+in+the+Treatment+of+Type+1+Diabetes+Mellitus&rank=1>.
15. <https://clinicaltrials.gov/ct2/show/record/NCT01722240?term=NCT01722240&rank=1>.
16. <https://clinicaltrials.gov/ct2/show/NCT00809705?term=A+study+of+the+effect+of+Taspoglutide+on+gastric+emptying+in+patients+with+type+2+Diabetes&rank=1>.
17. <https://clinicaltrials.gov/ct2/show/NCT00529048?term=Quantification+of+the+Incretin+Effect+in+Healthy+Subjects+and+Patients+With+Type+2+Diabetes&rank=1>.
18. <https://clinicaltrials.gov/ct2/show/NCT00625040?term=NC-T00625040&rank=1>.
19. Cohen J., Aaron A., Singer P. The paracetamol absorption test: a useful addition to the enteral nutrition algorithm?. *Clin Nutr* 2000; 19(4): 233-236.
20. Soroksky A, Lorber J, Klinowski E, Ilgayev E, Mizrachi A, Miller A, Ben Yehuda TM, Leonov Y. A Simplified Approach to the Management of Gastric Residual Volumes in Critically Ill Mechanically Ventilated patients: A Pilot Prospective Cohort Study. *Isr Med Assoc J*. 2010; 12(9): 543-8.
21. Glerup H, Bluhme H, Villadsen GE, Rasmussen K, Ejlskjær N, Dahlerup JF. Gastric emptying: a comparison of three methods. *Scand J Gastroenterol*. 2007;42(10):1182-6.



Original/*Valoración nutricional*

Estilo de vida y seguimiento de la ingesta dietética en estudiantes del Campus de la Universidad de Granada en Melilla

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Resumen

Introducción: los estudiantes universitarios representan un colectivo social en riesgo desde el punto de vista nutricional, ya que a menudo mantienen estilos de vida y hábitos nutricionales inapropiados.

Objetivos: analizar el estilo de vida de los alumnos del Campus de la Universidad de Granada en Melilla. Analizar la evolución de los hábitos alimentarios de los estudiantes del campus durante el curso académico 2013-2014.

Material y método: se realizó un estudio longitudinal durante el curso académico 2013-2014 en el cual, a su inicio, se evaluó el estilo de vida y, de forma continuada los hábitos nutricionales de un grupo representativo de 257 estudiantes, 90 chicos (35%) y 167 chicas (65%), todos ellos del campus de la Universidad de Granada en la Ciudad Autónoma de Melilla (norte de África).

Resultados: los hábitos nutricionales empeoran a medida que avanza el curso académico, caracterizándose por una reducción significativa ($p < 0.001$) en la ingesta de carbohidratos, así como por una elevación significativa ($p < 0.001$) en la ingesta proteica y lipídica, siendo especialmente rica en grasas saturadas y baja en fibra.

Conclusiones: la población estudiada posee un estilo de vida eminentemente sedentario. A medida que avanza el curso académico, los hábitos nutricionales de los estudiantes empeoran, alejándose del patrón de alimentación mediterráneo con el consiguiente riesgo de desarrollar enfermedades metabólicas y cardiovasculares. De estos resultados se desprende la necesidad de continuar profundizando a fin de identificar los factores que influyen en sus hábitos nutricionales y establecer las medidas correctoras oportunas.

(Nutr Hosp. 2015;31:2651-2659)

DOI:10.3305/nh.2015.31.6.8973

Palabras clave: Población universitaria. Hábitos nutricionales. Estilo de vida.

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Recibido: 15-III-2015.
Aceptado: 16-IV-2015.

LIFE STYLE AND MONITORING OF THE DIETARY INTAKE OF STUDENTS AT THE MELILLA CAMPUS OF THE UNIVERSITY OF GRANADA

Abstract

Introduction: university students represent a social group at risk, from the nutritional point of view because they usually have inappropriate nutritional habits and lifestyle.

Objective: analyze the students' lifestyle from the Campus of University of Granada in Melilla. Analyze the evolution of the eating habits of these students during the academic year 2013-2014.

Methods: a longitudinal study was carried out during the academic year 2013-2014, the lifestyle was evaluated and, in an ongoing way, the eating habits in a representative sample of 257 students, 90 men (35%) and 167 women (65%), all of them from the campus of University of Granada in Melilla.

Results: the results get worst as the academic year progresses and they are characterized by a significant reduction ($p < 0.001$) of carbohydrates intake as well as a significant increase ($p < 0.001$) of the lipid and protein intake, especially, rich in saturated fat and a low-fiber diet.

Conclusions: the population studied shows a sedentary lifestyle. As the academic year progresses, the students' eating habits get worst distance from the Mediterranean Diet pattern with the consequent risk at the development of cardiovascular diseases and metabolism disorder. So, it is necessary to get into these results in order to identify the influential factors in their eating habits and take the appropriate actions.

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DOI:10.3305/nh.2015.31.6.8973

Key words: University population. Nutritional habits. Lifestyle.

Introducción

Investigaciones recientes han establecido una asociación entre el estado de salud y las características de la alimentación, concretamente la ingesta de alimentos propios de la Dieta Mediterránea^{1,2}. La dieta mediterránea se caracteriza por un alto consumo de frutas y hortalizas, aceite de oliva como fuente de grasa, bajo consumo de carne y productos lácteos, bajo contenido en ácidos grasos saturados y elevado en monoinsaturados, carbohidratos complejos y fibra. Además, la DM incluye un consumo moderado de vino³. Desde los primeros datos obtenidos a partir del Estudio Siete Países⁴, la DM se ha asociado con un menor riesgo de padecer enfermedades crónicas tales como diabetes mellitus tipo 2, enfermedad cardiovascular⁵, algunos tipos de cáncer como el de mama⁶ y en general una supervivencia más prolongada⁷. En este sentido, la DM constituye un modelo de alimentación saludable por su naturaleza variada y aporte de macronutrientes adecuado.

Según datos de la Valoración Nutricional del Panel de Consumo Alimentario, llevada a cabo por la Fundación Española de la Nutrición (FEN) en colaboración con el Ministerio de Agricultura, Alimentación y Medio Ambiente, los patrones de consumo de alimentos en España y la ingesta de energía y nutrientes se han modificado sustancialmente en los últimos 40 años, alejándose de la DM tradicional⁸. De estos resultados, es la población juvenil la que más se ha alejado. Estudios realizados en los estudiantes universitarios de Alicante y Navarra confirman que los alumnos presentan una baja adherencia a la DM^{9,10}.

En este sentido, diferentes estudios sugieren que la universidad no ejerce el papel que podría significar en cuanto a la potenciación de estilos de vida sanos y el abandono de estilos nocivos para la salud^{11,12}. Los adultos jóvenes y en modo especial los estudiantes universitarios, representan un colectivo social en riesgo desde el punto de vista nutricional ya que a menudo no cumplen con los principios nutricionales de la DM^{13,14}. La asunción en algunos casos de nuevas responsabilidades tales como la compra de alimentos, la elaboración del menú a diario o la adaptación a la preparación de los alimentos en el lugar de residencia durante el curso, son factores que van a condicionar fuertemente los hábitos alimentarios¹⁵.

Por otra parte, se trata de un colectivo muy receptivo a prácticas nutricionales de riesgo tales como dietas rápidas de adelgazamiento, régimen de comidas irregular, omisión del desayuno, consumo excesivo de alimentos hipercalóricos¹⁶ e ingesta excesiva de alcohol¹⁷ y otras sustancias tóxicas¹⁸. Este tipo de prácticas puede conllevar el desarrollo de deficiencias en micronutrientes y otros componentes esenciales propios de la alimentación tradicional mediterránea¹⁶. Los objetivos de este estudio fueron, en primer lugar, analizar el estilo de vida de los alumnos del Campus de la Universidad de Granada en Melilla. En segundo

lugar, analizar la evolución de los hábitos alimentarios de los estudiantes del Campus durante el curso académico 2013-2014.

Material y Método

Se realizó un estudio longitudinal durante el curso académico 2013-2014 en el cual, a su inicio se evaluó el estilo de vida, y de forma continuada los hábitos nutricionales de un grupo representativo de estudiantes del Campus de la Universidad de Granada en la Ciudad Autónoma de Melilla (norte de África).

Para la selección de la muestra se realizó un muestreo aleatorio estratificado con afijación proporcional entre todo el alumnado del Campus Universitario de Melilla. La población de estudio estuvo integrada por alumnos pertenecientes a los tres centros que integran el campus, alumnos de la Facultad de Enfermería, alumnos de la Facultad de Ciencias Sociales y de la Facultad de Educación y Humanidades. Dentro de cada estrato, la selección de los participantes fue de forma aleatoria y proporcional al número de chicos y chicas por curso. En base a lo anterior, en el estudio participaron un total de 257 estudiantes, 90 chicos (35%) y 167 chicas (65%).

El estudio se desarrolló durante el curso académico 2013-2014. Durante el mes de septiembre de 2013 se realizaron reuniones informativas con todo el alumnado del Campus Universitario. Las reuniones se realizaron de forma individual en cada una de las tres Facultades y en cada curso académico. En dichas reuniones fueron explicados los objetivos del estudio así como las diferentes determinaciones y cuestionarios que les serían aplicados en caso de aceptar participar en el estudio. Todos los alumnos recibieron además un documento de consentimiento informado donde se explicaban con detalle las características del estudio y objetivos del mismo. Una vez leído el documento y aclaradas sus posibles dudas los alumnos debían prestar o no su autorización a participar en el estudio por escrito.

Durante el mes de octubre de 2013 tuvo lugar la primera evaluación completa de los alumnos. En ella se realizó una valoración completa del estilo de vida y hábitos nutricionales. Para ello, fueron utilizados dos cuestionarios, uno general sobre estilos de vida y frecuencia de consumo alimentario, y un cuestionario alimentario recordatorio de 72 horas, el cual debían cumplimentar en su domicilio durante tres días consecutivos. En el mes de Julio de 2014 fueron nuevamente valorados aplicando nuevamente el cuestionario general sobre estilos de vida y frecuencia de consumo alimentario, y el cuestionario recordatorio de 72 horas.

El cuestionario general sobre estilos de vida y frecuencia de consumo alimentario fue adaptado a partir del cuestionario elaborado y validado por González y colaboradores (2012)¹⁹. Dicho cuestionario se compone de dos partes, una primera sección sobre datos so-

ciodemográficos y una segunda parte sobre frecuencia de consumo alimentario y hábitos de actividad física. De igual modo, los estudiantes debían cumplimentar un segundo cuestionario nutricional recordatorio de 72 horas. En él, los alumnos debían registrar todos los alimentos y bebidas que ingerían a lo largo del día durante 72 horas, concretamente durante los días jueves, viernes y sábado. La información nutricional recabada mediante este cuestionario fue analizada mediante el programa nutricional Diet Source[®] versión 3.0.

El análisis estadístico se realizó con el programa estadístico SPSS versión 20.0 (SPSS Inc, Chicago, IL, EE.UU). Las medias y desviaciones estándar fueron utilizadas como estadísticos descriptivos para las variables cuantitativas. Las proporciones se utilizan para describir variables cualitativas. La normalidad de las distribuciones se comprobó mediante la prueba de Kolmogorov-Smirnov, realizando test de Student o el test de Wilcoxon, según el caso, para comparar dos medias. El nivel de significación se estableció cuando $p < 0.05$.

Resultados

La muestra estaba integrada por un 54.9% de estudiantes de religión cristiana católica, seguido de un 40.9% de participantes de religión musulmana y sólo un 0.8% de religión hebrea (Tabla I). Relativo al lugar de residencia durante el curso académico, el 70% de todos los estudiantes del campus residía en el domicilio familiar. Si bien, distinguiendo entre sexos eran los varones quienes con mayor frecuencia vivían en el domicilio familiar durante el curso académico. Otra forma de residencia frecuente eran los pisos de alquiler. Esta forma de residencia era más frecuente en las chicas (28.1%) que en los chicos (13.3%). En el caso de la residencia universitaria, era una opción menos frecuente, representada por sólo un 18% de todos los alumnos, siendo igualmente más frecuente entre las chicas. Con relación a la preparación del menú diario, el 57.2% de los alumnos afirmó ser la madre la persona encargada de elaborar el menú diario en el hogar, seguido de un 33.1% de alumnos quienes manifestaron ser ellos mismos los responsables de elaborar su menú diario. Sobre la práctica de dietas milagro, hasta un 20.4% de chicas manifestaron haberlas realizado. Sobre el consumo de productos para perder peso rápidamente, chicos y chicas habían consumido en proporciones cercanas productos que garantizaban una pérdida de peso rápida. Sobre las comidas que realizaban a diario regularmente, un 30% de chicos seguido de un 26.9% de chicas nos desayunaban a diario antes de asistir a clase. En el caso de la toma de media mañana, el 67.7% del total de alumnos no la realizaba. El 58% de los estudiantes manifestó realizar “picoteos” frecuentemente entre las principales comidas. Relativo a la variable miedo a ganar peso, el 44.7% de estudiantes indicó haber tenido miedo a la ganancia de peso algu-

nas veces. El 5.1% de los alumnos afirmó tener pánico a ganar peso, siendo esta situación más frecuente entre las chicas (6.6%). Otra variable explorada fue el grado de importancia concedido a la práctica ejercicio físico. El 81.4% de todos los alumnos del campus consideraba bastante importante la práctica de ejercicio físico. Sobre la práctica de deportes, el 49% del total de alumnos del campus indicó no realizar ningún tipo de deporte. Sobre la práctica de ocio sedentario, el 80.2% del total de alumnos del campus practicaba ocio sedentario durante su tiempo libre. Considerando la variable sexo, eran las chicas quienes con mayor frecuencia practicaban ocio sedentario (80.9%), frente a un 78.9% de chicos. Relativo al uso de medios de transporte a diario, el 52.1% de alumnos indicó utilizar todos los días medio de transporte para desplazarse hasta el Campus universitario.

La tabla II muestra la ingesta de energía, macronutrientes y micronutrientes de acuerdo con el sexo. Los resultados muestran diferencias significativas ($p < 0.001$) entre la ingesta energética inicial y la final de los chicos. Respecto de los macronutrientes, en las chicas se encontró una disminución significativa ($p < 0.001$) entre la ingesta inicial y la final de carbohidratos al igual que entre los chicos aunque en éstos sin diferencias significativas. Existe un incremento estadísticamente significativo ($p < 0.001$) entre la ingesta lipídica inicial y final tanto en chicas como en chicos. Sobre la ingesta proteica se observa un incremento significativo ($p < 0.001$) en ambos sexos, aunque superior entre los chicos. El análisis de ingesta de micronutrientes muestra una reducción significativa ($p < 0.001$) entre la ingesta inicial y final de calcio en ambos sexos, aunque de forma más pronunciada entre los chicos. Asimismo, se observa un descenso significativo ($p < 0.001$) entre la ingesta diaria inicial y final de hierro en ambos sexos y un incremento significativo en la ingesta de sodio, siendo éste especialmente pronunciado entre los chicos. Relativo a la ingesta diaria de vitaminas en ambos sexos, se observa una reducción significativa ($p < 0.001$) entre el inicio y el final en la ingesta diaria de vitaminas C y D. En chicas se observa un incremento significativo ($p < 0.001$) entre el inicio y el final en la ingesta de vitamina E a diferencia de los chicos, en los que su ingesta diaria se reduce significativamente ($p < 0.001$). En el caso de la vitamina B₁₂, se observó una reducción significativa ($p < 0.001$) en su ingesta diaria en ambos sexos entre la valoración inicial y la final. Los resultados muestran un incremento significativo ($p < 0.001$) en la ingesta de ácidos grasos saturados para ambos sexos entre la valoración de la ingesta inicial y la final. En el caso de los ácidos grasos monoinsaturados, su ingesta se redujo de forma significativa ($p < 0.001$) entre las chicas a diferencia de los chicos en los que se incrementó. Por su parte, la ingesta de ácidos grasos poliinsaturados disminuyó de forma significativa ($p < 0.001$) en ambos sexos entre la valoración inicial y la final. La ingesta diaria de colesterol total experimentó un incremento significativo

Tabla I
Características sociodemográficas y estilo de vida de los participantes

<i>Variable</i>	<i>Chicos (n=90)</i>	<i>Chicas (n=167)</i>	<i>Total (n=257)</i>
Población	35%	65%	100%
Edad (años)	22.06 ± 4.06	22.63 ± 5.10	22.43 ± 4.76
Facultad			
Enfermería	34 (37.8%)	92 (55.1%)	126 (49%)
Educación y Humanidades	17 (18.9%)	37 (22.2%)	54 (21%)
Ciencias sociales	39 (43.3%)	38 (22.8%)	77 (30%)
Curso Académico			
Primero	22 (24.4%)	39 (23.4%)	61 (23.7%)
Segundo	30 (33.3%)	43 (25.7%)	73 (28.4%)
Tercero	21 (23.3%)	40 (24.0%)	61 (23.7%)
Cuarto	17 (18.9%)	45 (26.9%)	62 (24.1%)
Religión			
Cristiana	52 (57.8%)	89 (53.3%)	141 (54.9%)
Musulmana	34 (37.8%)	71 (42.5%)	105 (40.9%)
Hebrea	2 (2.2%)	0	2 (0.8%)
No se identifica	2 (2.2%)	7 (4.2%)	9 (3.5%)
Lugar de residencia			
Domicilio familiar	73 (81.1%)	107 (64.1%)	180 (70%)
Residencia Universitaria	5 (5.6%)	13 (7.8%)	18 (7%)
Piso de alquiler	12 (13.3%)	47 (28.1%)	59 (23%)
Persona encargada de elaborar el menú diario			
Madre	58 (64.4%)	89 (53.3%)	147 (57.2%)
Padre	2 (2.2%)	1 (0.6%)	3 (1.2%)
Yo mismo	23 (25.6%)	62 (37.1%)	85 (33.1%)
Otros	7 (7.8%)	15 (9%)	22 (8.6%)
Realización de dietas “milagro”			
Si	10 (11.1%)	34 (20.4%)	44 (17.1%)
No	80 (88.9%)	133 (79.6%)	213 (82.9%)
Consumo de productos para perder peso rápidamente			
Si	16 (17.8%)	33 (19.8%)	49 (19.1%)
No	74 (82.2%)	134 (80.2%)	208 (80.9%)
Comidas a diario con regularidad			
Desayuno			
Si	63 (70%)	122 (73.1%)	185 (72%)
No	27 (30%)	45 (26.9%)	72 (28%)
Media mañana			
Si	34 (37.8%)	49 (29.3%)	83 (32.3%)
No	56 (63.2%)	118 (70.7%)	174 (67.7%)

Tabla I (cont.) <i>Características sociodemográficas y estilo de vida de los participantes</i>			
<i>Variable</i>	<i>Chicos (n=90)</i>	<i>Chicas (n=167)</i>	<i>Total (n=257)</i>
Almuerzo			
Si	86 (95.6%)	165 (98.8%)	251 (97.7%)
No	4 (4.4%)	2 (1.2%)	6 (2.3%)
Merienda			
Si	48 (53.3%)	71 (42.5%)	119 (46.3%)
No	42 (46.7%)	96 (57.5%)	138 (53.7%)
Cena			
Si	77 (85.6%)	132 (79%)	209 (81.3%)
No	13 (14.4%)	35 (21%)	48 (18.7%)
Picoteo entre comidas			
Si	48 (53.3%)	101 (60.5%)	149 (58%)
No	42 (46.7%)	66 (39.5%)	108 (42%)
Miedo a ganar peso			
Nunca	44 (48.9%)	35 (21%)	79 (30.7%)
Algunas veces	35 (38.9%)	80 (47.9%)	115 (44.7%)
Siempre	9 (10%)	41 (24.6%)	50 (19.5%)
Pánico a ganar peso	2 (2.2%)	11 (6.6%)	13 (5.1%)
Considera importante la práctica de ejercicio físico			
Nada	1 (1.1%)	5 (3%)	6 (2.3%)
Regular	8 (8.9%)	34 (20.4%)	42 (16.3%)
Bastante	81 (90%)	128 (76.6%)	209 (81.4%)
Realiza algún deporte			
Si	69 (76.7%)	62 (37.1%)	131 (51%)
No	21 (23.3%)	105 (62.9%)	126 (49%)
Durante su tiempo libre practica ocio sedentario			
Si	71 (78.9%)	135 (80.9%)	206 (80.2%)
No	19 (21.1%)	32 (19.2%)	51 (19.8%)
Tiempo medio dedicado al ocio sedentario (Horas)	2.95 ± 1.808	3.23 ± 1.756	3.13 ± 1.776
Uso de transporte a diario para asistir al Campus			
Si	52 (57.8%)	82 (49.1%)	134 (52.1%)
No	38 (42.2%)	85 (50.9%)	123 (47.9%)

($p < 0.001$) en ambos sexos entre la valoración inicial y la final. Si bien, eran los chicos quienes presentaban los mayores niveles de colesterol. La ingesta de fibra diaria era, en general, baja en ambos sexos con una reducción significativa en su ingesta entre el inicio y el final del estudio.

Discusión/Conclusión

Los resultados obtenidos muestran como el lugar de residencia preferente durante el curso académico entre los estudiantes del Campus era el domicilio familiar (70%), frente al 23% de los estudiantes que residían en

Tabla II
Ingesta diaria de energía, macronutrientes y micronutrientes de los participantes

	Chicas (n=170)		Chicos (n=87)		
	Inicio	Final	p valor	Inicio	Final
Energía (Kcal)	1962.51±618.38	1955.87±633.40	0.515*	2253.72±675.89	2262.48±680.01
Carbohidratos (g)	226.91±83.46	224.31±83.79	<0.001*	255.08±92.40	253.30±95.29
Lípidos (g)	81.49±29.66	85.44±33.56	<0.001**	90.72±31.37	95.33±36.21
Proteínas (g)	76.89±20.83	78.78±23.09	<0.001**	99.47±36.24	103.28±39.72
Calcio (mg/día)	793.55±293.93	789.35±289.43	<0.001**	918.40±370.10	913.15±365.85
Hierro (mg/día)	11.82±3.59	11.69±3.42	<0.001**	14.10±5.50	13.84±5.08
Sodio (mg/día)	1837.36±724.62	1838.95±725.69	<0.001**	2147.79±920.02	2150.07±921.00
Fósforo (mg/día)	1146.65±362.93	1147.02±362.71	0.016**	1354.62±510.00	1354.41±509.86
Vitamina C (mg/día)	144.13±80.11	143.14±79.41	<0.001**	152.61±77.39	151.70±76.90
Vitamina D (µg)	7.14±7.47	7.01±7.20	<0.001**	10.01±8.99	9.78±8.60
Vitamina E (mg/día)	6.26±3.30	6.54±6.19	<0.001**	8.06±7.36	7.81±6.96
Vitamina B12 (µg)	5.77±7.64	5.59±7.20	<0.001**	6.81±5.41	6.40±4.90
Ác. G. Saturados (g/día)	25.35±10.50	26.73±11.03	<0.001**	27.25±11.54	28.40±12.15
Ác. G. Monoinsaturados (g/día)	30.07±12.17	29.70±12.01	<0.001**	32.18±11.90	34.50±26.46
Ác. G. Poliinsaturados (g/día)	7.49±3.50	6.95±2.97	<0.001**	9.55±5.49	8.81±4.84
Colesterol Total (mg/día)	391.79±169.27	410.25±175.35	<0.001**	454.48±195.57	458.15±207.33
Fibra (g/día)	13.18±5.54	13.02±5.53	<0.001**	13.97±6.44	13.83±6.25

Los datos indican media ± desviación típica.

* Prueba t de Student; ** Test de Wilcoxon

pisos de alquiler y sólo un 18% en residencia universitaria. Esta circunstancia puede explicarse en base al elevado número de alumnos del Campus cuya ciudad de residencia habitual y familiar es Melilla. Si bien, estos resultados contrastan con los datos obtenidos por Riba (2002)²⁰, quien en su estudio con universitarios de la Universidad de Barcelona describe que la residencia durante el curso académico en el domicilio familiar es la forma de residencia más frecuente en ciudades muy grandes. Relativo a la persona encargada de preparar el menú diario, el 57.2% de los alumnos afirmó ser la madre la persona encargada de elaborar el menú diario en el hogar. Esta circunstancia sugiere que en la actualidad aún continúa siendo la madre la persona encargada de la elaboración diaria del menú familiar, aún cuando los hijos han alcanzado ya la etapa adulta^{21,22}. Sobre la práctica de dietas milagro, un 20.4% de chicas manifestaron haberlas realizado seguido de un 11.1% de chicos. Estos resultados contrastan con lo descrito en el estudio de Ruiz Moreno (2014)²³, quienes en su estudio describen que sólo el 7.5% de los universitarios seguía de forma ocasional algún tipo de dieta o restricción alimentaria y de entre ellos sólo el 26.1% seguían dietas milagro. Asimismo, un 30% de chicos seguido de un 26.9% de chicas no desayunaban a diario antes de asistir a clase, circunstancia que contrasta con los datos reportados en el estudio de Cervera y colaboradores (2013)²⁴, quienes encuentran que más del 98% de la población de estudiantes universitarios de Albacete desayunan diariamente antes de asistir a clase. Con relación al número de tomas de alimento realizadas a diario, los resultados obtenidos se asemejan a lo descrito por otros estudios²⁵, siendo la toma de media mañana y la merienda las que con mayor frecuencia eran abolidas. Relativo a la variable miedo a ganar peso, el 44.7% de estudiantes indicó haber tenido miedo a la ganancia de peso algunas veces seguido por otro 5.1% quienes afirmaron tener pánico a ganar peso. Dentro de este grupo de alumnos, el pánico a ganar peso era más frecuente entre las chicas (6.6%). Estos resultados coinciden con lo descrito por Lameiras y colaboradores (2003)²⁶, quienes en su estudio concluyen que son las chicas quienes en mayor medida poseen miedo a ganar peso y se muestran preocupadas por su imagen corporal. Esta circunstancia, justifica la necesidad de implementar programas de prevención y educación nutricional entre los colectivos de estudiantes universitarios. Sobre el grado de importancia concedido a la práctica ejercicio físico, el 81.4% de todos los alumnos del campus consideraba bastante importante la práctica de ejercicio físico, especialmente los chicos. Por su parte, eran las chicas quienes con menor frecuencia practicaban deporte. Estos resultados coinciden con lo descrito por otros estudios con población universitaria española^{27,28}. Relativo al uso de medios de transporte a diario, hasta un 52.1% de alumnos indicó utilizar a diario medio de transporte para desplazarse hasta el Campus universitario. Considerando el reducido tamaño en extensión de la Ciudad Autónoma de Melilla, es-

tos resultados muestran el carácter eminentemente sedentario de la población universitaria estudiada. Estos resultados concuerdan igualmente con lo descrito por otros autores en estudiantes universitarios españoles²⁹.

Con relación a la ingesta energética, los resultados muestran diferencias significativas entre la energía ingerida al comienzo del curso académico y a su final entre los chicos. Estos resultados contrastan con lo descrito por otros estudios llevados a cabo en estudiantes universitarios españoles, en los que se describe un déficit de energía en sus dietas a lo largo del curso^{30,31,32}. Relativo a la ingesta de carbohidratos, su consumo se redujo progresivamente a lo largo del curso académico siendo especialmente significativa su reducción entre las chicas, a diferencia de la ingesta lipídica y proteica en cuyo caso hubo un incremento significativo en su ingesta a lo largo del curso en ambos sexos aunque muy superior entre los chicos. Al comparar los resultados de este estudio con los de estudiantes de otras universidades españolas se observan desequilibrios similares en la ingesta de carbohidratos, lípidos y proteínas^{30,31,33,34}, resultados que también coinciden con los descritos en universitarios de otros países como Estados Unidos, Alemania y Francia³⁵ o Chile³⁶. Estos resultados justifican considerar al colectivo de estudiantes universitarios como población de riesgo nutricional, debiendo ser incluidos en los programas de promoción de la salud, con el fin de favorecer la adquisición de unos hábitos alimentarios saludables.

Sobre la ingesta de micronutrientes, a medida que avanza el curso académico se observa una reducción significativa en la ingesta de hierro y calcio en ambos sexos, aunque en el caso del calcio más pronunciada entre los chicos. Asimismo, se observa un incremento en la ingesta de sodio igualmente superior entre los chicos. Estos resultados coinciden con lo descrito por Iglesias y colaboradores (2013)²⁵, quienes encuentran un déficit en la ingesta de calcio y hierro en una población de universitarios de Madrid. Relativo a la ingesta de vitaminas, se observa una reducción significativa en la ingesta diaria de las vitaminas C, D y B₁₂ entre el inicio y el final del curso, a excepción de la vitamina E, en cuyo caso se observa un incremento en su ingesta entre las chicas. Estos resultados sobre ingesta vitamínica se asemejan a lo descrito por estudios previos en otras poblaciones universitarias, en los que se describen igualmente déficits vitamínicos entre estudiantes universitarios^{37,38}.

Con relación a la ingesta de ácidos grasos, se observa un incremento significativo en el consumo de grasas saturadas a medida que avanza el curso académico, siendo sus valores de ingesta significativamente superiores en ambos sexos al finalizar el curso. En el caso de los ácidos grasos monoinsaturados, su ingesta se redujo de forma significativa entre las chicas a diferencia de los chicos en los que se incrementó. En relación a los ácidos grasos poliinsaturados, su consumo se redujo significativamente en ambos sexos entre el inicio y el final del curso. Estos resultados coinciden

con lo hallado por otros estudios^{10,24,39}, cuyos autores justifican este perfil de ingesta grasa en base a una alimentación basada en alimentos precocinados, fritos, comida rápida y en general hábitos muy alejados del estilo tradicional de alimentación mediterráneo. Sobre la ingesta de colesterol total, al igual que la grasa saturada, experimentó un incremento significativo en ambos sexos entre el inicio y el final del curso, no así en el caso de la fibra, cuya ingesta diaria se redujo significativamente en ambos sexos.

El estilo de vida eminentemente sedentario de la población universitaria estudiada se aleja de las recomendaciones actuales de la Dieta Mediterránea para preservar la salud y prevenir el desarrollo futuro de enfermedades metabólicas y cardiovasculares. Los hábitos nutricionales se alejan del estilo tradicional de alimentación mediterráneo caracterizándose por una ingesta deficiente de carbohidratos y elevada en proteínas y lípidos, siendo especialmente rica en grasas saturadas y baja en ingesta de fibra. Teniendo en cuenta que hasta el momento los diferentes estudios realizados con universitarios españoles no habían incluido población de la Ciudad Autónoma de Melilla estos resultados revelan la necesidad de continuar profundizando a fin de identificar los factores que influyen en los hábitos nutricionales de los estudiantes y establecer las medidas correctoras oportunas.

Agradecimientos

Agradecemos a los estudiantes del Campus de la Universidad de Granada en Melilla la colaboración prestada en todo momento para el desarrollo de este estudio.

Referencias

- Trichopoulou A, Martínez-González MA, Tong TY, Forouhi NG, Khandelwal S, Prabhakaran D, Mozaffarian D, de Lorge-ril M. Definitions and potential health benefits of the Mediterranean diet: views from experts around the world. *BMC Med* 2014; 12: 112.
- Santomauro F, Lorini C, Tanini T, Indiani L, Lastrucci V, Comodo N, Bonaccorsi G. Adherence to Mediterranean diet in a sample of Tuscan adolescents. *Nutrition* 2014; 30(11-12): 1379-1383.
- Trichopoulou A, Costacou T, Bamia C, Trichopoulos D. Adherence to a Mediterranean diet and survival in a Greek population. *N Engl J Med* 2003; 348: 2599-2608.
- Keys A. Seven countries: a multivariate analysis of death and coronary heart disease. Cambridge, MA: Harvard University Press, 1980.
- Serra-Majem L, Roman B, Estruch R. Scientific evidence of interventions using the Mediterranean diet: a systematic review. *Nutr Rev* 2006; 64: S27-47.
- Castelló A, Pollán M, Buijsse B, Ruiz A, Casas AM, Baena-Cañada JM, Lope V, Antolín S, Ramos M, Muñoz M, Lluch A, de Juan-Ferré A, Jara C, Jimeno MA, Rosado P, Díaz E, Guillem V, Carrasco E, Pérez-Gómez B, Vioque J, Boeing H, Martín M. Spanish Mediterranean diet and other dietary patterns and breast cancer risk: case-control EpiGEICAM study. *Br J Cancer* 2014; 111(7): 1454-1462.
- Sofi F, Cesari F, Abbate R, Gensini GF, Casini A. Adherence to Mediterranean diet and health status: meta-analysis. *BMJ* 2008; 337: a1344.
- Varela-Moreiras G, Ruiz-Moreno E, Valero T, Avila J, Del Pozo S. The Spanish diet: an update. *Nutr Hosp* 2013; 28(5 Suppl): 13-20.
- Ortiz-Moncada R, Norte Navarro A, Zaragoza Martí A, Fernández Sáez J, Davó Blanes M. ¿Siguen patrones de dieta mediterránea los universitarios españoles? *Nutr Hosp* 2012; 27(6): 1952-1959.
- Durá Travé T, Castroviejo Gandarias A. Adherencia a la dieta mediterránea en la población universitaria. *Nutr Hosp* 2011; 26(3): 602-608.
- Castro Cuesta JY, Abellán Huerta J, Leal Hernández M, Gómez Jara P, Ortín Ortín EJ, Abellán Alemán J. Lifestyles related with cardiovascular risk in university students. *Clin Invest Arterioscler* 2014; 26(1): 10-16.
- Hernan M, Fernández A, Ramos M. La salud de los jóvenes. *Gac Sanit* 2004; 18(1 Suppl): 47-55.
- García Segovia P, Martínez-Monzó J. Hábitos alimentarios de los alumnos de la Universidad Politécnica de Valencia. *Revista Española de Nutrición Comunitaria* 2002; 8(3-4): 90-94.
- Baldini M, Pasqui F, Bordoni A, Maranesi M. Is the Mediterranean lifestyle still a reality? Evaluation of food consumption and energy expenditure in Italian and Spanish university students. *Public Health Nutrition* 2009; 12(2): 148-155.
- Rakicioglu N, Yildiz EA. Energy and nutrient intake and food patterns among Turkish university students. *Nutrition Research and Practice* 2011; 5(2): 117-123.
- Rodríguez F, Palma X, Romo A, Escobar D, Aragü B, Espinoza L, McMillan N, Gálvez J. Eating habits, physical activity and socioeconomic level in university students of Chile. *Nutr Hosp* 2013; 28(2): 447-455.
- Cortés Tomás MT, Giménez Costa JA, Motos Sellés P, Cadaveira Mahía F. The importance of expectations in the relationship between impulsivity and binge drinking among university students. *Adicciones* 2014; 26(2): 134-145.
- Patiño-Masó J, Gras-Pérez E, Font-Mayolas S, Baltasar-Bagué A. Cocaine abuse and multiple use of psychoactive substances in university students. *Enferm Clin* 2013; 23(2): 62-67.
- González Jiménez E, Aguilar Cordero MJ, García García CJ, García López P, Álvarez Ferre J, Padilla López CA, Ocete Hita E. Influencia del entorno familiar en el desarrollo del sobrepeso y la obesidad en una población de escolares de Granada (España). *Nutr Hosp* 2012; 27(1): 177-184.
- Riba M. Estudio de los hábitos alimentarios en población universitaria y sus condicionantes. Tesis doctoral. (2002) Universidad Autónoma de Barcelona.
- Orrell-Valente JK, Hill LG, Brechwald WA, Dodge KA, Pettit GS, Bates JE. Just three more bites: An observational analysis of parents' socialization of children's eating at mealtime. *Appetite* 2007; 48: 37-45.
- Popkin BM, Gordon-Larsen P. The nutrition transition: worldwide obesity dynamics and their determinants. *Int J Obes Relat Metab Disord* 2004; 28: 2-9.
- Ruiz Moreno E, Del Pozo de la Calle S, Valero Gaspar T, Ávila Torres JM, Varela-Moreiras G. Estudio de hábitos alimentarios y estilos de vida de los universitarios españoles. Patrón de consumo de bebidas fermentadas. Fundación Española de la Nutrición (FEN), 2014.
- Cervera F, Serrano R, Vico C, Milla M, García Meseguer MJ. Hábitos alimentarios y evaluación nutricional en una población universitaria. *Nutr Hosp* 2013; 28(2): 438-446.
- Iglesias MT, Mata G, Pérez A, Hernández S, García-Chico R, Papadaki C. Nutritional status of students at university in Madrid. *Nutr Clin Diet Hosp* 2013; 33(1): 23-30.
- Lameiras Fernández M, Calado Otero M, Rodríguez Castro, M Fernández Prieto. Hábitos alimentarios e imagen corporal en estudiantes universitarios sin trastornos alimentarios. *International Journal of Clinical and Health Psychology* 2003; 3(1): 23-33.
- Castillo I, Molina-García J. Adiposidad corporal y bienestar psicológico: efectos de la actividad física en universitarios de Valencia, España. *Pan Am J Public Health* 2009; 26(4): 334-340.

28. Molina-García J, Castillo I, Pablos C, Queralto A. La práctica de deporte y la adiposidad corporal en una muestra de universitarios. *Apunts Educ Fis Deportes* 2007; 89: 23-30.
29. Montero A, Úbeda N, García A. Evaluación de los hábitos alimentarios de una población de estudiantes universitarios en relación con sus conocimientos nutricionales. *Nutr Hosp* 2006; 21(4): 466-473.
30. Soriano JM, Moltó JC, Mañes J. Dietary intake and food pattern among university students. *Nutr Res* 2000; 20(9): 1249-1258.
31. Martínez C, Veiga P, López A, Cobo JM, y Carbajal A. Evaluación del estado nutricional de un grupo de estudiantes universitarios mediante parámetros dietéticos y de composición corporal. *Nutr Hosp* 2005; 20(3): 197-203.
32. Iglesias MT, Escudero E. Evaluación nutricional en estudiantes de enfermería. *Nutr Clín y Diet Hosp* 2010; 30(3): 21-26.
33. Rizo-Baeza MM, González-Brauer NG, Cortés E. Calidad de la dieta y estilos de vida en estudiantes de Ciencias de la Salud. *Nutr Hosp* 2014; 29(1): 153-157.
34. Zarrazquin I, Torres-Unda J, Ruiz F, Irazusta J, Kortajarena M, Hoyos Cillero I, Gil J, Irazusta A. Longitudinal study: lifestyle and cardiovascular health in health science students. *Nutr Hosp* 2014; 30(5): 1144-1151.
35. De Castro JM, Bellisle F, Feunekes GIJ, Dalix AM, De Graaf C. Culture and meal patterns: A comparison of the food intake of free-living American, Dutch, and French students. *Nutr Res* 1997; 17(5): 807-829.
36. Rodríguez F, Palma X, Romo A, Escobar D, Aragón B, Espinoza L, McMillan N, Gálvez J. Eating habits, physical activity and socioeconomic level in university students of Chile. *Nutr Hosp* 2013; 28(2): 447-455.
37. Durán Aguero S, Reyes García S, Gaete MC. Vitamin and minerals consumed food group by Chilean university students. *Nutr Hosp* 2013; 28(3): 830-838.
38. Gil M, Głodek E, Rudy M. Evaluation of the dietary intake of vitamins and minerals in the daily food rations by the students of the Rzeszów University. *Rocz Panstw Zakl Hig* 2012; 63(4): 441-446.
39. García-Meseguer MJ, Burriel FC, García CV, Serrano-Urrea R. Adherence to Mediterranean diet in a Spanish university population. *Appetite* 2014; 78: 156-164.



Original/*Valoración nutricional*

Estimación de la distribución diaria de nutrientes en la dieta estándar en España

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Resumen

A partir de datos de consumo alimentario de España se han realizado las transformaciones y agrupaciones necesarias para establecer los contenidos nutricionales por toma, en forma de porcentajes, respecto a la ingesta total diaria de cada individuo encuestado ($n = 3000$). Así mismo, se ha comprobado el efecto de los factores de clasificación (sexo, edad y localidad) sobre la distribución de dichos porcentajes. El resultado del estudio estadístico indica que se deben considerar como grupos diferentes los individuos por debajo de 25 años respecto a los que superan esa edad y que el efecto localidad (entendido como aleatorio y no como fijo) ocasiona diferencias en la distribución de nutrientes entre las tomas de alimentos del día. En cambio, el factor sexo no resultó relevante al encontrarse en tomas anecdóticas las diferencias estadísticamente significativas. Se propone una distribución porcentual de nutrientes concretos entre las diferentes tomas de alimentos.

(Nutr Hosp. 2015;31:2660-2667)

DOI:10.3305/nh.2015.31.6.8896

Palabras clave: *Ingesta. IDR. Tomas de alimento.*

ESTIMATION OF THE DAILY NUTRIENTS DISTRIBUTION IN THE SPANISH STANDARD DIET

Abstract

Based on the raw data from the Spanish intake, have made the necessary changes and groupings to establish nutritional content per serving as percentages, regarding the total daily intake of each individual surveyed ($n = 3000$). Also, it was found the effect of the rating factors (sex, age and location) on the distribution of these percentages. The result indicates that individuals below 25 year should be considered as different groups, front those above that age; and locality effect (treated as random factor rather than fixed) causes differences in the distribution of nutrients between food daily intakes. However, the sex was not relevant to the anecdotal footage found in statistically significant differences. Percentage distribution of individual nutrients between different food outlets is proposed.

(Nutr Hosp. 2015;31:2660-2667)

DOI:10.3305/nh.2015.31.6.8896

Key words: *Intake. RDI. Feedings.*

Introducción

España, pese a estar enmarcada en un contexto social y científico de país desarrollado, ha presentado durante las décadas, incluso podemos decir que hasta finales del siglo xx, una actuación coordinada en las políticas institucionales relacionadas con la alimentación y la nutrición, aspecto que otros países, incluso en vías de desarrollo, han abordado y corregido desde hace años. Ante esta falta de iniciativas públicas coordinadas, las diferentes sociedades de nutrición y dietética han ido cubriendo este vacío mediante publicaciones de distintas tablas de composición de alimentos, o estudios nutricionales de grupos poblacionales determinados, abarcando en el mejor de los casos, una co-

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Recibido: 3-III-2015.

Aceptado: 22-III-2015.

munidad autónoma concreta o un grupo de población con características concretas. Todo ello ha ocasionado que los diferentes estudios no sean comparables y, por tanto, no se puedan extraer conclusiones fiables de los mismos a nivel nacional.

Sin embargo, esta política se vio modificada con la creación en 2001 de la Agencia Española de Seguridad Alimentaria (AESA) (posteriormente también de Nutrición –AESAN– y actualmente con las competencias de Consumo –AECOSAN–), donde se han tomado diversas iniciativas que están permitiendo obtener una información global a nivel nacional y unos criterios uniformes de actuación. En 2010, amparada por la AESAN y reconocida por los Ministerios de Sanidad y el de Agricultura, se presenta públicamente tras un trabajo de más de 5 años la Base de Datos Española de Composición de Alimentos (BEDCA). Aprovechando esta nueva herramienta, el Ministerio de Sanidad, Política Social e Igualdad acomete la primera Encuesta Nacional de Ingesta Dietética (ENIDE), cuyos resultados se conocen a principios de 2011¹. Los resultados de dicha encuesta, no han sido explotados completamente, dada la magnitud del proyecto y este pretende ser el primer trabajo de aproximación a la distribución diaria de nutrientes en la dieta estándar en España.

En el mismo año de la presentación de BEDCA, se publican auspiciada por la constitución de la Federación Española de Sociedades de Nutrición (FESNAD) las primeras Ingestas Dietéticas de Referencia (IDR)² para la Población Española como complemento a las guías nutricionales que venía consensuando la Sociedad Española de Nutrición Comunitaria (SENC) desde el año 1995. Esta publicación presenta las recomendaciones de ingesta diaria de los principales nutrientes para diferentes grupos de población (por sexos, edades y situaciones fisiológicas especiales de la mujer).

Por tanto, hoy en día tenemos referencias nutricionales válidas, tanto de ingestas habituales como de las recomendadas para un día completo, de un amplio abanico de grupos poblacionales. Sin embargo, a la hora de valorar ingestas concretas de un menú, un plato, o una receta, no contamos con elementos de referencia válidos, salvo la tradicional distribución de porcentajes de energía entre las diferentes tomas de alimentos, tácitamente aceptada por la mayoría de los dietistas y nutricionistas que corresponde en torno a un 20% en el desayuno, 40% en el almuerzo, 10% en la merienda y 30% en la cena. Estas proporciones se consideran adecuadas para que la población española alcance unos hábitos alimentarios saludables, pero son exclusivamente referidas a ingesta energética, por lo que para otros nutrientes y, fundamentalmente vitaminas y minerales, puede que no se ajusten a la realidad de distribución entre las diferentes tomas de alimentos.

Por ejemplo, en el trabajo de Durá Travé³ sobre desayuno y almuerzo en población universitaria, tan sólo se puede comparar la ingesta energética a las proporciones recomendadas de dichas toma de alimento. En cambio para el resto de nutrientes sólo se puede

comparar con la ingesta recomendada para día completo. Al igual que este estudio, son varios los que recientemente se han realizado sobre tomas concretas de alimentos (sobre todo desayuno y almuerzo), que no pudieron ofrecer una referencia validada para comparar con sus datos de dichas tomas⁴⁻⁹.

La intención de esta investigación es aprovechar los datos del estudio ENIDE, para obtener la información específica de distribución de los distintos nutrientes a lo largo de las tomas diarias. En base a estos datos y, una vez discriminados algunos factores que pudieran afectar a dicha distribución, se pretende valorar nutricionalmente las tomas de alimentos aisladas, dentro de la ingesta dietética diaria de un individuo o colectivo para posteriormente realizar propuestas nutricionales aplicables a las IDR españolas.

Objetivos

1. Establecer el patrón de distribución de ingesta de nutrientes a lo largo de las tomas de comida diarias, en base a datos globales de consumo alimentario de la población española.
2. Valorar la influencia que los factores, sexo, edad y ubicación geográfica, puedan tener en el patrón de distribución de nutrientes entre tomas establecido.
3. Proponer las distribuciones de nutrientes entre tomas coherentes a los resultados obtenidos en los anteriores objetivos para aplicar sobre las Ingestas Dietéticas de Referencia Españolas (FESNAD, 2010) que permitan poder valorar correctamente tomas de comidas completas.

Material y métodos

Para abordar esta investigación partimos de los datos del estudio ENIDE. Éste consistió en la aplicación de un registro de alimentos de tres días no consecutivos (incluido uno festivo), un recordatorio de 24h y un cuestionario de frecuencia de consumo (semicuantitativo) sobre un total final de 3000 encuestas evaluables con una distribución de muestreo que se indica a continuación:

Dado que disponíamos de los datos concretos de edad de cada individuo se procedió a agrupar dichas edades en tres grupos (un grupo más que los publicados en el estudio ENIDE) correspondiendo a la siguiente clasificación: 18-24, 25-44 y 45-64 años.

El factor estación del año no se utilizó al no disponer de esta información en todos los datos que se manejaron y por considerar que no era un objetivo prioritario para este estudio.

Se usó como factor de clasificación la ubicación, en forma de las localidades concretas en lugar de las regiones geográficas usadas por ENIDE, por no tener acceso a los métodos estadísticos de selección de las

localidades para formar parte del muestreo. Por tanto se consideran las localidades como elegidas al azar en el conjunto de las del ámbito nacional.

Los datos brutos obtenidos de las encuestas en las que cada individuo indicaba los alimentos consumidos y las cantidades de los mismos (352.901 alimentos en total), se transformaron en sus nutrientes constituyentes (25) mediante un algoritmo diseñado al efecto para combinar los datos de ENIDE con la base de datos BEDCA, lo que ocasionó un total de 10.587.030 datos. El resultado de esta combinación se agrupó por tomas de alimento (desayuno, almuerzo, merienda, cena y entre horas), por lo que se obtuvo la composición nutricional de cada toma. Esto supuso una matriz de datos de 12.515 registros (no todos los encuestados realizaron las 5 tomas de alimentos diarias). Considerando 25 componentes de los alimentos con interés nutricional, 4 factores de clasificación (sexo, edad, localidad y toma de alimento) y el identificador individual correspondiente, el número total de datos manejado fue de 375.450.

Estudio estadístico

A partir de esta matriz de datos se realizaron los estudios estadísticos encaminados a un objetivo final: establecer el efecto que los factores de agrupación tenían sobre la distribución de cada uno de los componentes, con interés nutricional, en su reparto entre tomas de alimentos.

Los datos manejados eran porcentajes sobre la ingesta total de nutrientes a lo largo de un día y, por lo tanto, presentaban una distribución multinomial. No obstante, los cálculos factoriales y combinatorias del número de muestras que en total se elevan a 3000 individuos son imposibles de realizar. Por otra parte, el teorema central del límite indica que todas las distribuciones con un número elevado de datos tienden a asimilarse a una distribución normal. Por ello, se realizaron los correspondientes test para todos los nutrientes dentro de cada toma de alimentos con el fin de establecer la normalidad interna de los datos mediante el test de Kolmogorov y Smirnov y el test de Shapiro-Wilk, obteniéndose bondades de ajuste a la distribución normal estadísticamente significativas ($p < 0.05$) para todas las variables estudiadas.

Una vez establecida estadísticamente la posibilidad de manejar los datos como variables cuantitativas con distribución normal y tener la capacidad de aplicar análisis paramétricos, se optó por usar el Modelo Lineal Generalizado (SPSS vs15) que aplica análisis de varianza multivariantes y multifactorial. Los factores considerados han sido sexo, grupo de edad y localidad. Las variables han sido todos los componentes con interés nutricional contemplados en el estudio ENIDE. En aquellos casos que se obtienen diferencias significativas ($p < 0.05$) para un nutriente y factor (con más de dos grupos) se aplicó el Test de Tukey de homogeneidad de muestras a posteriori ($p < 0.05$).

Resultados y Discusión

En las tablas I, II y III se presentan la distribución porcentual de ingesta de nutrientes a lo largo de las 5 tomas habituales diarias en la población española de modo global, en adultos y en jóvenes, respectivamente. Del estudio del conjunto de la población (Tabla I) se aprecia que entre sexos, para la mayoría de nutrientes y en las diferentes tomas, no existe diferencia estadísticamente significativas ($p > 0.05$) en el porcentaje que dicha toma supone sobre el total del nutriente ingerido en el día. Algunas excepciones a esta norma lo suponen el contenido de carbohidratos en almuerzo, de magnesio en desayuno, fósforo entre horas y alcohol en cena y entre horas ($p < 0.001$), aunque con menores niveles de significación existen otras tomas para otros nutrientes. Por tanto de forma global podemos entender que la distribución de nutrientes media podría ser utilizada para ambos sexos.

Entre grupos de edad, el número de diferencias con la probabilidad de error más baja considerada ($p < 0.001$) son mucho más numerosas, centrándose sobre todo en la merienda. En todos los casos se encuentra progresión entre los grupos de edad y en la mayor parte de los casos diferenciándose netamente el grupo de los más jóvenes (18-24) de los otros dos grupos que suelen formar grupo común. Habitualmente, los resultados de mayor porcentaje que supone la merienda con respecto al resto de comidas, lo presentan este grupo de edad (18-24). La única excepción a esta regla lo presenta el consumo de alcohol donde la progresión entre edades es inversa. Para el resto de tomas las diferencias con un nivel de significación muy alto son anecdóticas como es el caso del calcio y algunas vitaminas en desayuno, el consumo de alcohol, hierro y fósforo en almuerzo; o la energía total, carbohidratos y el hierro total entre horas. Esta distribución hace plantearse si se podría optar por dos modelos de distribución de nutrientes entre tomas uno para los más jóvenes y otro para el resto de edades (Tablas II y III).

Entre localidades se puede observar que existen diferencias estadísticamente significativas ($p < 0.001$) para la mayoría de los nutrientes en casi todas las tomas entre localidades. Dado que el criterio de inclusión de las localidades es puramente aleatorio dentro de unos cupos de ubicación geográfica y tamaño de municipio, no se pueden extraer conclusiones con base estadística para indicar un patrón regional en la distribución de tomas, pero deja claro que dicho estudio debería realizarse para obtener aproximaciones más realistas sobre la distribución de nutrientes entre tomas en las diferentes ubicaciones geográficas de España.

Las propuestas de distribución del porcentaje de nutrientes entre tomas diarias de alimentos se establece de forma global para toda la población española y diferenciando entre edades (jóvenes=18-24 años y adultos >25 años). Aquellos nutrientes que no habían sido contemplados en la ENIDE, pero que tienen interés desde el punto de vista de las recomendaciones de FESNAD

Tabla I
Distribución porcentual de nutrientes entre tomas a lo largo del día para la totalidad de la población española

Componente nutricional	DESAYUNO	ALMUERZO	MERIENDA	CENA	ENTRE HORAS
Energía (Kcal)	15	46	6	30	3
Proteínas (g)	12	50	4	33	2
Lípidos (g)	13	46	5	33	3
Carbohidratos (g)	21	42	7	26	4
Fibra (g)	12	51	6	28	3
Ca (mg)	26	32	7	30	5
Mg (mg)	18	44	6	26	5
P (mg)	16	45	5	31	3
Na (mg)	10	50	3	35	2
K (mg)	15	49	5	28	3
Fe (mg)	12	51	4	31	2
Cu (mg)	13	50	5	31	2
Zn (mg)	14	48	5	31	2
Mn (mg)	13	50	5	31	2
I (ug)	10	49	4	35	2
Se (mg)	12	47	4	35	3
Tiamina (mg)	16	48	5	30	2
Riboflavina (mg)	24	38	6	29	3
Niacina (mg EN)	13	49	4	31	2
Pantoténico (mg)	14	48	4	31	3
Vit B6 (mg)	11	51	4	33	1
Biotina (ug)	14	48	4	31	3
Ac Fólico (ug)	13	47	4	33	3
Vit B12 (ug)	13	45	4	36	2
Ac Ascórbico (mg)	14	52	5	27	2
Vit A (ug ER)	13	46	4	35	2
Vit D (ug)	17	37	6	39	1
Vit E (mg a-TE)	9	51	3	33	3
Ac grasos saturados (g)	13	46	5	33	3
Ac grasos monoinsaturados (g)	13	46	5	33	3
Ac grasos poliinsaturados (g)	13	46	5	33	3
Colesterol (mg)	10	47	4	37	1
Polisacaridos (g)	21	42	7	26	4
Azúcares (g)	21	42	7	26	4

Tabla II
Distribución porcentual de nutrientes entre tomas a lo largo del día para adultos de la población española

<i>Componente nutricional</i>	<i>DESAYUNO</i>	<i>ALMUERZO</i>	<i>MERIENDA</i>	<i>CENA</i>	<i>ENTRE HORAS</i>
Energía (Kcal)	15	46	5	31	3
Proteínas (g)	12	50	3	33	2
Lípidos (g)	13	47	4	33	2
Carbohidratos (g)	21	43	7	26	3
Fibra (g)	12	51	6	28	3
Ca (mg)	26	32	6	30	5
Mg (mg)	19	45	6	26	5
P (mg)	16	46	5	31	3
Na (mg)	11	50	3	35	1
K (mg)	15	49	5	28	3
Fe (mg)	12	52	4	31	2
Cu (mg)	13	50	4	31	2
Zn (mg)	14	49	4	32	2
Mn (mg)	13	50	4	31	2
I (ug)	10	49	3	35	2
Se (mg)	12	47	3	35	2
Tiamina (mg)	15	48	4	30	2
Riboflavina (mg)	24	38	6	29	3
Niacina (mg EN)	14	50	4	30	2
Pantoténico (mg)	15	49	4	30	2
Vit B6 (mg)	10	52	3	33	1
Biotina (ug)	15	49	4	30	2
Ac Fólico (ug)	12	48	4	33	3
Vit B12 (ug)	13	45	3	37	2
Ac Ascórbico (mg)	14	53	4	27	2
Vit A (ug ER)	13	47	4	35	1
Vit D (ug)	17	36	5	40	1
Vit E (mg a-TE)	9	52	3	33	3
Ac grasos saturados (g)	13	47	4	33	2
Ac grasos monoinsaturados (g)	13	47	4	33	2
Ac grasos poliinsaturados (g)	13	47	4	33	2
Colesterol (mg)	10	47	4	38	1
Polisacaridos (g)	21	43	7	26	3
Azúcares (g)	15	46	5	31	3

Tabla III
Distribución porcentual de nutrientes entre tomas a lo largo del día para jóvenes población española

<i>Componente nutricional</i>	<i>DESAYUNO</i>	<i>ALMUERZO</i>	<i>MERIENDA</i>	<i>CENA</i>	<i>ENTRE HORAS</i>
Energía (Kcal)	14	44	8	29	5
Proteínas (g)	11	48	6	33	2
Lípidos (g)	11	45	8	32	4
Carbohidratos (g)	19	41	10	25	6
Fibra (g)	11	47	9	28	5
Ca (mg)	27	31	9	28	6
Mg (mg)	16	43	8	27	7
P (mg)	16	42	7	31	4
Na (mg)	9	48	6	35	2
K (mg)	15	46	7	28	4
Fe (mg)	13	47	6	30	4
Cu (mg)	13	47	6	30	4
Zn (mg)	14	46	7	31	3
Mn (mg)	13	47	6	30	4
I (ug)	11	48	5	33	3
Se (mg)	12	44	6	35	4
Tiamina (mg)	16	44	7	30	3
Riboflavina (mg)	25	36	7	28	4
Niacina (mg EN)	12	47	5	32	3
Pantoténico (mg)	14	46	6	31	3
Vit B6 (mg)	15	46	5	33	2
Biotina (ug)	14	46	6	31	3
Ac Fólico (ug)	15	43	6	32	4
Vit B12 (ug)	15	43	6	33	3
Ac Ascórbico (mg)	16	48	6	27	3
Vit A (ug ER)	15	44	6	33	2
Vit D (ug)	17	38	8	35	2
Vit E (mg a-TE)	8	49	5	33	5
Ac grasos saturados (g)	11	45	8	32	4
Ac grasos monoinsaturados (g)	11	45	8	32	4
Ac grasos poliinsaturados (g)	11	45	8	32	4
Colesterol (mg)	11	46	6	35	2
Polisacaridos (g)	19	41	10	25	6
Azúcares (g)	19	41	10	25	6

Tabla IV
Ejemplo de distribución de nutrientes entre tomas de alimentos para mujeres de 20 a 29 años

<i>Toma de alimento</i>	<i>TOTAL</i>	<i>DESAYUNO</i>	<i>ALMUERZO</i>	<i>MERIENDA</i>	<i>CENA</i>	<i>ENTREHORA</i>
Energía (Kcal)	2200	302	962	180	645	111
Proteínas (g)	46	5,1	21,9	2,8	15,1	1,1
Lípidos (g)	80	9,2	35,7	6,1	25,9	3,1
Carbohidratos (g)	275	51	112	27	68	16
Fibra (g)	25	2,7	11,9	2,3	6,9	1,2
Ca (mg)	900	243	275	83	249	51
Mg (mg)	300	48,3	128,7	22,5	79,9	20,6
P (mg)	700	112	296	49	214	29
Na (mg)	1500	133	726	86	519	35
K (mg)	3100	466	1436	206	875	118
Fe (mg)	18	2,34	8,47	1,12	5,38	0,69
Cu (mg)	1,1	0,14	0,52	0,07	0,33	0,04
Zn (mg)	7	0,95	3,19	0,49	2,14	0,23
Mn (mg)	1,8	0,23	0,85	0,11	0,54	0,07
I (ug)	150	16	72	7	50	4
Se (mg)	55	6,4	24,2	3,0	19,1	2,1
Tiamina (mg)	1	0,16	0,44	0,07	0,30	0,03
Riboflavina (mg)	1,3	0,33	0,47	0,10	0,36	0,05
Niacina (mg EN)	14	1,66	6,58	0,76	4,54	0,46
Pantoténico (mg)	5	0,70	2,30	0,30	1,55	0,15
Vit B6 (mg)	1,2	0,17	0,55	0,06	0,39	0,02
Biotina (ug)	30	4,20	13,80	1,80	9,30	0,90
Ac Fólico (ug)	300	44	129	19	95	13
Vit B12 (ug)	2	0,30	0,86	0,12	0,67	0,05
Ac Ascórbico (mg)	60	10	29	4	16	2
Vit A (ug ER)	600	90	262	38	198	12
Vit D (ug)	5	0,85	1,89	0,41	1,76	0,08
Vit E (mg a-TE)	15	1,25	7,40	0,70	4,93	0,73
Ac grasos sat (g)	20	2,3	8,9	1,5	6,5	0,8
Ac grasos mono (g)	50	5,7	22,3	3,8	16,2	1,9
Ac grasos polii (g)	30	3,4	13,4	2,3	9,7	1,2
Colesterol (mg)	300	32	138	19	106	5
Polisacaridos (g)	90	16,8	36,6	8,9	22,4	5,4
Azúcares (g)	10	1,9	4,1	1,0	2,5	0,6

se han extrapolado de los nutrientes cuyo aporte está correlacionado o presentan las mismas fuentes dietéticas.

Conclusiones

Se ha obtenido una información realista de la distribución de los nutrientes entre las principales comidas del día, basada en el único estudio de ingesta alimentaria que se ha realizado a nivel nacional en España (ENIDE 2011).

Se comprueba que no existen diferencias generales en la distribución de nutrientes por tomas entre sexos. Las diferencias puntuales pueden ser obviadas en favor de una más eficaz aplicación de los porcentajes calculados

Se establecen diferencias estadísticamente significativas en la distribución de nutrientes a lo largo del día entre el grupo de población más joven (18-24 años) respecto a los otros dos grupos de más edad que no presentan de forma general diferencias de distribución entre ellos.

Queda patente una influencia geográfica en la distribución de nutrientes a lo largo del día, que dado el carácter aleatorio en la determinación de los lugares de encuesta no permite un estudio de agrupaciones regionales o locales.

Las tablas de porcentajes de distribución de componentes nutricionales entre tomas puede resultar una herramienta eficaz a la hora de diseñar dietas destinadas a individuos o población española al reflejar sus hábitos alimentarios. Suponen también una fórmula de cálculo de la distribución de nutrientes entre todas las tomas para las Ingestas Dietéticas de Referencia.

Propuestas

A la vista de las conclusiones obtenidas se propone el uso de los porcentajes de tomas calculados, para aplicarlos sobre los datos diarios de ingesta recomendada de FESNAD (2010). Estos datos pormenorizados de IDR por tomas, permitirá una mayor eficacia a la hora de valorar tomas de alimentos. Este elemento es de crucial importancia a la hora de establecer la calidad nutricional pormenorizada de los alimentos inge-

ridos por la población española. Dada la diversidad de recomendaciones de las IDR por sexo y grupo de edad, sólo se expone en la tabla IV un ejemplo, pudiéndose calcular para el resto de grupos de forma fácil, simplemente multiplicando los porcentajes correspondientes a la toma por la IDR.

Además, con la presente información se pueden ofrecer datos de aporte a la ingesta de tomas de alimentos. Este tipo de información es de especial relevancia para valoración de comidas institucionales (comidas a domicilio para personas mayores o discapacitadas, comedores de empresa, colegios, etc) o menús ofertados por empresas de restauración. Por otra parte, con las tablas obtenidas de IDR por tomas, se pueden realizar cálculos de consecución de ingesta en aquellos estudios (encuestas) que se aborden ingestas de tomas concretas de alimentos³⁻⁸.

Referencias

1. AESAN (2011). Agencia Española de Seguridad Alimentaria y Nutrición. Encuesta Nacional de Ingesta Dietética Española (ENIDE).
2. FESNAD (2010). Ingestas Dietéticas de Referencia (IDR) para la Población Española. ISBN: 9788431326807.
3. Durá Travé (2013). Análisis nutricional del desayuno y almuerzo en una población universitaria. *Nutrición Hospitalaria*, 28 (3): 1291-1299.
4. Durá Travé (2002). El desayuno de los alumnos de Educación Secundaria Obligatoria (ESO). *Nutrición Hospitalaria*, XVII (4): 189-196.
5. Aguilar Cordero, M^a J; González Jiménez, E.; Sánchez Perona J.; Padilla López C. A.; Álvarez Ferré J. (2010). Metodología del estudio Guadix sobre los efectos de un desayuno de tipo mediterráneo sobre los parámetros lipídicos y postprandiales en preadolescentes con sobrepeso y obesidad. *Nutrición Hospitalaria*, 25(6): 1025-1033.
6. Herrero Lozano R. y Fillat Ballesteros J.C. (2006). Estudio sobre el desayuno y el rendimiento escolar en un grupo de adolescentes. *Nutrición Hospitalaria*, 21(3):346-352.
7. Rufino Rivas P., Redondo Figuero C., Amigo Lanza T., González-Lamuño D., García Fuentes M. y grupo AVENA (2005). Desayuno y almuerzo de los adolescentes escolarizados de Santander. *Nutrición Hospitalaria* XX (3): 217-222.
8. Sánchez Hernández J.A. y Serra Majem L. (2000). Importancia del desayuno en el rendimiento intelectual y en el estado nutricional de los escolares. *Rev Esp Nutr Comunitaria* 6(2):53-95.
9. Navarro-González, I., López-Nicolás, R., Rodríguez-Tadeo, A., Ros-Berrueto, G., Martínez-Marín, M. and Doménech-Asensi, G. (2014). Adherence to the Mediterranean diet by nursing students of Murcia (Spain). *Nutrición Hospitalaria*. 30 (1): 165-172.



Original/*Valoración nutricional*

Accuracy of body mass index for age to diagnose obesity in Mexican schoolchildren

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Abstract

Objective: to compare the accuracy of three BMI-for-age references (World Health Organization reference, WHO; the updated International Obesity Task Force reference, IOTF; and Centers for Disease Control and Prevention (CDC) growth charts) to diagnose obesity in Mexican children.

Methods: a convenience sample of Mexican schoolchildren (n = 218) was assessed. The gold standard was the percentage of body fat estimated by deuterium dilution technique. Sensitivity and specificity of the classical cutoff point of BMI-for-age to identify obesity (i.e. > 2.00 standard deviation, SD) were estimated. The accuracy (i.e. area under the curve, AUC) of three BMI-for-age references for the diagnosis of obesity was estimated with the receiver operating characteristic (ROC) curves method. The optimal cutoff point (OCP) was determined.

Results: the cutoff points to identify obesity had low (WHO reference: 57.6%, CDC: 53.5%) to very low (IOTF reference: 40.4%) sensitivities, but adequate specificities (91.6%, 95.0%, and, 97.5%, respectively). The AUC of the three references were adequate (0.89). For the IOTF reference, the AUC was lower among the older children. The OCP for the CDC reference (1.24 SD) was lower than the OCP for WHO (1.53 SD) and IOTF charts (1.47 SD).

Conclusions: the classical cutoff point for obesity has low sensitivity -especially for the IOTF reference. The accuracy of the three references was similar. However, to obtain comparable diagnosis of obesity different cutoff points should be used depending of the reference.

(Nutr Hosp. 2015;31:2668-2675)

DOI:10.3305/nh.2015.31.6.8639

Key words: *Obesity. Body fat. Schoolchildren. Accuracy. Diagnosis. Body mass index.*

EXACTITUD DEL ÍNDICE DE MASA CORPORAL PARA LA EDAD PARA DIAGNOSTICAR OBESIDAD EN ESCOLARES MEXICANOS

Resumen

Objetivo: comparar la exactitud de tres referencias del IMC para la edad (de la Organización Mundial de la Salud, OMS; de la *International Obesity Task Force*, IOTF; y de los Centros para el Control y Prevención de Enfermedades (CDC) de las tablas de crecimiento) para diagnosticar obesidad en niños mexicanos.

Métodos: se evaluó una muestra por conveniencia de escolares de la ciudad de México (n = 218). El estándar de oro fue el porcentaje de grasa corporal estimado por la técnica de dilución de deuterio. Se estimaron la sensibilidad y la especificidad del punto de corte clásico del IMC para la edad para identificar obesidad (i.e. > 2.0 desviaciones estándar, DE). La exactitud (i.e., área bajo la curva, ABC) de las tres referencias del IMC para el diagnóstico de la obesidad se estimó con el método de curvas ROC. Se identificó el punto de corte óptimo (PCO).

Resultados: los puntos de corte para identificar obesidad tuvieron baja (OMS: 57.6% y CDC: 53.5%) o muy baja (IOTF referencia: 40.4%) sensibilidad, pero especificidades adecuadas (91.6%, 95.0% y 97.5%, respectivamente). El ABC de las tres referencias fueron adecuadas (0.89). Entre los niños mayores la referencia de la IOTF tuvo el menor ABC. El PCO para la referencia de los CDC (1.24 DE) fue menor que el PCO para la de la OMS (1.53 DE) y la de la IOTF (1.47 DE).

Conclusiones: el punto de corte clásico para la obesidad tiene baja sensibilidad, especialmente para la referencia de la IOTF. La exactitud de las tres referencias fue similar. Sin embargo, para obtener el diagnóstico comparable de obesidad en diferentes puntos de corte se debe utilizar en función de la referencia seleccionada.

(Nutr Hosp. 2015;31:2668-2675)

DOI:10.3305/nh.2015.31.6.8639

Palabras clave: *Obesidad. Grasa corporal. Escolares. Exactitud. Diagnóstico. Índice de masa corporal.*

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Recibido: 8-I-2015.

Aceptado: 29-III-2015.

Abbreviations

BMI: body mass index.
WHO: World Health Organization reference.
IOTF: International Obesity Task Force reference.
CDC: Centers for Disease Control and Prevention growth charts.
SD: standard deviation.
AUC: area under the curve.
ROC: receiver operating characteristic curves method.
OCP: optimal cutoff point.
TBW: total body water.
 $^2\text{H}_2\text{O}$: isotope deuterium oxide.
FFM: fat free mass.
%BF: percent of body fat.
W: body weight.

Introduction

The body mass index (BMI=weight kg/stature m^2) is used to identify children with obesity because its convenience (i.e. simple, fast, practical and cheap). Three references for BMI-for-age can be used to assess child adiposity: a) the criteria of the International Obesity Task Force (IOTF), which recently was updated and was derived from data of the population from six countries^{1,2}; b) the Centers for Disease Control and Prevention (CDC) growth charts³, whose BMI values were obtained from the National Health Surveys of the United States of America²; and c) the reference of the World Health Organization (WHO)⁴, also based on representative samples of the US population.

The majority of the studies validating the BMI-for-age references have been carried out in pediatric populations from Europe^{5,6}, United States of America⁷, Asia^{8,9} and Oceania¹⁰. We are not aware of studies reporting the validity of BMI-for-age in Latin-American populations. Also, while some data are available validating the first IOTF charts^{5,6,8,9} and the CDC growth charts^{5,7,8}, no study about the validity of the updated IOTF reference as adiposity indicator was found. In children from Switzerland¹¹, Australia⁵ and Tobago¹² the CDC reference had better sensitivity than IOTF. Although there is evidence that the WHO reference can identify children at risk of metabolic abnormalities¹³; we did not find some study that assess its capacity to identify body fat excess.

Most studies about the validity of BMI-for-age are also restrictive because only the sensitivity and specificity of pre-defined cutoff points (e.g. percentile 97 or > 2.00 standard deviation, SD) were estimated, leaving unexplored the possibility of increasing the accuracy of the index by use higher or lower cutoff points. This is relevant since some studies have observed very low sensitivities (<50%) with the percentile 95 of CDC growth charts⁵ or the cutoff point to obesity (i.e. the equivalent to 30 kg/ m^2 in adulthood) of the previous

version of the IOTF reference^{6,14}. Such sensitivities can be increased modifying the cutoff points. Finally, previous works have used skinfolds^{11,14,15} or bioelectric impedance^{12,16} as gold standards, which are not the best indicators of adiposity. On another hand, one problem concerning the existence of multiple references is that the estimates of the obesity rates differ according to the reference and the cutoff points utilized, limiting comparisons between studies that applied different criteria.

In this work we compared the accuracy of the three BMI-for-age references (WHO, CDC, and IOTF) and determined the optimal cutoff point to identify obesity by means of these BMI references. A study of diagnostic validity was carried out using the percentage of body fat estimated by deuterium dilution technique as gold standard.

Methods

Sample

Sampling was carried out in two phases. First, with exception of children with plaster cast or motor disabilities, all students ($n=1,050$) aged 5 to 12 years from two primary schools of Coyoacan County in Mexico City were invited to participate in an assessment of weight and height. Six hundred seven parents consented the participation of their children. With this data, children with normal weight, overweight, and obesity were identified. In the second phase a quota sampling was done aimed to obtain a heterogeneous sample in terms of sex, age, and nutritional status. An exhaustive evaluation of body dimensions and body composition was carried out in the final sample ($n=218$).

In both phases the written informed consent were obtained from children and their guardians. The Ethics Committee of the Health and Biological Sciences Division from the Metropolitan Autonomous University campus Xochimilco approved the research protocol. The authors declare that they do not have conflicts of interest.

Body fat

The estimation of body fat by means of deuterium dilution have been validated in Mexican children¹⁷. Measurements of total body water (TBW) were made using hydrometry with stable, non-radioactive, non-toxic isotope deuterium oxide ($^2\text{H}_2\text{O}$). Participants were fasted at the time of dosing. A saliva sample (≈ 2 ml) was collected upon arrival at the elementary school to determine the basal $^2\text{H}_2\text{O}$ concentration. After that, the participants received an accurately weighed oral dose (0.1 g/kg of body weight) of $^2\text{H}_2\text{O}$ (99.9% atom percent excess; Cambridge Isotope Laboratories, Andover, MA, USA). To ensure complete ingestion of the

total dose, the container was rinsed with 20 ml of bottled water and given to participants to drink. Following the $^2\text{H}_2\text{O}$ dosing, post-dose salivary samples were collected after 3.5–4.0 h of equilibrium time (i.e. the time needed for the tracer to equilibrate with all water spaces)¹⁸. Due to conditions of the fieldwork (i.e. the children were in the school), only limited restrictions were imposed on dietary or fluid intake on the participants during the equilibrium period, and a light meal was given to all of them 1 h after the deuterium dose was ingested, as has been suggested¹⁹. The volumes of water in food and beverage were recorded so they could be subtracted from the dilution space. All saliva samples were stored in a freezer at -20°C in tubes with screw-on caps.

The enrichment of the bottled water, the dose given, and the $^2\text{H}_2\text{O}$ in the pre-dose and post-dose samples were measured by chromium reduction of water into hydrogen gas at 850°C using an H/Device system coupled online to an isotope-ratio mass spectrometer (DELTA PLUS, Thermo Finnigan, Bremen, Germany) at the Unit of Medical Research in Nutrition of the *Centro Médico Nacional Siglo XXI*, Mexican Institute of Social Security, in Mexico City. The results were expressed relative to standards measured against V-SMOW and SLAP²⁰, with a precision of 0.16–0.32 ppm. All assays were performed in triplicate.

The dilution space was calculated by subtracting the pre-dose saliva sample enrichment from that of the post-dose sample, based on the dilution principle, and corrected considering a 4% deuterium exchange with non-aqueous compartment in the body¹⁹. The fat free mass (FFM, kg) was calculated using Fomon's age and gender specific hydration values, and was then recalculated as described by Schoeller¹⁹. For children older than 10 years, FFM was calculated using the hydration factors proposed by Lohman²¹. The percent of body fat (%BF) was subsequently derived from FFM and body weight (W) as follows: $\%BF = [(W - \text{FFM})/W] \times 100$. Finally, a child was considered obese when the %BF was equal or higher than 25.0% in boys and 30.0% in girls. In children, higher adiposity than these cutoff points has been associated with an increased cardio-metabolic risk^{22,23}.

Body mass index for age

Using standardized protocols^{24,25}, the observers were trained to measure weight and height. The BMI-for-age was estimated using the WHO⁴, the CDC³, and updated IOTF² references.

Analysis

The mean and standard deviation of anthropometry and body composition variables were calculated. The rates of obesity were estimated using the classical cu-

toff point (i.e. Z score > 2.0) of three BMI references. The performance of each BMI-for-age reference to diagnose obesity using the classical cutoff point (> 2.0 SD) was assessed using the following estimates: sensitivity (true positives/[true positives + false negatives]), specificity (true negatives/[true negatives + false positives]), and efficiency ([true positives + true negatives]/total population). The 95% confidence interval for every estimate was calculated.

The accuracy of the three BMI-for-age references for the diagnosis of obesity was assessed with the receiver operating characteristic (ROC) curves method²⁶. With this method the area under the curve (AUC) is obtained, which is a statistic of the diagnostic tool accuracy, i.e. its capacity to differentiate between cases and no-cases. Values of 0.50 to 0.70, 0.70 to 0.90, and ≥ 0.90 of AUC are considered as low, moderate, and high accuracy, respectively. To determine the optimal cutoff point (i.e. that with maximal specificity and sensitivity) the Youden index was estimated²⁶. The estimations were made in total population and by sex and age. The statistical analysis was carried out using SPSS and STATA software. The STATA software allows calculate the Chi-square statistic to determine if there are significant statistical differences between two AUC.

Results

Similar number of girls ($n=111$) and boys ($n=107$) participated in the study. Age distribution was: 5 to 7 years old, 21.1%; 8 to 9 years, 31.2%; and 10 to 11 years, 47.17% (see table I). The means of weight, BMI, Z score of BMI-for-age with the three references, and fat free mass (FFM) were higher in boys than girls; but the opposite occurred with height and fat mass (FM). The older children had higher values of weight, height, BMI, FMM, and FM. The 8–9 years old children had higher mean of percentage of body fat and Z score of BMI-for-age with the three references.

Taking into account the body fat percent, almost four out ten schoolchildren had obesity (45.4%) and the rate was higher in boys and older children (10 to 12 years old) (see table II). The highest prevalence of obesity was obtained with the WHO reference (30.7%), whereas the lowest was estimated with the IOTF reference (19.7%). The estimates of obesity rates derived from BMI-for-age references were lower than ones obtained with body fat percent. These differences were similar in both sexes and in the three age groups.

Using the cutoff points to identify obesity (i.e. > 2.0 SD), the sensitivity of the WHO and CDC references was low (57.6% and 53.5%, respectively), while with the IOTF reference was very low (40.4%) (see table III). With the three references the specificities ($>90\%$) were adequate, while the efficiencies were moderate (71.5–77.1%). In contrast with the values obtained for boys, in girls the sensitivities

Table I
Descriptive analysis ^a of anthropometry and body composition of a sample of Mexican school children by sex and age

	All, n=218	Sex		Age		
		Boys, n=107	Girls, n=111	5-7 yr., n=46	8-9 yr., n=68	10-12 yr., n=104
Age, yr.	9.3 (1.8)	9.2 (1.8)	9.3 (1.9)	6.7 (0.6)	8.5 (0.5)	10.9 (0.7)
Weight, kg	39.6 (12.3)	40.3 (13.0)	38.8 (11.6)	28.0 (6.1)	36.3 (9.6)	46.8 (11.1)
Height, cm	138.5 (12.0)	138.2 (12.3)	138.8 (11.8)	123.8 (6.2)	133.6 (6.4)	148.2 (7.3)
BMI, kg/m ²	20.2 (4.0)	20.6 (4.2)	19.8 (3.8)	18.1 (2.9)	20.1 (4.1)	21.1 (4.1)
Z-BMI/WHO	1.2 (1.3)	1.5 (1.3)	1.0 (1.2)	1.2 (1.3)	1.4 (1.4)	1.1 (1.2)
Z-BMI/CDC	0.9 (1.1)	1.1 (1.1)	0.7 (1.0)	0.9 (1.1)	1.0 (1.1)	0.8 (1.0)
Z-BMI/IOTF	1.3 (1.2)	1.5 (1.2)	1.1 (1.1)	1.2 (1.2)	1.4 (1.3)	1.2 (1.1)
FFM, kg	28.6 (7.8)	29.8 (8.2)	27.4 (7.2)	20.8 (3.0)	25.9 (4.8)	33.8 (7.0)
FM, kg	11.0 (6.5)	10.5 (7.1)	11.4 (6.0)	7.2 (3.6)	10.4 (6.2)	13.0 (7.0)
FM, %	26.2 (9.6)	24.2 (10.1)	28.1 (8.6)	24.3 (8.7)	26.8 (10.1)	26.6 (9.6)

^a Mean and standard deviation (in parenthesis) are reported.

Abbreviators: BMI, body mass index; Z-BMI/WHO, Z score of BMI-for-age according to World Health Organization reference (de Onis et al., 2007); Z-BMI/CDC, Z score of BMI-for-age according to Centers for Disease Control and Prevention reference (Kuczmarski et al., 2002); BMI/IOTF, Z score of BMI-for-age according to the International Obesity Task Force reference (Cole and Lobstein, 2012). FFM, fat free mass; FM, fat mass.

Table II
Overweight and obesity rates according to different criteria among a sample of Mexican schoolchildren

	Total		Sex		Age (years)		
			Boys	Girls	5-7	8-9	10-12
	n	%	%	%	%	%	%
Body fat percent ^a							
Normal	119	54.6	50.5	58.6	63.0	52.9	51.9
Obesity	99	45.4	49.5	41.4	37.0	47.1	48.1
Z-BMI/WHO							
Normal	151	69.3	58.0	80.2	67.4	66.2	72.1
Obesity	67	30.7	42.0	19.8	32.6	33.8	27.9
Z-BMI/CDC							
Normal	159	72.9	62.6	82.9	67.4	67.6	78.9
Obesity	59	27.1	37.4	17.1	32.6	32.4	21.2
Z-BMI/IOTF							
Normal	175	80.3	73.8	86.5	80.4	75.0	83.6
Obesity	43	19.7	26.2	13.5	19.6	25.0	16.4

^a Estimated through isotopic dilution and using the cutoff point of 25% in boys and 30% in girls.

Abbreviators: Z-BMI/WHO, Z score of BMI-for-age according to World Health Organization reference (de Onis et al., 2007); Z-BMI/CDC, Z score of BMI-for-age according to Centers for Disease Control and Prevention reference (Kuczmarski et al., 2002); BMI/IOTF, Z score of BMI-for-age according to the International Obesity Task Force reference (Cole and Lobstein, 2012).

(49.1-71.7% versus 30.4-41.3%) and efficiencies (72.9-79.4% versus 70.3-73.9%) were lower, but the specificities (87.0-96.3% versus 95.4-98.5%) were higher. The sensitivity, specificity, and efficiency va-

lues in the older group tended to be lower than in the younger groups.

In the total sample, the accuracy of three references was moderate (AUC=0.89) (see table IV). The optimal

Table III
Validity of BMI references as indicators of obesity^a by sex and age group in a sample of Mexican children

		Z-BMI / WHO ^b	Z-BMI / CDC ^c	Z-BMI / IOTF ^d
Total	Se	57.6 (47.2-67.5)	53.5 (43.2-63.6)	40.4 (30.7-50.7)
	Sp	91.6 (85.1-95.9)	95.0 (89.3-98.1)	97.5 (92.8-99.5)
	Ef	76.1 (69.9-81.6)	77.1 (70.9-82.5)	71.5 (65.1-77.4)
Sex				
Boys	Se	71.7 (57.7-83.2)	66.0 (51.7-78.5)	49.1 (35.1-63.2)
	Sp	87.0 (75.1-94.6)	90.7 (79.7-96.9)	96.3 (87.3-99.5)
	Ef	79.4 (70.5-86.6)	78.5 (69.5-85.8)	72.9 (63.4-81.0)
Girls	Se	41.3 (27.0-56.8)	39.1 (25.1-54.6)	30.4 (17.7-45.8)
	Sp	95.4 (87.1-99.0)	98.5 (91.7-100.0)	98.5 (91.7-100.0)
	Ef	73.0 (63.7-81.0)	73.9 (64.7-81.7)	70.3 (60.8-78.6)
Age				
5-7 yr.	Se	76.5 (50.1-93.2)	76.5 (50.1-93.2)	52.9 (27.8-77.0)
	Sp	93.1 (77.2-99.2)	93.1 (77.2-99.2)	100.0 (88.1-100.0)
	Ef	87.0 (73.7-95.0)	87.0 (73.7-95.0)	82.6 (68.6-92.2)
8-9 yr.	Se	65.6 (46.8-81.4)	65.6 (46.8-81.4)	50.0 (31.9-68.1)
	Sp	94.4 (81.3-99.3)	97.2 (85.5-99.9)	97.2 (85.5-99.9)
	Ef	80.8 (69.5-89.4)	82.3 (71.2-90.5)	75.0 (63.0-84.7)
10-12 yr.	Se	46.0 (31.8-60.7)	38.0 (24.7-52.8)	30.0 (17.9-44.6)
	Sp	88.9 (77.4-95.8)	94.4 (84.6-98.8)	96.3 (87.3-99.5)
	Ef	68.2 (58.4-77.0)	67.3 (57.3-76.2)	64.4 (54.4-73.6)

^aEstimated through isotopic dilution and using the cutoff point of 25% in boys and 30% in girls. ^bZ-BMI / WHO, Z score of BMI-for-age according to World Health Organization reference (de Onis et al., 2007); ^cZ-BMI / CDC, Z score of BMI-for-age according to Centers for Disease Control and Prevention reference (Kuczmarski et al., 2002); ^dZ-BMI / IOTF, Z-score of BMI-for-age according to the International Obesity Task Force reference (Cole and Lobstein, 2012).

For the three BMI references the sensitivity (Se), specificity (Sp), and efficiency (Ef) with their respective confidence intervals (in parenthesis) were estimated. In the three cases the cutoff point to define obesity was > 2.00 standard deviation.

cutoff point (OCP) for the CDC reference (1.24) was lower than the OCP for WHO (1.53) and IOTF references (1.47). The sensitivity (77.8-83.8%), specificity (80.7-84.4%), and efficiency (81.2-86.1%) of the OCP for each reference were moderate.

There were not differences among sexes respect the AUC of references. The OCP for the CDC and IOTF references were higher in girls than in boys. For the three references, the AUC and the OCP were lower in oldest children than in youngest ones. For example, for the IOTF reference the AUC was 0.97 among children aged 5-7 years and 0.85 in those aged 10-12 years ($p < 0.050$). The sensitivities, specificities, and efficiencies were lower in older children.

Discussion

Among Mexican school children, the classical cutoff point for references of BMI-for-age (> 2 SD) did not provided an estimation of obesity prevalence closer

to that one derivate by deuterium dilution technique. The classical cutoff point to identify obesity with the three references had low (CDC and WHO charts) or very low (IOTF) sensitivities. With the ROC curves approach a cutoff point for each reference was identified and better balance between sensitivity and specificity was obtained. The accuracy of these references was lower in older children.

In our study, the "gold standard" was the %BF estimated through deuterium isotopic dilution, which has been validated previously in Mexican children¹⁷. With this method, four out of ten children had obesity. Referred to this estimates, those obtained with the classical cutoff point to diagnose obesity with BMI-for-age were lower: from -14.7 (difference respect to the prevalence derived from WHO reference) to -25.7 (difference respect to the rate estimated from IOTF reference). This shows that the references based in more contemporary American populations (i.e. the CDC charts were made with data collected from 1963 to 1980) produced lower figures of obesity rates than

Table IV
Accuracy and optimal cutoff point of BMI to diagnostic obesity^a in a sample of Mexican schoolchildren.
Differences between reference populations and by sex and age

	<i>AUC</i>	<i>OCP</i>	<i>Se</i>	<i>Sp</i>	<i>Ef</i>
Z-BMI / WHO					
Total	0.89 (0.85-0.93)	1.53	77.8 (68.3-85.5)	84.0 (76.2-90.1)	81.2 (75.4-86.1)
Sex					
Boys	0.91 (0.86-0.96)	1.64	86.8 (74.7-94.5)	81.5 (68.6-90.7)	84.1 (75.8-90.5)
Girls	0.86 (0.79-0.93)	1.53	67.4 (52.0-80.5)	89.2 (79.1-95.6)	80.2 (71.5-87.1)
Age group					
5-7 yr.	0.95 ^b (0.90-1.00)	1.75	88.2 (63.6-98.5)	93.1 (77.2-99.2)	91.3 (79.2-97.6)
8-9 yr.	0.92 (0.86-0.98)	1.22	100.0 (89.1-100.0)	66.7 (49.0-81.4)	82.3 (71.2-90.5)
10-12 yr.	0.84 ^b (0.77-0.92)	1.13	82.0 (68.6-91.4)	74.1 (60.3-85.0)	77.9 (68.7-85.4)
Z-BMI / CDC					
Total	0.89 (0.84-0.93)	1.24	78.8 (69.4-86.4)	84.0 (76.2-90.1)	86.1 (75.9-86.5)
Sex					
Boys	0.91 (0.85-0.96)	0.88	96.2 (87.0-99.5)	70.4 (56.4-82.0)	83.2 (74.7-89.7)
Girls	0.86 (0.79-0.93)	1.24	69.6 (54.2-82.3)	89.2 (79.1-95.6)	81.1 (72.5-87.9)
Age group					
5-7 yr.	0.97 ^b (0.92-1.00)	1.33	94.1 (71.3-99.9)	93.1 (77.2-99.2)	93.5 (82.1-98.6)
8-9 yr.	0.92 (0.85-0.98)	0.96	100.0 (89.1-100.0)	66.7 (49.0-81.4)	82.3 (71.2-90.5)
10-12 yr.	0.84 ^b (0.77-0.92)	1.00	78.0 (64.0-84.5)	77.8 (64.4-88.0)	77.9 (68.7-85.4)
Z-BMI / IOTF					
Total	0.89 (0.85-0.93)	1.47	83.8 (75.1-90.5)	80.7 (72.4-87.3)	82.1 (76.4-86.9)
Sex					
Boys	0.91 (0.86-0.96)	1.09	96.2 (87.0-99.5)	70.4 (56.4-82.0)	83.2 (74.7-89.7)
Girls	0.86 (0.80-0.93)	1.48	80.4 (66.1-90.6)	83.1 (71.7-91.2)	82.0 (73.5-88.6)
Age group					
5-7 yr.	0.97 ^b (0.93-1.00)	1.88	88.2 (63.6-98.5)	93.1 (77.2-99.2)	91.3 (79.2-97.6)
8-9 yr.	0.91 (0.85-0.98)	1.80	78.1 (60.0-90.7)	88.9 (73.9-96.9)	83.8 (72.9-91.6)
10-12 yr.	0.85 ^b (0.77-0.92)	1.04	86.0 (73.3-94.2)	72.2 (58.4-83.5)	78.8 (69.7-86.2)

^aThe gold standard was the body fat estimated through isotopic dilution and using the cutoff point of 25% in boys and 30% in girls.

^bDifferences among age groups $p < 0.050$ using the same reference.

Area under the curve (AUC) of each BMI-for-age reference is reported. For each optimal cutoff point (OCP) the sensitivity (Se), specificity (Sp), efficiency (Ef) with their respective confidence intervals (in parenthesis) were estimated.

Abbreviators: Z-BMI / WHO, Z score of BMI-for-age according to World Health Organization reference (de Onis et al., 2007); Z-BMI / CDC, Z score of BMI-for-age according to Centers for Disease Control and Prevention reference (Kuczmarski et al., 2002); Z-BMI / IOTF, Z score of BMI-for-age according to the International Obesity Task Force reference (Cole et al., 2012).

those based in surveys carried out previously (i.e. the WHO reference is based in data collected between 1963 and 1974). This difference can be attributed to the increasing obesity rate experienced in American contemporary populations in the last decades²⁷. Although the IOTF reference was built in with populations from six countries (including American participants), it produces a lower rate of obesity. Again, the time when the fieldwork was done should be con-

sidered: the data for the IOTF reference was collected in the decades of sixties-to-nineties²⁸.

With respect the results of the accuracy assessment, when the classical cutoff point (> 2 SD) was used, the sensitivities of the references tending to be low (CDC and WHO) or very low (IOTF). In other populations the IOTF reference has had low sensitivity^{6,9} and some studies have showed that the CDC reference is more accurate than the IOTF^{5,11,12}. These results showed that

in order to assess adiposity, it is necessary to identify a cutoff point for each reference to yield estimations closer to a more precise method.

For clinical practice and population studies, a diagnostic tool to identify obesity with highest accuracy is required. If the diagnostic tool will be used in the clinical practice, it should have high specificity to avoid negative consequences in children after wrongful positive diagnosis, such as stigma, excessive concern due their body weight or body image, and parental pressure. Likewise, is convenient to avoid low sensitivity, otherwise the children that can be benefited by any treatment would not be identified. On the other hand, when the diagnostic tool is used in epidemiologic research (i.e. prevalence rate estimation) a balance is necessary because low sensitivity yields sub-estimation of the outcome, while the opposite occurs with low specificity; in other words, higher efficiency is recommendable. Although in our sample the CDC, IOTF, and WHO references had similar accuracy to diagnose obesity (AUC=0.89), the cutoff point that maximizes sensitivity and specificity was lower in the first one (1.24, 1.47, and 1.53, respectively). In this respect, de Onis²⁹ noticed that the CDC reference has upward skewness, therefore its use could imply that American children who have gained weight in the context of obesity epidemic were to considered normal. To avoid this situation, lower cutoff point should be used when the CDC reference is utilized.

In general terms, among older children the accuracy of the three references was lower. This might be a reflection of the onset of puberty spurt among older girls. Due to differences of timing of the puberty, an increase of the variability of the BMI occurs during the adolescence and the association of the body fat with the BMI changes³⁰. In future studies the role of sexual maturity on accuracy of BMI-for-age references should be examined.

Our study has several limitations. The sampling was by convenience; therefore the representativeness of our sample is restricted. The small size of sample precluded us to verify if there were differences in validity of the BMI-for-age references according to age within each sex group. In addition, the small sample size produces wider confidence intervals in the stratified analysis. Finally, although our gold standard was an adiposity measure, we did not include any clinical outcome to assess the capacity of BMI-for-age references to identify higher risks for health.

In summary, when in this sample of Mexican children the classical cutoff for the three references under evaluation were used, the results were not comparable because they produced divergent estimations of obesity rate and they have low to very low sensitivity. But, when the full range of values of three references was examined, the three references had adequate accuracy. Our results suggest that to obtain comparable results is needed to use different cutoff for each reference; also

is not convenient to use the classical cutoff point for obesity, especially for the IOTF reference. Although is necessary to confirm if our results are replicated in a larger and representative sample, our data suggest that in epidemiological studies –in which often only the weight and height are assessed– the obesity in Mexican children could be diagnosed using as criteria ≥ 1.53 SD of the WHO reference ≥ 1.47 SD of IOTF reference, or ≥ 1.53 SD of the WHO reference. The use of these cutoff points could enable the comparison among studies that use different references.

Conflict of Interest statement

We claim no conflict of interest related to our research.

Grant information

This work was supported by CAMBIO, which is funded by the Global Health Research Initiative (GHRI) a collaborative research funding partnership of the Canadian Institutes of Health Research, the Canadian International Development Agency, the International Development Research Centre, Health Canada and the Public Health Agency of Canada, and by CONACYT (grant 127557-M to JV).

Acknowledgments

This work was supported by CAMBIO, which is funded by the Global Health Research Initiative (GHRI) a collaborative research funding partnership of the Canadian Institutes of Health Research, the Canadian International Development Agency, the International Development Research Centre, Health Canada and the Public Health Agency of Canada, and by CONACYT (grant 127557-M to JV). We are very grateful to the support of PhD Mardia Guadalupe López Alarcón, head of the Unit of Medical Research in Nutrition, *Centro Médico Nacional Siglo XXI*, and MSc Jorge Maldonado Hernández who carried out the deuterium determinations. We thank Magdalena Rodríguez Magallanes head of the Unit of Nutrition, Body Composition and Energy Expenditure of *Universidad Autónoma Metropolitana Xochimilco* who trained to anthropometry observers.

References

1. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 2000; 320: 1240-3.
2. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. *Pediatr Obes* 2012; 7: 284-94.

3. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R, et al. CDC growth charts: United States. *Advance data* 2000(314): 1-27.
4. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ* 2007; 85: 660-7.
5. Wickramasinghe VP, Cleghorn GJ, Edmiston KA, Murphy AJ, Abbott RA, Davies PS. Validity of BMI as a measure of obesity in Australian white Caucasian and Australian Sri Lankan children. *Ann Hum Biol* 2005; 32: 60-71.
6. Reilly JJ, Dorosty AR, Emmett PM. Identification of the obese child: adequacy of the body mass index for clinical practice and epidemiology. *Int J Obes Relat Metab Disord* 2000; 24: 1623-7.
7. Mei Z, Grummer-Strawn LM, Wang J, Thornton JC, Freedman DS, Pierson RN, Jr., et al. Do skinfold measurements provide additional information to body mass index in the assessment of body fatness among children and adolescents? *Pediatrics* 2007; 119: e1306-13.
8. Wickramasinghe VP, Lamabadusuriya SP, Cleghorn GJ, Davies PS. Validity of currently used cutoff values of body mass index as a measure of obesity in Sri Lankan children. *Ceylon Med J* 2009; 54: 114-9.
9. Fu WP, Lee HC, Ng CJ, Tay YK, Kau CY, Seow CJ, et al. Screening for childhood obesity: international vs population-specific definitions. Which is more appropriate? *Int J Obes Relat Metab Disord* 2003; 27: 1121-6.
10. Duncan JS, Duncan EK, Schofield G. Accuracy of body mass index (BMI) thresholds for predicting excess body fat in girls from five ethnicities. *Asia Pac J Clin Nutr* 2009; 18: 404-11.
11. Zimmermann MB, Gubeli C, Puntener C, Molinari L. Detection of overweight and obesity in a national sample of 6-12-y-old Swiss children: accuracy and validity of reference values for body mass index from the US Centers for Disease Control and Prevention and the International Obesity Task Force. *Am J Clin Nutr* 2004; 79: 838-43.
12. Nichols SD, Cadogan F. BMI-based obesity cutoffs and excess adiposity in a Caribbean adolescent population of African origin. *Eur J Clin Nutr* 2009; 63: 253-8.
13. de Onis M, Martinez-Costa C, Nunez F, Nguetack-Tsague G, Montal A, Brines J. Association between WHO cut-offs for childhood overweight and obesity and cardiometabolic risk. *Public Health Nutrition* 2013; 16: 625-30.
14. Gaskin PS, Walker SP. Obesity in a cohort of black Jamaican children as estimated by BMI and other indices of adiposity. *Eur J Clin Nutr* 2003; 57: 420-6.
15. Glasser N, Zellner K, Kromeyer-Hauschild K. Validity of body mass index and waist circumference to detect excess fat mass in children aged 7-14 years. *Eur J Clin Nutr* 2011; 65: 151-9.
16. Ortiz-Hernandez L, Lopez Olmedo NP, Genis Gomez MT, Melchor Lopez DP, Valdes FJ. Application of body mass index to schoolchildren of Mexico City. *Ann Nutr Metab* 2008; 53: 205-14.
17. Ramirez E, Valencia ME, Moya-Camarena SY, Aleman-Mateo H, Mendez RO. Four-compartment model and validation of deuterium dilution technique to estimate fat-free mass in Mexican youth. *Nutrition* 2009; 25: 194-9.
18. Salazar G, Infante C, Vio F. Deuterium equilibration time in infant's body water. *Eur J Clin Nutr* 1994; 48: 475-81.
19. Schoeller DA. Hydrometry. In: Roche AF, Heymsfield SB, Lohman TG, editors. *Human body composition*. United States: Human Kinetics; 1996. p 25-43.
20. International Atomic Energy Agency. Sample storage and analysis. *Assessment of body composition and total energy expenditure in humans using stable isotope techniques*. Vienna: International Atomic Energy Agency; 2009. p 44-57.
21. Lohman TG. Estimating body composition in children and elderly. In: Lohman TG, editor. *Advances in body composition assessment*. United States: Human Kinetics Publisher; 1992. p 65-77.
22. Dwyer T, Blizzard CL. Defining obesity in children by biological endpoint rather than population distribution. *Int J Obes Relat Metab Disord* 1996; 20: 472-80.
23. Williams DP, Going SB, Lohman TG, Harsha DW, Srinivasan SR, Webber LS, et al. Body fatness and risk for elevated blood pressure, total cholesterol, and serum lipoprotein ratios in children and adolescents. *Am J Public Health* 1992; 82(3):358-63.
24. Habicht JP. Standardization Procedures for Quantitative Epidemiologic Field Methods. *Bol Oficina Sanitaria Panamericana* 1974; 75(5): 375-84.
25. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign: Human Kinetics Books; 1988.
26. Akobeng AK. Understanding diagnostic tests 3: Receiver operating characteristic curves. *Acta Paediatr* 2007; 96: 644-7.
27. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA* 2002; 288: 1728-32.
28. Cole TJ, Flegal KM, Nicholls D, Jackson AA. Body mass index cut offs to define thinness in children and adolescents: international survey. *BMJ* 2007; 335(7612):194.
29. de Onis M. The use of anthropometry in the prevention of childhood overweight and obesity. *Int J Obes Relat Metab Disord* 2004; 28 Suppl 3: S81-5.
30. Daniels SR, Khoury PR, Morrison JA. The utility of body mass index as a measure of body fatness in children and adolescents: differences by race and gender. *Pediatrics* 1997; 99: 804-7.



Original/*Valoración nutricional*

Prevalencia de desnutrición en pacientes ancianos hospitalizados no críticos

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Resumen

Introducción: los cambios fisiológicos propios del envejecimiento, junto con distintos procesos patológicos, predisponen a los ancianos a la aparición de complicaciones nutricionales, siendo el estado nutricional un factor pronóstico importante. El objetivo del estudio es conocer la prevalencia de desnutrición en los mayores de 65 años en nuestro centro, tanto al ingreso como al alta.

Métodos: realizamos un estudio transversal, observacional. Para ello evaluamos 174 pacientes mayores de 65 años que ingresaron de forma consecutiva, mediante la aplicación del Nutritional Risk Screening 2002 (NRS-2002) y el Mini Nutritional Assessment Short Form (MNA-SF) en las primeras 48 horas de ingreso. Los pacientes oncológicos también se evaluaron mediante la Valoración Global Subjetiva Generada por el Paciente (VGS-GP). Al alta se realizó de nuevo el NRS-2002.

Resultados: el 29,31% de los pacientes estaban en situación de riesgo nutricional según los resultados del NRS-2002 al ingreso. Este porcentaje aumentaba hasta el 57,89% al alta. El MNA-SF objetivó alteración nutricional en el 70,35% (54,65% riesgo de desnutrición, 15,7% desnutrición). Según el NRS-2002 el 34,14% de los pacientes con cáncer presentaban riesgo nutricional; sin embargo, la VGS-GP mostraba deterioro nutricional en el 56,41% de los casos (46,15% desnutrición moderada y 10,26% desnutrición grave). Existen grupos de pacientes (los de mayor edad, los ingresados de forma urgente, los que presentan insuficiencia cardíaca) con mayor riesgo de deterioro nutricional durante el ingreso ($p < 0,05$).

Conclusiones: el porcentaje de pacientes mayores de 65 años en riesgo nutricional en nuestro centro es muy alto, tanto al ingreso como al alta. Se hace necesario el cribado nutricional sistemático.

(Nutr Hosp. 2015;31:2676-2684)

DOI:10.3305/nh.2015.31.6.8989

Palabras clave: Ancianos. Desnutrición hospitalaria. NRS-2002. MNA-SF.

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Recibido: 27-III-2015.
Aceptado: 23-IV-2015.

PREVALENCE OF MALNUTRITION IN NOT CRITICALLY ILL OLDER INPATIENTS

Abstract

Background: elder people suffer physiological changes and illness that increase the risk of malnutrition. Nutritional status is a major prognosis factor in older people. This study is aimed at estimating the prevalence of malnutrition among the population of 65 and over inpatients as much at admission as at discharge.

Methods: we conducted a transversal observational study. 174 consecutive inpatients were examined using Nutritional Risk Screening 2002 (NRS-2002) and Mini Nutritional Assessment Short Form (MNA-SF) in the first 48 hours from admission. Patient Generated Subjective Global Assessment (PG-SGA) was applied to cancer patients. All patients were submitted the NRS-2002 at discharge.

Results: 29.31% of patients were at malnutrition risk according to the results of NRS-2002 at admission. This percentage increased up to 57.89% at discharge. The MNA-SF revealed nutritional alteration in 70.35% (54.65% with malnutrition risk, 15.7% with malnutrition). The NRS-2002 showed that 34.14% of cancer patients presented with nutritional risk; however, according to PG-SGA 56.41% of the cases presented with malnutrition to a certain extent (46.15% with moderate malnutrition and 10.26% with serious malnutrition). There are different groups of patients (older patients, transferred from emergency department, patients with heart failure) who present higher risk of nutritional deterioration while they are hospitalised ($p < 0.05$).

Conclusions: there is a very high percentage of 65 and over patients at nutritional risk in our centre, as much at admission as at discharge. It is necessary to install a systematic screening of the nutritional status.

(Nutr Hosp. 2015;31:2676-2684)

DOI:10.3305/nh.2015.31.6.8989

Key words: Elderly. Hospital malnutrition. NRS-2002. MNA-SF.

Abreviaturas

CB: circunferencia del brazo.
CMB: circunferencia muscular del brazo.
ESPEN: European Society for Clinical Nutrition and Metabolism.
HADO: Hospitalización a domicilio.
IMC: Índice de Masa Corporal.
MNA: Mini Nutritional Assessment.
MNA-SF: Mini Nutritional Assessment Short Form.
MST: Malnutrition Screening Tool.
MUST: Malnutrition Universal Screening Test.
NICE: National Institute for Health and Clinical Excellence.
NRS-2002: Nutritional Risk Screening 2002.
OMS: Organización Mundial de la Salud.
PT: pliegue tricipital.
SENPE: Sociedad Española de Nutrición Parenteral y Enteral.
SNAQ: Short Nutritional Assessment Questionnaire.
VGS: Valoración Global Subjetiva.
VGS-GP: Valoración Global Subjetiva Generada por el Paciente.

Introducción

El aumento en la esperanza de vida y la disminución de la mortalidad en los países desarrollados se acompaña del envejecimiento poblacional¹, lo que conlleva una alta prevalencia de enfermedades crónicas. Los cambios fisiológicos propios del envejecimiento junto con los procesos patológicos, que con más frecuencia afectan a la población anciana, predisponen a este grupo poblacional a la aparición de complicaciones nutricionales²; de hecho la Organización Mundial de la Salud (OMS) ya declaró en 1992 a la población mayor como uno de los grupos más vulnerables desde el punto de vista nutricional³.

El estado nutricional es un importante factor pronóstico en los ancianos⁴. La desnutrición es un problema relevante en este grupo de edad, especialmente en los pacientes hospitalizados, pues conduce a un aumento de la morbilidad. Se asocia a alteración en la respuesta inmune, tasas más altas de infección, retraso en la cicatrización de heridas, pérdida de función muscular... lo que va a conducir a deterioro del estado funcional, estancias hospitalarias más prolongadas, reingresos, aumento en el número de prescripciones, necesidad de institucionalización; con el consiguiente aumento de los costes económicos y deterioro de la calidad de vida. De hecho una nutrición adecuada se asocia con una reducción en los eventos adversos relacionados con la inmovilización, como úlceras por presión, trombosis venosas, incontinencia y deterioro funcional⁵; y las intervenciones dirigidas a mejorar el estado nutricional conllevan una mejoría significativa en la calidad de vida⁶. Además, la desnutrición es un predictor independiente de mortalidad en el anciano hospitalizado⁷.

La desnutrición en los pacientes mayores hospitalizados es un problema importante desde el punto de vista cualitativo, por sus implicaciones, pero también cuantitativo. Su prevalencia es del 40-50%⁸, y significativamente mayor que en los pacientes de menor edad, como pudo demostrarse en España en el estudio PREDiCES⁹. En Galicia la cifra asciende hasta el 78.9%¹⁰. Por otra parte, el estado nutricional con frecuencia se deteriora más durante el ingreso hospitalario en relación con diversas causas, como la baja ingesta. Esta baja ingesta se justifica en base a factores relacionados con el paciente (como anorexia, dependencia para la alimentación, alteración cognitiva), con el personal y con el ambiente (interrupciones...).

En este momento nadie pone en duda que una nutrición adecuada es un requerimiento absoluto para una buena calidad de vida y un óptimo cuidado médico. Sin embargo, las consecuencias de la desnutrición son insidiosas y pueden tardar en hacerse aparentes; por ello, mientras que el personal médico y de enfermería monitoriza cuidadosamente la función respiratoria, cardíaca, balance de fluidos, etc, los efectos de la desnutrición son obviados¹¹. La detección temprana de la desnutrición en los mayores es una prioridad para optimizar los cuidados de salud y tiene un efecto significativo sobre la morbilidad de esta población¹².

Distintas sociedades científicas a nivel internacional, como American Society for Parenteral and Enteral Nutrition (ASPEN)¹³, National Institute for Health and Clinical Excellence (NICE), European Society for Clinical Nutrition and Metabolism (ESPEN)¹⁴; recomiendan el cribado nutricional sistemático a todos los pacientes e iniciar apoyo nutricional en aquellos en riesgo de desnutrición. En el año 2011 la Sociedad Española de Nutrición Parenteral y Enteral (SENPE) publicó un Consenso Multidisciplinar sobre el abordaje de la desnutrición hospitalaria en España¹⁵. En él se recogen 30 recomendaciones para la prevención, cribado, diagnóstico, tratamiento y seguimiento de la desnutrición en el ámbito hospitalario; entre ellas, con un nivel de recomendación A, la realización de un cribado nutricional a todos los pacientes en las primeras 24-48 horas del ingreso y una valoración nutricional completa a aquellos pacientes con cribado positivo. En la actualidad la SENPE está trabajando con las autoridades sanitarias para introducir la lucha contra la desnutrición entre las líneas de trabajo de los planes estratégicos del Ministerio de Sanidad, y a nivel autonómico de las Consejerías de Salud.

El objetivo principal de este estudio es conocer la prevalencia de desnutrición entre los pacientes de 65 o más años ingresados en nuestro centro, tanto en el momento del ingreso como al alta. Como objetivos secundarios estarían estudiar la relación entre desnutrición y diversas variables sociodemográficas y clínicas y el grado de correlación del diagnóstico nutricional realizado mediante distintos métodos de valoración. El estudio forma parte de uno más amplio diseñado para

conocer la situación nutricional de los pacientes ingresados en nuestro hospital.

Material y métodos

Pacientes

La población evaluada la constituye el subgrupo de pacientes de 65 o más años de edad sobre el total de pacientes que formaban parte de un estudio más amplio planteado para conocer la prevalencia de la desnutrición en nuestro centro hospitalario. Se diseñó un estudio transversal, observacional, en el que se reclutaron los pacientes ingresados de forma consecutiva desde el inicio del estudio hasta que se alcanzó el tamaño muestral calculado. Para ser elegibles los pacientes debían cumplir todos los criterios de inclusión y ninguno de exclusión. En el subestudio que presentamos ahora los criterios de inclusión eran: tener 65 o más años y ser reclutado en las primeras 48 horas tras el ingreso; y los de exclusión: edad menor de 65 años, ingreso en unidades de críticos, cuidados paliativos, unidad de corta estancia o psiquiatría; ingreso para estudio por pérdida de peso y dificultad para comprender la información referente al estudio o negativa a firmar el consentimiento informado.

Valoración nutricional

Los pacientes fueron evaluados por el personal de la Unidad de Nutrición del centro en las primeras 48 horas tras el ingreso y de nuevo al alta. En el momento del ingreso se realizó el Nutritional Risk Screening 2002 (NRS-2002) y el Mini Nutritional Assessment Short Form (MNA-SF) a la totalidad de la población. En el caso de los pacientes oncológicos también se llevó a cabo la Valoración Global Subjetiva-Generada por el Paciente (VGS-GP). Al alta el riesgo nutricional se valoró mediante el NRS-2002.

NRS-2002: el NRS-2002 fue realizado tal y como lo describió y aceptó la ESPEN¹⁶, considerando en riesgo nutricional a aquellos sujetos con una puntuación de 3 o más.

VGS-GP: modificación realizada por Ottery¹⁷ sobre la VGS original en el Fox Chase Cancer Center, al incluir información adicional relativa a síntomas característicos del paciente con cáncer. Validada y recomendada por diversas sociedades de oncología y nutrición, permite clasificar a los pacientes desde el punto de vista nutricional en tres grupos: A (con buen estado nutricional), B (riesgo de desnutrición o desnutrición moderada) y C (desnutrición severa).

MNA-SF: el MNA fue creado específicamente para la población anciana¹⁸. El MNA-SF fue desarrollado por Kaiser et al, mediante un análisis retrospectivo de bases de datos que recogían las variables que estudia el MNA completo. Validado como herramienta de va-

loración nutricional, tiene una sensibilidad (97%) y especificidad tan alta como el test completo. Permite clasificar a los pacientes según la puntuación obtenida en: desnutridos (0-7 puntos), en riesgo de desnutrición (8-11 puntos) y bien nutridos (12-14 puntos).

En el momento de la evaluación inicial se recogió el dato relativo al peso tres meses antes del ingreso y se realizaron las siguientes determinaciones antropométricas: talla, peso, circunferencia del brazo (CB) y pliegue tricípital (PT). Cuando el paciente no podía ser tallado ni pesado y tampoco disponíamos de estos datos en la historia clínica inmediata se estimó la talla a partir de la longitud del antebrazo y se recogió el peso referido por el paciente o su familia. A partir de los datos obtenidos se calculó el índice de masa corporal (IMC) mediante la fórmula peso (kg) dividido entre el cuadrado de la talla (m²), el porcentaje de peso perdido en los últimos tres meses ((peso previo - peso actual)/ peso previo) x 100 y la circunferencia muscular del brazo (CMB): CB - (3.14 x PT), donde la CB y el PT se expresan en cm. En función del IMC los individuos se clasificaron como desnutridos (IMC < 18.5 kg/m²), con peso insuficiente (IMC entre 18.5 y 22 kg/m²), con normopeso (IMC de 22 a 26.9 kg/m²), sobrepeso (IMC entre 27 y 29.9 kg/m²) u obesidad (IMC > 30 kg/m²)¹⁹.

Otras variables recogidas

Se procedió a la recogida de datos relativos a variables sociodemográficas (edad, sexo, nivel educacional) y clínicas: comorbilidades, hábitos tóxicos, tratamientos habituales (considerando polimedicación la toma de 5 o más fármacos), diagnóstico del ingreso (Categorías Diagnósticas Mayores CIE-9-MC), procedencia del ingreso (urgencias vs programado), servicio de ingreso (agrupando en servicios médicos vs quirúrgicos) y datos analíticos disponibles (albúmina, linfocitos).

Estudio estadístico

Considerando que en el estudio PREDyCES la prevalencia de desnutrición fue del 23,7%, y que el número de ingresos anuales en nuestro centro es de 20000 pacientes, para una precisión del 5% y un nivel de confianza del 95% se calculó un tamaño muestral necesario de 277 pacientes. De ellos, los 174 con 65 o más años en el momento de la valoración constituyen la población del subestudio que nos ocupa.

Se realizó un estudio estadístico donde las variables continuas con distribución normal se expresan como media $\pm$ DE y las que no tienen distribución normal como mediana (1Q,3Q). Las variables cualitativas se expresan como frecuencia y porcentaje. La prevalencia se calculó mediante la fórmula: (nº de pacientes que presentaban la condición a estudio/nº total de pacientes estudiados) x 100.

Se realizaron pruebas paramétricas/no paramétricas (Chi-Cuadrado, Test exacto de Fisher, T-Student y U de Mann-Withney) para determinar la asociación entre la variable riesgo nutricional (No/Si) y las variables del estudio. Se valoró la evolución del estado nutricional durante el período comprendido entre el ingreso y el alta utilizando el test de Mc-Nemar.

Se realizó análisis de regresión logística multivariante (donde la variable dependiente es el riesgo nutricional), en el cual se introdujeron las variables significativas en el bivalente y aquellas de interés clínico (prescindiendo de las que presentan colinealidad o son combinación lineal de otras).

En todos los análisis consideramos estadísticamente significativas las diferencias con $p < 0.05$. Los análisis se realizaron utilizando el software libre R (<http://www.r-project.org>).

Aspectos éticos y legales

El tratamiento, comunicación y cesión de los datos se ajusta a lo dispuesto por la Ley Orgánica 15/1999, de 13 de diciembre, de protección de datos de carácter personal y por su reglamento (RD 1720/2007).

El presente trabajo forma parte de un estudio mayor, previo a cuyo inicio se solicitó la autorización de la gerencia del centro y la evaluación del Comité Ético de Investigación Clínica de Galicia, que emitió un informe favorable (Código de Registro 2013/169).

Resultados

Características de la población

La población a estudio fue de 174 individuos. El 62.64% de los pacientes incluidos eran varones (109/174) y la edad media fue de 78.43 ± 7.89 años. El 36.21% (63/174) tenían menos de 75 años, el 40.8% (71/174) entre 75 y 85 años y el 22.99% (40/174) 85 o más años. La estancia media fue de 9.75 ± 5.84 días. En la tabla I pueden verse las características de los pacientes respecto a su nivel de formación, procedencia del ingreso (urgencias vs programado), servicio de ingreso (médico vs quirúrgico) y diagnósticos de ingreso (Categorías Diagnósticas Mayores CIE-9-MC), así como las comorbilidades más frecuentes. El 71.84% (125/174) de los sujetos estaban polimedicados.

Al alta se analizaron los datos correspondientes a 167 pacientes (7 perdidos: 5 fallecimientos, un traslado a críticos y un traslado al centro de referencia); de los cuales 7 ingresaron en una residencia geriátrica (4.19%) y uno fue trasladado a su domicilio con hospitalización domiciliaria (HADO).

Valoración al ingreso

La talla media de nuestra población era de 162.4 ± 8.6 cm y el IMC medio de 27.56 ± 5.04 kg/m². La distribución en función del IMC resultó como sigue: en el

Tabla I
Características de la población analizada: nivel de formación, procedencia del ingreso, servicio de ingreso y diagnósticos de ingreso (Categorías diagnósticas Mayores CIE-9-MC) y comorbilidades más frecuentes

Nivel de formación (n: 170)	Analfabetismo	4.71% (8)
	Leer-escribir	36.47% (62)
	Estudios primarios	50.59% (86)
	Estudios secundarios	5.88% (10)
	Estudios universitarios	2.35% (4)
Procedencia del ingreso (n: 174)	Programado	21.26% (37)
	Urgente	78.74% (137)
Servicio de ingreso (n: 174)	Médico	71.84% (125)
	Quirúrgico	28.16% (49)
Diagnóstico de ingreso (n: 174)	E. y trastornos del sistema circulatorio	22.99% (40)
	E. y trastornos del sistema musculoesquelético y tejido conectivo	17.82% (31)
	E. y trastornos del sistema digestivo	15.52% (27)
	E. y trastornos del sistema respiratorio	14.94% (26)
	E. y trastornos del riñón y vías urinarias	8.62% (15)
	E. y trastornos del sistema hepatobiliar y páncreas	8.05% (14)
Comorbilidades (n: 174)	Enfermedades y trastornos del sistema nervioso	4.6% (8)
	Diabetes Mellitus	35.06% (61)
	Cáncer	23.56% (41)
	Broncopatía	20.69% (36)
	Insuficiencia cardíaca	17.24% (30)
	Enfermedades neurológicas con secuelas o degenerativas	9.2% (16)
	Hepatopatía crónica	4.6% (8)

1.72% de los casos el IMC era inferior a 18.5 kg/m², el 9.77% de los pacientes tenían un IMC que se correspondía con un peso insuficiente para este grupo de edad, el 39.66% estaban en el rango de normopeso y el 48.85% tenían sobrepeso (21.84%) u obesidad (27.01%). El 50.57% (88/174) de los pacientes valorados habían perdido peso en los 3 meses previos al ingreso, de ellos el 53.41% (47/88) habían perdido menos de un 5%, el 37.5% (33/88) entre un 5 y un 10% y el 9.09% (8/88) más de un 10%.

El cribado inicial del NRS-2002 fue positivo en el 59.2% (103/174) de los individuos, a los que se les realizó, por tanto, la valoración completa. De ellos el 49.66% (51/103) estaban en riesgo nutricional, lo que significa que el 29.31% (51/174) del total de los pacientes analizados al ingreso estaban en riesgo nutricional según este test.

En la tabla II pueden verse los principales parámetros antropométricos y analíticos al ingreso en el total de los sujetos analizados, así como en los clasificados como “con riesgo nutricional” o “sin riesgo nutricional” según el NRS-2002. No pudimos establecer diferencias estadísticamente significativas en ninguno de estos parámetros entre los pacientes con o sin riesgo nutricional. A pesar de incluir en el protocolo inicial del estudio la recogida de las cifras de proteínas viscerales, finalmente no procedimos al análisis de estos datos por disponer de ellos en un número muy reducido de casos.

No observamos diferencias estadísticamente significativas en el resultado del NRS-2002 al ingreso en función de género, edad, nivel de formación, procedencia del ingreso (urgente vs programado), servicio de ingreso (médico vs quirúrgico), polimedicación o comorbilidades presentes. Respecto al servicio de ingreso de los pacientes, a pesar de no hallar diferencias estadísticamente significativas, sí observamos un mayor porcentaje de sujetos en riesgo nutricional en las salas médicas (32.8%), frente a las quirúrgicas (20.41%).

Los resultados del MNA-SF mostraron que el 15.7% de los pacientes estaban desnutridos y el 54.65% en riesgo de desnutrición. Existe una concordancia pobre entre los resultados obtenidos mediante el NRS-2002 al ingreso y el MNA-SF (kappa = 0.04).

En la tabla III se muestran los resultados de los parámetros antropométricos y analíticos en función del estado nutricional diagnosticado mediante el MNA-SF. Los resultados del MNA-SF no mostraron diferencias en función del género, pero sí de la edad. Los pacientes con buen estado nutricional tenían una edad media de 75.47±7.61 años, frente a los 78.63±6.50 de los desnutridos o los 79.96±7.85 de los que estaban en riesgo nutricional, siendo estas diferencias estadísticamente significativas (p<0.05). También hubo diferencias estadísticamente significativas en el estado nutricional diagnosticado mediante el MNA-SF en función del servicio de ingreso (médico vs quirúrgico) y del tipo de ingreso (urgente vs programado). Así, el 85.19% de los pacientes desnutridos y el 79.79% de los que estaban en riesgo nutricional estaban ingresados en salas médicas; y el 96.30% de los desnutridos y el 87.23% de los diagnosticados de riesgo nutricional habían ingresado de forma urgente. Respecto a las comorbilidades, predecían la existencia de deterioro nutricional los antecedentes de cirugía gastrointestinal y la insuficiencia cardíaca, lo mismo que la polimedicación, siendo estas diferencias estadísticamente significativas (p<0.05).

Valoración al alta

El 73.05% de los pacientes evaluados al alta (122/167) presentaban un cribado inicial positivo. De ellos el 65.57% (80/122) estaban en riesgo nutricional; lo que se traduce en que el 47.9% (80/167) del total de sujetos a los que se les realizó el NRS-2002 estaban en riesgo nutricional.

Tabla II

Principales parámetros antropométricos y analíticos al ingreso en el total de la población analizada, y en pacientes con/ sin riesgo nutricional según NRS-2002

	<i>Población total</i>	<i>Con riesgo nutricional</i>	<i>Sin riesgo nutricional</i>	<i>p</i>
Peso (kg)	72.8 ± 14.66	74.04 ± 13.96	72.28 ± 14.96	ns
Pp	3.35 (2,6)	3.3 (1.42,6)	3.35 (2,5.7)	ns
IMC (kg/m ²)	26.98 (24.33,30.19)	26.99 (24.42,30.72)	26.98 (24.35,30.06)	ns
PT (mm)	14.45 (10.3,20.95)	12.2 (9.7,19.95)	15.3 (10.65,21.1)	ns
CB (cm)	29 (27,32)	29 (27.15,32)	29 (27,32)	ns
CMB (cm)	24.5 (22.2,26.28)	24.86 (22.33,26.48)	24.35 (22.22,26.19)	ns
Linfocitos (células/ml)	1275 (840,1900)	1510 (877,2088)	1235 (800,1795)	ns

Pp: pérdida de peso en los 3 meses previos al ingreso. IMC: índice de masa corporal. PT: pliegue tricúspido. CB: circunferencia del brazo. CMB: circunferencia muscular del brazo. Las variables continuas con distribución normal se expresan como media ± DE, las que no tienen distribución normal como mediana (1Q,3Q). Significación estadística: p<0.05

Tabla III
Principales parámetros antropométricos y analíticos en función del diagnóstico nutricional realizado mediante MNA-SF

	Buen estado nutricional	Con riesgo nutricional	Desnutridos	p
Peso (kg)	78 ± 14.55	71.96 ± 13.07	66.96 ± 17.46	<0.05
Pp (kg)	0 (0,1.8)	-1.45 (-3.55,0)	-5 (-6.75,-3)	<0.05
IMC (kg/m ²)	28.5 (25.8,33.0)	26.7 (24.2,29.7)	25.3 (21.8,27.3)	<0.05
PT (mm)	16 (11.6,23)	14 (9.8,19.7)	11.1 (8.3,17)	<0.05
CB (cm)	31 (29,33)	28.5 (27,30.9)	26 (24.2,31)	<0.05
CMB (cm)	25.1 (24.1,27.3)	24.2 (22.2,26.1)	22.6 (20.8,25.9)	<0.05
Linfocitos (células/ml)	1635 (1152,2220)	1220 (800,1715)	1020 (710,1788)	<0.05

Pp: pérdida de peso en los 3 meses previos al ingreso. IMC: índice de masa corporal. PT: pliegue tricipital. CB: circunferencia del brazo. CMB: circunferencia muscular del brazo. Las variables continuas con distribución normal se expresan como media ± DE, las que no tienen distribución normal como mediana (1Q,3Q). Significación estadística: p<0.05

No objetivamos diferencias en la prevalencia de riesgo nutricional en función del género, pero sí de la edad, con un aumento en los grupos de mayor edad, como puede verse en la figura 1; siendo esta diferencia estadísticamente significativa (p<0.05).

El tipo de ingreso parece influir en el estado nutricional al alta, objetivándose diferencias estadísticamente significativas: el 25.00% (9/36) de los pacientes ingresados de forma programada estaban en riesgo nutricional al alta, frente al 54.19% (71/131) de aquellos que ingresaron procedentes de urgencias (p<0.05). Respecto al servicio de ingreso, el 40.43% (19/47) de los individuos ingresados en servicios quirúrgicos estaban en riesgo nutricional, aumentando este porcentaje hasta el 50.83% (61/120) en las plantas médicas, pero esta diferencia no alcanzó significación estadística.

La única comorbilidad en la que demostramos un aumento estadísticamente significativo en la prevalencia de riesgo nutricional al alta fue la insuficiencia cardíaca. El 75.00% (21/28) de los sujetos con insuficiencia cardíaca estaban en riesgo, frente al 42.44% (59/139) de los que no la padecían (p<0.05).

El IMC del ingreso mostró una asociación estadística significativa con la prevalencia de riesgo nutricional al alta: a mayor IMC menor prevalencia, como puede verse en la figura 2 (p<0.05).

La estancia hospitalaria media de la población estudiada fue de 9.75±5.84 días. No objetivamos un aumento de la estancia hospitalaria en los pacientes que ingresaban en situación de riesgo nutricional definido mediante el NRS-2002, respecto a los que no estaban en riesgo. Tampoco hubo diferencias estadísticamente significativas en función del riesgo nutricional al alta ni del estado nutricional definido mediante el MNA-SF.

El análisis multivariante, mediante la aplicación de un modelo de regresión logística, mostró un mayor riesgo nutricional en relación con: edad (cada año aumenta un 7.42% la probabilidad de estar en riesgo nutricional), insuficiencia cardíaca y pérdida de peso.

Cambios en el estado nutricional durante la hospitalización

En la tabla IV pueden verse los cambios en el estado nutricional durante el ingreso. Existe un aumento en el porcentaje de pacientes en riesgo nutricional al alta (47.9%) respecto al ingreso (29.94%), siendo esta diferencia estadísticamente significativa (p<0.05).

Subpoblación de pacientes oncológicos

41 pacientes de los 174 que formaron parte del estudio presentaban enfermedad oncológica activa. De ellos el 34.14% estaban en riesgo nutricional en el momento del ingreso según los resultados del NRS-2002. Según la VGS-GP, también realizada al ingreso, el 56.41% presentaba algún grado de deterioro nutricional: el 46.15% desnutrición moderada / riesgo de desnutrición y el 10.26% desnutrición severa. El MNA-SF evidenció la presencia de problemas nutricionales en el 68.29% de los sujetos con cáncer: el 23.07% desnutrición y el resto riesgo de desnutrición. Al alta fueron analizados 38 pacientes, a los que se les realizó de nuevo el NRS-2002, el 57.89% de ellos estaban en riesgo nutricional.

La concordancia entre el NRS-2002 al ingreso y la VGS-GP es pobre (kappa = 0.16), lo mismo que entre el MNA-SF y la VGS-GP.

Discusión

Presentamos un estudio sobre la prevalencia de desnutrición entre los pacientes mayores de 65 años ingresados en un hospital universitario. Realizamos al total de la población el NRS-2002 y el MNA-SF, y a los pacientes con enfermedad oncológica activa la VGS-GP.

Según los resultados del NRS-2002 el 29.31% de los individuos evaluados estaban en riesgo nutricional.

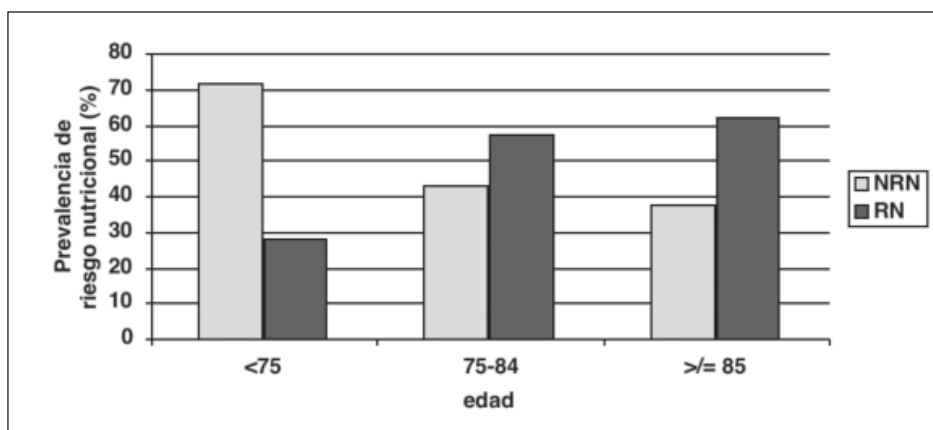


Fig. 1.—Prevalencia de riesgo nutricional al alta en función de la edad.

NRN: no riesgo nutricional.
RN: riesgo nutricional.

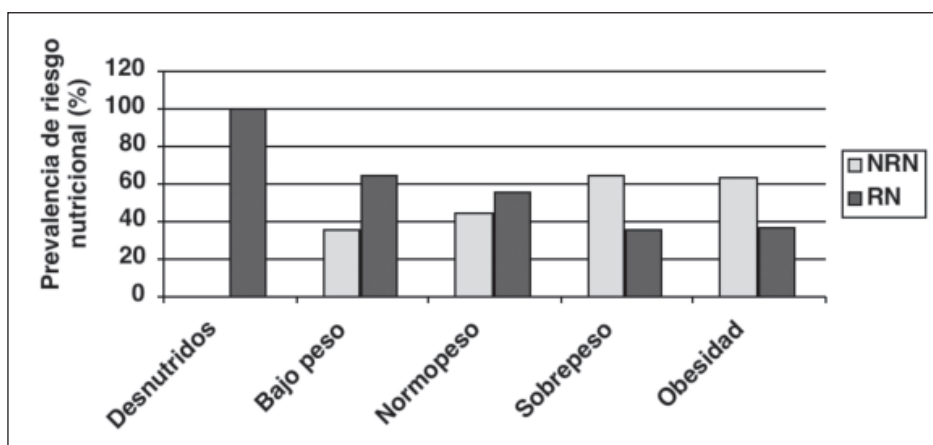


Fig. 2.—Prevalencia de riesgo nutricional al alta en función del Índice de Masa corporal.

NRN: no riesgo nutricional.
RN: riesgo nutricional

Tabla IV
Cambios en el estado nutricional durante el ingreso
(n=167)

		NRS alta	
NRS ingreso	NRN	NRN	RN
	RN		
	NRN	117 (70.06%)	60 (51.28%)
	RN	50 (29.94%)	27 (54%)
			23 (46%)
			87 (52.1%)
			80 (47.9%)

NRS: Nutritional Risk Screening 2002. NRN: No riesgo nutricional.
RN: riesgo nutricional.

nal al ingreso, aumentando este porcentaje hasta el 47.90% en el momento del alta. En nuestro país el estudio más importante sobre desnutrición hospitalaria es el PREdYCES⁹, diseñado para evaluar su prevalencia y costes. Para ello se valoraron, mediante el NRS-2002, 1707 pacientes de 31 hospitales públicos elegidos aleatoriamente. De los 741 pacientes de 70 ó más años el 37.0% estaban en riesgo nutricional al ingreso y el 38.08% al alta. Si bien en nuestro centro el porcentaje de sujetos en riesgo al ingreso es inferior al del estudio PREdYCES, es claramente superior en

el momento del alta. Estos resultados son congruentes con los hallazgos de otros trabajos que muestran un empeoramiento de la desnutrición durante la estancia hospitalaria^{20,21}.

Resulta difícil comparar resultados de distintos estudios, no sólo por las diferencias existentes entre las poblaciones analizadas, sino también por las distintas herramientas utilizadas en la valoración. Se han desarrollado múltiples sistemas para el cribado nutricional con diferentes sensibilidades y especificidades, y no igualmente aplicables a todos los pacientes^{22,23}. Neelemaat F et al²⁴ realizaron un estudio en el que compararon 5 métodos de cribado nutricional en ingresados, a saber: Malnutrition Screening Tool (MST), Short Nutritional Assessment Questionnaire (SNAQ), MNA-SF, MUST y NRS-2002. Llegan a la conclusión de que en los pacientes mayores el MUST y el NRS-2002 tienen una excelente sensibilidad (97% vs 92%) y especificidad (79% vs 83%); sin embargo, el MNA-SF presenta frente a una sensibilidad del 100% una especificidad de tan sólo el 41%.

El MNA-SF mostraba problemas nutricionales en el 70.35% de los sujetos: el 15.70% estaban desnutridos y el 54.65% en riesgo de desnutrición. Calvo I et al²⁵ diagnosticaron mediante el MNA de desnutrición al 22% y de riesgo nutricional al 55% de un total de

106 pacientes mayores de 65 años ingresados en salas médicas de un hospital terciario español. Nos encontramos con cifras similares en estudios realizados en otros países^{26,27}, entre ellos en un gran estudio multicéntrico belga. En él se evaluaron mediante el MNA-SF 2329 individuos mayores hospitalizados: el 33% presentaban desnutrición y el 43% estaban en riesgo nutricional²⁸. En nuestro trabajo la concordancia entre el NRS-2002 y MNA-SF fue pobre.

En la comunidad gallega Martínez Olmos et al¹⁰ diagnosticaron de desnutrición el 78.9% de los pacientes mayores de 65 años hospitalizados en su centro, mediante la aplicación de un protocolo diagnóstico que incluía parámetros antropométricos, bioquímicos e inmunológicos. Esta cifra está próxima a la publicada en distintos trabajos que usan como herramienta de valoración el MNA, pero es claramente superior a la obtenida cuando se aplican otras herramientas, como el NRS-2002 o el MUST.

No observamos una relación estadísticamente significativa entre los parámetros antropométricos y el riesgo nutricional al ingreso valorado mediante el NRS-2002, lo que sugiere que la utilización de éstos de forma aislada puede no resultar adecuada en la estratificación del riesgo nutricional. Otros autores constataron una infraestimación del diagnóstico de desnutrición mediante antropometría frente a la VGS²⁹. Tampoco observamos una asociación estadísticamente significativa entre el riesgo nutricional al ingreso y distintas variables sociodemográficas, procedencia de ingreso, servicio de ingreso, existencia de polimedicación, ni comorbilidades asociadas. Posiblemente esto sea debido a que el estudio carece de la potencia estadística suficiente.

En el momento del alta el porcentaje de pacientes en riesgo nutricional era significativamente mayor en los grupos de más edad (de forma similar a lo observado en el estudio PREDyCES⁹), en los pacientes que ingresaban procedentes del servicio de urgencias y en los diagnosticados de insuficiencia cardíaca. No encontramos diferencias estadísticamente significativas en relación con otras comorbilidades, probablemente, de nuevo, por una potencia estadística insuficiente.

La estancia hospitalaria media fue 9.75±5.84 días, no existiendo diferencias estadísticamente significativas en función del estado nutricional diagnosticado mediante el NRS-2002 al ingreso ni al alta, ni mediante el MNA-SF. Por lo tanto, al contrario que en otros estudios⁹, no pudimos demostrar un aumento de la estancia hospitalaria en los pacientes con deterioro nutricional.

La presencia de cáncer aumenta el riesgo nutricional, en relación con factores vinculados a la propia enfermedad, al paciente y a los tratamientos aplicados³⁰. En la población analizada, según el NRS-2002, el porcentaje de pacientes oncológicos en riesgo nutricional al ingreso era del 34.14%, y al alta del 57.89% (33.9% y 36.4% respectivamente al ingreso y al alta en el estudio PREDyCES⁹). Si revisamos los resultados de la

VGS-GP, un instrumento diseñado y validado específicamente para enfermos con cáncer, el porcentaje de desnutridos al ingreso asciende al 56.41%. Esta cifra es muy similar al 50% que objetivamos en un estudio previo en nuestro centro en el que se evaluaron pacientes con cáncer digestivo inmediatamente antes de la intervención quirúrgica³¹. M Planas et al³² diagnosticaron de desnutrición mediante la VGS al 43.4% de los ingresados con cáncer. En nuestro centro el MNA-SF todavía mostraba un porcentaje más elevado de pacientes con deterioro nutricional (68.29%). Como ya mencionamos previamente, los datos obtenidos son difíciles de comparar con los de otros estudios, y dentro del mismo estudio entre los distintos test. En este sentido, la concordancia que observamos entre el NRS-2002 y la VGS-GP y entre el NRS-2002 y el MNA-SF fue pequeña.

En conclusión, podemos afirmar que el porcentaje de pacientes mayores de 65 años en riesgo nutricional, tanto al ingreso como al alta, es elevado en nuestro centro. Entre ellos, los de mayor edad, los pacientes oncológicos, con insuficiencia cardíaca o los que ingresan de forma urgente presentan un mayor riesgo de deterioro durante la estancia en el centro. Se hace imprescindible introducir algún tipo de cribado nutricional como práctica generalizada en nuestros hospitales, de cara a establecer vías de valoración, tratamiento y seguimiento nutricional de los pacientes en riesgo.

Referencias

1. Calvo I, Olivar J, Martínez E, Rico A, Díaz J, Gimena M. MNA Mini Nutritional Assessment as a nutritional screening tool for hospitalized older adults; rationales feasibility. *Nutr Hosp* 2012; 27 (5):1619-25.
2. Goodwin JS: Social, psychological and physical factor affecting the nutritional status of elderly subjects: separating cause and effect. *Am J Clin Nutr* 1989; 50:1201-9.
3. Ruiz MD, Artacho R, Oliva P, Moreno R, Bolaños J, De Teresa C et al. Nutritional risk in institutionalized older woman determined by mini nutritional assessment test: What are the main factors? *Nutrition* 2003; 19:767-71.
4. Poisson PP, Laffond T, Campos S, Dupois V, Bourdel-Marchasson I. Relationships between oral health, dysphagia and undernutrition in hospitalised elderly patients. *Gerontology* 2014; doi:10.1111/ger.12123.
5. Bourdel-Marchasson I. Troubles nutritionnels chez le sujet âgé. *La revue de Praticien* 2008; 58:673-8.
6. Rasheed S, Woods RT. Malnutrition and quality of life in older people: a systematic review and meta-analysis. *Ageing Res Rev* 2012; S:1568-637.
7. Covinsky KE, Martin GE, Beyth RJ, Justice AC, Seygal AR, Landefeld CS. The relationship between clinical assessments of nutritional status and adverse outcomes in older hospitalized medical patients. *J Am Geriatric Soc* 1999; 47:532-8.
8. Kaize MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T et al. Frequency of malnutrition in older adults: a multinational perspective using the Mini Nutritional Assessment. *J Am Geriatr Soc* 2010; 58:1734-8.
9. Alvarez-Hernández J, Planas Vila M, León-Sanz M, García de Lorenzo A, Celaya-Pérez S, García-Lorda PP, Araujo K, Sarto Guerra B, on behalf of the PREDyCES researchers. Prevalence and costs of malnutrition in hospitalized patients; the PREDyCES Study. *Nutr Hosp* 2012; 27:1049-59.

10. Martínez Olmos MA, Martínez Vazquez MJ, Lopez Sierra A, Morales Gorriá MJ, Bouzon Cal S, Castro Nuñez I et al. Detección del riesgo de malnutrición en ancianos hospitalizados. *Nutr Hosp* 2002; 17(1):22-7.
11. Rasheed S, Woods RT. Malnutrition and associated clinical outcomes in hospitalized patients aged 60 and older: an observational study in rural Wales. *Journal of Nutrition in Gerontology and Geriatrics* 2013; 32:71-80.
12. Chan M, Lim YP, Ernest A, Tan TL. Nutritional assessment in Asian nursing home and its associated mortality. *J Nutr Health Aging* 2010; 14(1):23-8.
13. White JV, Guenter P, Jensen G, Malone A, Schofield M, Group AMW et al. Consensus statement: academy of nutrition and dietetics and american society for parenteral and enteral nutrition: characteristics recommended for the identification and documentation of adult malnutrition (undernutrition). *JPEN* 2012; 36(3):275-83.
14. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. ESPEN Guidelines for Nutrition Screening 2002. *Clin Nutr* 2003; 22:415-21.
15. Consenso multidisciplinar sobre el abordaje de la desnutrición hospitalaria en España. Coordinadoras: Álvarez Hernández J, Burgos Peláez R, Planas Vilá M. Barcelona: Glosa SL; 2011.
16. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z and ad hoc ESPEN working group. Nutritional risk screening (NRS-2002): a new method based on an analysis of controlled clinical trials. *Clin Nutr* 2003; 22:321-36.
17. Ottery FD. Oncology patients-generated SGA of nutritional status. *Nutr Oncol* 1994; 1:9.
18. Guigoz Y, Vellas B, Garry PJ. Mini Nutricional Assessment: a practical assessment tool for grading the nutritional state of elderly patients: Facts and research in gerontology. *Nutrition* 1994; suppl:15-59.
19. Carmina Wander-Berghe. Valoración antropométrica. En: Valoración nutricional en el anciano. Documentos de consenso. Sociedad Española de Nutrición Parenteral y Enteral (SENPE) y Sociedad Española de Geriátría y Gerontología (SEGG).
20. Kyle UG, Schneider SM, Pirlich M et al. Does nutritional risk, as assessed by Nutritional Risk Index increase during hospital stay? A multinational Population-based study. *Clin Nutr* 2005; 24:516-24.
21. McWhirter JP, Pnnington CR. Incidence and recognition of malnutrition in hospital. *BMJ* 1994; 308:945-8.
22. Valero MA, Díez L, El Kadaoui N, Jiménez AE, Rodríguez H, León MI. Are the tools recommended by ASPEN and ESPEN comparable to for assessing the nutritional status? *Nutr Hosp* 2005; 20:259-67.
23. Kyle UG, Sossovsky MPP, Karsegard VL, Pichard C. Comparison of tools for nutritional assessment and screening at hospital admission: a population study. *Clin Nutr* 2006; 25:409-17.
24. Neelemaat F, Meijers J, Kruizenga H, van Ballegooijen H, van Bokhorst-de van der Schueren M. Comparison of five malnutrition screening tools in one hospital inpatient sample. *JCN* 2011; 20:2144-52.
25. Calvo I, Olivar J, Martínez E, Rico A, Díaz J, Gimena M. MNA Mini Nutricional Assessment as a nutritional screening tool for hospitalized older adults: rationales and feasibility. *Nutr Hosp* 2012; 27(5):1619-25.
26. Marques de Oliveira MR, Leandro-Merhi VA. Food intake and nutritional status of hospitalized older people. *International Journal of Older People Nursing* 2010; 196-200.
27. Vischer UM, Frangos E, Graf C, Gold G, Weiss L, Hermann FR. The prognostic significance of malnutrition as assessed by the Mini Nutritional Assessment (MNA) in older hospitalized patients with a heavy disease burden. *Clin Nutr* 2012; 31:113-7.
28. Vanderwee K, Clays E, Bocquaert I, Gobert M, Folens B, Defloor T. Malnutrition and associated factors in elderly hospital patients: A Belgian cross-sectional, multi-centre study. *Clin Nutr* 2010; 29:469-76.
29. Kyle UG, Unger PU, Mensi N, Genton L, Pichard C. Nutrition status in patients younger and older than 60 y at hospital admission: a controlled population study in 995 subjects. *Nutrition* 2002; 18:463-9.
30. García Luna PP, Parejo Campos J, Pereira Cunill JL. Causas e impacto clínico de la desnutrición y caquexia en el paciente oncológico. *Nutr Hosp*. 2006; 21 (S3):10-6.
31. Cid Conde L, Fernández López T, Neira Blanco PP, Arias Delgado J, Varela Correa JJ, Gómez Lorenzo FF. Prevalencia de desnutrición en pacientes con neoplasia digestiva previa a cirugía. *Nutr Hosp*. 2008; 23: 46-53.
32. Planas M, Audivert S, Pérez-Portabella C, Burgos R, Puiggrós C, Casanelles JM, Roselló J. Nutricional status among adult patients admitted to an university-affiliated hospital in Spain at the time of genome. *Clin Nutr* 2004; 23: 1016-24.



Original/*Valoración nutricional*

Estado nutricional de dos generaciones de hermanos(as) < de 5 años de edad beneficiarios(as) de *Oportunidades*, en comunidades rurales marginadas de Chiapas, México

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Resumen

En México, en las últimas décadas se han desarrollado varios programas para erradicar el problema de la desnutrición en infantes < de 5 años, principalmente de aquellos que viven en áreas indígenas y rurales. No obstante, no existe suficiente evidencia sobre su impacto en la salud y la nutrición infantil.

Objetivo: describir los cambios nutricionales de dos generaciones de hermanos(as) que han sido beneficiados por el programa *Oportunidades* en comunidades rurales de Chiapas.

Métodos: estudio transversal. Se determinó: bajo peso, baja talla, emaciación y SP + O (Sobrepeso más Obesidad). Los hermanos(as) mayores fueron evaluados en los años 2002-2003, para el 2010-2011 se evaluaron a los hermanos(as) menores, ambos grupos eran < de 5 años de edad en el momento de conseguir la información.

Resultados: la desnutrición en sus tres formas es un problema, 43,4% de los hermanos(as) evaluados(as) en 2010-2011 presentaron baja talla, la prevalencia de bajo peso disminuyó de 18% a 13,2%, la emaciación (peso bajo para la talla) aumentó de 8,1% a 10,4%. El SP + O aumentó significativamente 12 puntos porcentuales entre los hermanos(as) de 24,8% en 2002-2003 a 36,8% en 2010-2011. La desnutrición en los niños (varones) es menor que la de sus hermanos de la generación de 2002-2003 (baja talla $p = <0.05$), el SP + O fue de 10,9 puntos porcentuales más que el de sus hermanos (26,4% a 37,3%).

NUTRITIONAL STATUS OF TWO GENERATIONS OF BROTHERS AND SISTERS <5 YEARS OF AGE BENEFICIARIES FROM OPPORTUNITIES LIVING IN MARGINALIZED RURAL COMMUNITIES IN CHIAPAS, MEXICO

Abstract

Mexico, in recent decades, has developed several programs to eradicate the problem of infant malnutrition <5 years, primarily among those living in rural and indigenous areas. However, there is insufficient evidence on these programs' impact on child health and nutrition.

Objective: to describe the nutritional changes of two generations of brothers and sisters living in rural communities of Chiapas and who are *Oportunidades* beneficiaries.

Methods: cross-sectional study. It was determined: underweight, stunting, wasting and overweight plus obesity. Older brothers and sisters were evaluated in 2002-2003, for 2010-2011 younger brothers and sisters were evaluated, both groups were <5 years of age at the time of data collection.

Results: malnutrition, in its three types is a problem. 43.4% of brothers and sisters evaluated in 2010-2011 showed stunting, underweight prevalence declined from 18% to 13.2%, wasting (low weight for height) increased from 8.1% to 10.4%. Overweight and obesity increased significantly by 12 percentage points among brothers and sisters, from 24.8% in 2002-2003 to 36.8% in 2010-2011. Malnutrition among male children is lower than their brothers and sisters from the 2002-2003 generation (stunting $p = <0.05$), overweight and obesity was 10.9 percentage points higher than their brothers and sisters (26.4% to 37.3%).

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Recibido: 25-III-2015.
Aceptado: 23-IV-2015.

Conclusión: los niños(as) beneficiarios(as) de *Oportunidades* aún no han superado los problemas de desnutrición crónica. No se muestra un impacto claro en la mejora del estado nutricional de la población en estudio.

(Nutr Hosp. 2015;31:2685-2691)

DOI:10.3305/nh.2015.31.6.9020

Palabras clave: *Desnutrición infantil. Obesidad. Estudio antropométrico. Programas sociales. Transferencias monetarias condicionadas.*

Abreviaturas

SP+O (sobrepeso más obesidad).

Progresar: Programa de Educación, Salud y Alimentación.

Oportunidades: Programa para el desarrollo humano de la población en pobreza extrema que brinda apoyo en educación, salud, nutrición e ingresos.

Prospera: Programa de Inclusión Social.

IMSS-Oportunidades: Instituto Mexicano del Seguro Social, para población abierta.

SSA: Secretaría de Salud y Asistencia.

Ensanut: Encuesta Nacional de Salud y Nutrición.

Introducción

En el tema de la nutrición infantil, México es un país de grandes contrastes. Por un lado, prevalece la desnutrición infantil y por otro lado, va en incremento el sobrepeso y la obesidad infantil. Sin embargo, debido a las características económicas y sociodemográficas del país, la magnitud de la desnutrición infantil crónica aún supera con mucho a la del exceso (obesidad infantil), especialmente en áreas rurales marginadas¹. En 1988, la prevalencia de baja talla en menores de cinco años era 26.9%, para 1999 fue de 21.5%, en 2006 fue de 15.4% y para el 2012 se reporta una prevalencia de 13.6% a nivel nacional^{2,3,4,5}. Estas cifras son distintas cuando el análisis se realiza por área geográfica y por estado. En la región urbana del norte del país, la prevalencia de desnutrición crónica es de tan solo 6.9%, lo que equivale a la mitad del promedio nacional; mientras que en la zona sur rural del país, la prevalencia es más del doble que la prevalencia nacional 27.5%⁵. En cuanto a la población indígena menor de 5 años que vive en el área rural, la prevalencia de desnutrición crónica actualmente es de 33.1%, es decir, 19.5 puntos porcentuales más alta que la media nacional⁵. Chiapas ocupa el primer lugar en bajo peso y baja talla en niños menores de cinco años de edad, con una prevalencia a nivel estatal de 31.4% de baja talla, mientras que en los niños que viven en áreas rurales indígenas es de 44.2%⁵. Por otro lado, de 1990 a la fecha el problema de obesidad infantil en México se ha incrementado de tal manera que tiene las prevalencias más altas en el mundo^{6,7}. La prevalencia de sobrepeso y obesidad en

Conclusion: children beneficiaries from *Opportunities* have not yet overcome chronic malnutrition problems. This study shows that there is not a clear impact in improving the nutritional status of the study population.

(Nutr Hosp. 2015;31:2685-2691)

DOI:10.3305/nh.2015.31.6.9020

Key words: *Child malnutrition. Obesity. Anthropometric. Social programs. Conditional cash transfers.*

la región sur del país es de 9.6% en los niños menores de cinco años.

Para el estado de Chiapas la prevalencia de sobrepeso y obesidad en los niños menores de cinco años, aumentó de 3.5% (2006) a 6% (2012). Estos resultados reflejan el problema de salud pública que aún enfrenta este país. Pese a que en México se han implementado diversos programas y políticas alimentarias siguiendo un patrón similar al que se ha experimentado en el resto del mundo, iniciando con programas asistenciales hasta llegar a programas integrales de coordinación intersectorial^{8,9,10}. En 1997, comenzó un programa de combate a la pobreza, basado en incentivos, enfocado a incrementar el capital humano de la población pobre¹¹. Este programa fue nombrado inicialmente como *PROGRESA* y posteriormente, en 2006, como *Oportunidades* y actualmente es conocido como *PROSPERA*.

Este programa es uno de los de mayor duración y cuenta con 25 millones de beneficiarios, cinco de los cuales son chiapanecos¹². El programa conformado por tres componentes: transferencia monetaria (componentes de los alimentos), componente educativo, y un componente de salud y nutrición. La transferencia monetaria tiene como objetivo mejorar el consumo de alimentos y el estado nutricional de los niños(as). El componente educativo consiste en el otorgamiento de becas escolares por cada niño matriculado de tercero a sexto grado. El componente de salud y nutrición ofrece acceso a los servicios básicos de salud, suplementos nutricionales y pláticas educativas. Los suplementos nutricionales son proporcionados a las mujeres embarazadas y lactantes, y a los niños entre 4 y 24 meses de edad. También se les proporciona a los niños entre los 2 y 4 años de edad si se presentan síntomas de desnutrición y son detectados por el personal de la clínica.

Chiapas, es uno de los estados en donde el programa *Oportunidades* beneficia un mayor número de localidades y habitantes (8,839 localidades, otorga a 549, 567 familias apoyo para la alimentación y más de 560, 047 becas a los estudiantes)¹³. Sin embargo, no existe evidencia clara y definitiva de su impacto en la nutrición y salud infantil, particularmente en erradicar la desnutrición infantil especialmente en las áreas rurales indígenas. Chiapas, a pesar del apoyo recibido, continúa siendo el estado de la República Mexicana con mayor prevalencia de pobreza con 76.7%¹⁴.

Bajo este panorama, el propósito del presente artículo es describir el estado nutricional de dos generaciones de hermanos(as) menores de cinco años que han pertenecido al programa *Oportunidades* desde su nacimiento. Con el objetivo de analizar cómo ha impactado el programa *Oportunidades* entre los hermanos de una generación a otra.

Material y Métodos

Área de estudio

Chiapas es uno de los estados de la República Mexicana, localizado en la región sur-sureste con 4, 796,580 habitantes, de los cuales 51% viven en el área rural¹⁵. Está compuesto por 122 municipios, distribuidos en 15 regiones socioeconómicas¹⁶. Se presentan resultados de cuatro comunidades: dos del municipio de Simojovel y dos del municipio de Huitiupán, ambos municipios pertenecientes a la región VII llamada De los Bosques, que se caracterizan por ser de muy alta marginación¹⁷. Los municipios fueron seleccionados de acuerdo a su nivel de marginación, por tener población indígena y porque tiempo en que se realizó esta investigación eran municipios de prioridad para la Secretaría de Salud de Chiapas.

Las comunidades de estudio fueron seleccionadas de acuerdo a los siguientes criterios: acceso geográfico (dos de difícil acceso y dos que estuvieran cerca de la cabecera municipal); población indígena y no indígena; y adscripción a los servicios de salud para población abierta, dos comunidades atendidas por el Instituto Mexicano del Seguro Social (IMSS-Oportunidades) y dos por la Secretaría de Salud (SSA).

Población en estudio

222 niños menores de cinco años que fueron pesados y medidos en 2002-2003 y sus hermanos(as) menores de cinco años (n=106) que fueron medidos y pesados en 2010-2011.

En el año 2002-2003, se visitaron todos los hogares de las diferentes comunidades en estudio, se registraron a 407 niños menores de cinco años que vivían en las comunidades seleccionadas, de los cuales 379 pertenecían al programa *Oportunidades* y 28 no estaban dentro del programa. En los años 2004-2005, se regresó a las mismas comunidades en busca de los niños que aún eran menores de cinco años y seguían recibiendo los apoyos del programa *Oportunidades* como: los suplementos alimenticios, monitoreo del estado nutricional, subsidio monetario para la alimentación y pláticas de orientación alimentaria. Con base a lo anterior, se obtuvo una muestra de 237 niños y niñas menores de cinco años. En el periodo entre 2010 y 2011, se regresó nuevamente a las comunidades en estudio en búsqueda de los 237 infantes encontrándose 222 (15 niños no fueron encontrados, 6.3%). En esta visita del 2010-2011, también se realizó

el registro de todos los hermanos y hermanas de los 222 pero menores de cinco años. Teniendo una muestra final de 106 infantes menores de cinco años. Con estos dos grupos de población se realiza el análisis del presente artículo.

Mediciones antropométricas

Para realizar las mediciones de peso y talla, se capacitó y estandarizó al personal en los procedimientos para las mediciones, de acuerdo Habicht 1974; Lohman *et al.* 1988^{18,19}.

El estado nutricional se evaluó mediante índices antropométricos contruidos a partir de las mediciones de peso, talla y edad²⁰, utilizando las normas de crecimiento de Organización Mundial de la Salud²¹. Los índices antropométricos se transformaron a puntajes. Se clasificó con bajo peso, baja talla y emaciación (peso bajo para la talla), a los niños cuyo puntaje Z fue menor a -2 en peso para edad, longitud o talla para edad y peso para longitud o talla, respectivamente. Por otro lado, se clasificó con sobrepeso y obesidad (SP+O) a los menores cuyo puntaje Z del índice de masa corporal (IMC: peso/talla²) fuera > +1 DE según WHO, para los datos antropométricos se utilizó WHO Anthro.3.1.0²².

Se calcularon prevalencias de manera global, por sexo y edad agrupada en niños de 0 a 35 meses de edad y niños de 36 a menos de 60 meses de edad según año de estudio. Se utilizó el paquete estadístico SPSS versión 15 para procesar la información y para la comparación de proporciones con la prueba de chi cuadrado de Pearson, cuando se encontraban celdas con n<5 se aplicó la corrección de Yates.

Resultados

Distribución de la población en estudio

La población estuvo distribuida por 222 infantes menores de cinco años que fueron pesados y medidos en los años 2002-2003 de estos 116 son del sexo femenino y 106 del sexo masculino (menores de cinco años). La muestra de hermanos(as) que fueron pesados y medidos en los años 2010-2011 estuvo compuesta por 106 menores de cinco años de edad, de los cuales 55 son del sexo femenino y 51 del sexo masculino. La tabla I muestra la distribución de la población en estudio por grupo de edad y sexo.

Estado nutricional de dos generaciones de infantes menores de cinco años de edad

La prevalencia de desnutrición en sus tres formas aún continua siendo un problema de salud pública en la población en estudio. La prevalencia de bajo peso en la generación de hermanos(as) disminuyó 4.8 puntos por-

Tabla I
Distribución de la población en estudio por edad y sexo

Edad (en meses)	2002-2003 (n=222)		2010-2011 (n=106)	
	Niñas	Niños	Niñas	Niños
0-35	91	76	30	24
36-60	25	30	25	27
TOTAL	116	106	55	51

centuales, mientras que la de baja talla disminuyó 3.4 puntos porcentuales. La emaciación (peso bajo para la talla) aumentó 2.3 puntos porcentuales, figura 1. En esta misma figura también se puede observar que el sobrepeso combinado con la obesidad (SP+O) aumentó 12 puntos porcentuales entre los niños medidos en 2010-2011 en relación a sus hermanos que fueron medidos en 2002-2003 ($p=0.05$).

Estado nutricional de dos generaciones de infantes menores de cinco años de edad según sexo

En las niñas el problema de desnutrición en las tres formas (bajo peso, baja talla y emaciación) aumentó entre las mediciones, sin embargo, el resultado no fue estadísticamente significativo, figura 2. El resultado estadís-

ticamente significativo se encontró en el SP+O, entre las hermanas que fueron medidas en 2010-2011 contra las medidas en 2002-2004, el aumento fue de 13.1 puntos porcentuales ($p=0.05$), figura 2.

Contrario a lo que se observa en las niñas, la desnutrición en los niños que fueron evaluados en 2010-2011 es menor que la de sus hermanos medidos en 2002-2003 (baja talla $p<0.5$), mientras el SP+O fue de 10.9 puntos porcentuales más que el de sus hermanos, figura 3.

Estado nutricional de los infantes según grupo de edad

Al analizar la desnutrición por edad, se encontró que en ambos grupos de igual edad el problema de la prevalencia de desnutrición ahora es menor que la de sus hermanos medidos en 2002-2003. Sin embargo, los resultados no son estadísticamente significativos. La prevalencia de emaciación es ahora un problema de desnutrición en los infantes que se midieron en el 2010-2011 (Tabla II). El grupo de edad que se encontró con la prevalencia de SP+O significativamente mayor fue entre los niños evaluados en 2010-2011 de 36 a 60 meses de edad.

Discusión

La recolección de la información se llevó a cabo con hermanas y hermanos de las mismas familias en las comunidades en estudio en diferentes momentos

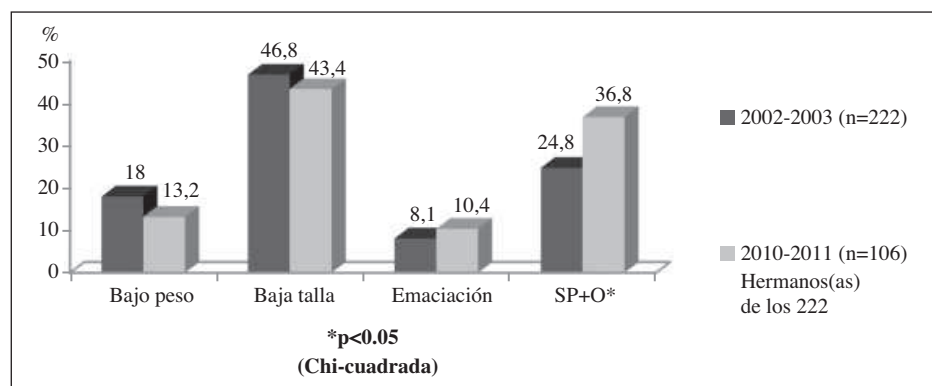


Fig. 1.—Prevalencia de desnutrición y SP+O en < de 5 años de edad, en 2002-2003 y sus hermanos(as) < de 5 años en 2010-2011.

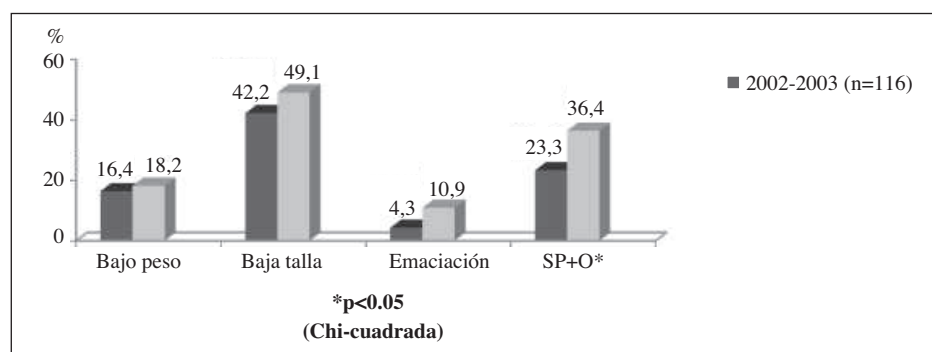


Fig. 2.—Prevalencia de desnutrición y SP+O en niñas < de 5 años de edad, entre 2002-2003 y sus hermanas en 2010-2011.

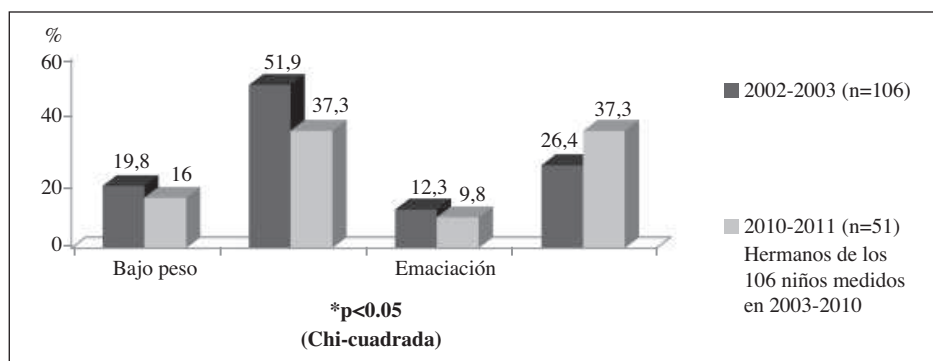


Fig. 3.—Prevalencia de desnutrición y SP+O en niños < de 5 años de edad en 2002-2003 y sus hermanos en 2010-2011.

(2002-2003 y 2010-2011). La importancia de describir el estado nutricional de estos niños, radica en que han pertenecido al programa *Oportunidades/PROSPERA* desde antes de su nacimiento y que se presentan resultados entre dos generaciones de hermanos. Se puede observar que el programa *Oportunidades/PROSPERA* ha tenido un impacto muy limitado en disminuir la prevalencia de desnutrición en cualquiera de sus tres formas (peso bajo, talla baja y emaciación) en estas comunidades. Las prevalencias de desnutrición crónica encontradas son similares a las reportadas en el área rural de Chiapas (44.2%)⁵, 54.1%²³ y 58.1%²⁴. Es importante resaltar que la emaciación es el problema nutricional que aumentó de manera global entre niños y niñas y por grupo de edad entre la población en estudio. A pesar de que se ha señalado que en México, a nivel nacional los problemas de emaciación dejaron de ser un problema generalizado de salud pública desde 1999²⁵, los resultados de este estudio no coinciden con lo reportado a nivel nacional. La emaciación, o peso

inferior al que corresponde a la estatura, es un importante indicador de la mortalidad entre los niños menores de cinco años y suele ser el resultado de la escasez aguda de alimentos y/o de enfermedades²⁶. Los resultados encontrados en la población en estudio pueden deberse a lo reportado por Martínez *et al.*, 2015 donde dice que 87%²⁷ de los hogares beneficiarios de *Oportunidades* mantiene inseguridad para alimentarse.

En cuanto a la diferencia encontrada por sexo, los resultados muestran que los niños (varones) medidos en 2010-2011 son quienes presentaron la menor prevalencia de desnutrición en comparación con sus hermanos medidos en 2002-2003. En el caso de las niñas únicamente hubo reducción en la desnutrición crónica pero no fue un resultado significativo.

La elevada prevalencia de déficit de talla es un predictor de riesgo que refleja el nivel general de desarrollo de la población. La baja talla adquirida hasta los cinco años limita la talla alcanzada en la edad adulta, lo que conlleva a una reducción en la capacidad laboral^{28,39} y en las niñas mayores riesgos obstétricos³⁰.

Con la finalidad de conocer cómo se presentan los problemas de malnutrición entre los niños < 3 años de edad y los > 3 años de edad, pero < 5 años de edad se realizó el análisis por grupo de edad. Se encontró que existe una reducción en la prevalencia de bajo peso y talla baja en los niños, independientemente del grupo de edad, pero también se puede observar que a mayor edad aumenta la prevalencia de desnutrición crónica. En relación a la emaciación se observa la misma tendencia hacia el aumento de este problema nutricional. La desnutrición infantil, particularmente la que ocurre durante la primera infancia, se asocia con menor desarrollo psicomotor, menor respuesta inmunológica y aumento en el riesgo de enfermedad y muerte. Además de repercutir a largo plazo en funciones fisiológicas dando como consecuencia individuos con menores capacidades de desempeño y productividad y, por lo tanto, menor desarrollo económico y social de los ambientes en los que se encuentran inmersos³¹. Razón por la que debemos poner un mayor énfasis, tratar de revertir este problema antes de que los niños cumplan tres años de vida.

Según datos oficiales de *Oportunidades*, los niños que son incorporados al programa desde edades

Tabla II
Desnutrición y SP+O por grupos de edad, entre < de 5 años de edad y sus hermanos(as) de la misma edad en 2010-2011

Grupo de edad y condición nutricia	2002-2003	2010-2011	Valor p ⁺
<i>0-35 meses</i>	<i>n=167</i>	<i>n=54</i>	
Bajo peso	18%	14.8%	p=0.59
Baja talla	40.7%	35.2%	p=0.47
Emaciación	10.8%	14.8%	p=0.42
SP+O	24.6%	33.3%	p=0.20
<i>36-60 meses</i>	<i>n=55</i>	<i>n=52</i>	
Bajo peso	18.2%	11.5%	p=0.34
Baja talla	65.5%	51.9%	p=0.16
Emaciación	0%	5.8%	p=0.22
SP+O	40%	60%	p=0.04

⁺Chi-cuadrada

tempranas, tienen un impacto favorable en el estado de nutrición. Sin embargo, la población en estudio es beneficiaria de dicho programa desde su nacimiento y la mayoría de ellos desde su concepción. Entre los diferentes estudios sobre el impacto del programa *Oportunidades* existen diferencias. Por ejemplo, Gertler (2004) después de analizar a los niños con *Oportunidades* a un año de ser beneficiados en áreas rurales, los comparó con los no beneficiarios, encontró que los niños con *Oportunidades* habían crecido 1 cm más. Por el contrario, Behraman y Hoddlinot (2005), no encontraron un efecto significativo en la nutrición infantil. Rivera *et al.*, (2004), encontró una ganancia de 1.1 cm en la talla en el grupo de niños de seis meses de edad que llevaban recibiendo el programa dos años; respecto a los niños de la misma edad que llevaban un año recibiendo dicho programa. Neufeld *et al.* (2004) comparó a los niños en las comunidades de intervención temprana y tardía, aquellos que comenzaron a recibir el programa en 1998 vs los que se incorporaron 18 meses después, y encontró que los niños que tuvieron intervención temprana crecieron 0.67 cm más que los niños que iniciaron 18 meses después. Fernald, Gertler y Neufeld (2009), reportaron no haber encontrado efecto sobre la talla de los niños, a pesar de que estos niños tenían en promedio 1 año o menos cuando comenzaron a recibir el programa comparado con los niños que eran mayores de un año cuando comenzaron con el programa^{32,33,34,35,36}.

Una posible razón de la continuidad con el problema de la desnutrición crónica en estas comunidades es que son hijos con madres con talla baja. Está documentado que existe relación entre la talla materna y el tamaño corporal al nacimiento, incluyendo la talla del recién nacido³⁷, estos resultados nos permiten pensar que es necesario más de una generación para disminuir significativamente la baja talla en poblaciones donde la talla materna es baja. Este ciclo intergeneracional de la falta de crecimiento, señala que las niñas que presentaron retraso del crecimiento en la primera infancia cuando son adultas tienen más probabilidades de dar a luz niños con bajo peso al nacer³⁸. Bajo la interpretación de este ciclo intergeneracional de la malnutrición, los resultados de este estudio muestran que estos niños pueden estar bajo la llamada 'La doble carga de la malnutrición'^{39,40}, lo que implica ser niños con baja talla y padres con sobrepeso y obesidad debido a la presencia de retraso en el crecimiento, especialmente en las niñas quienes en este estudio reflejan las prevalencias más altas de desnutrición crónica. Esta doble carga de la malnutrición ya ha sido observada en comunidades rurales de México^{41,42,43}.

Oportunidades/Prospera no sólo no ha podido combatir la desnutrición sino que ahora la población en estudio, también presentan problemas de sobrepeso y obesidad, de acuerdo a los resultados de este estudio la tendencia va en aumento. La prevalencia de SP+O encontrada en los niños y niñas que se evaluaron en 2010-2011 es más alta, que la que presentaban los her-

manos/as medidos en los años 2002-2003 y es, seis veces mayor a lo reportado en la Ensanut (2012). En ambos grupos hubo un incremento importante. Sin embargo, solo en las niñas resultó ser estadísticamente significativo. Este resultado refleja que niñas con baja estatura son también niñas con un exceso de peso corporal.

Conclusión

Los problemas de desnutrición en < 5 años en el periodo de 2010-2011 en estas comunidades continúan, aunque se observaron prevalencias ligeramente menores a las encontradas en sus hermanos de la misma edad evaluados en 2002-2003.

De manera general, se puede decir que los niños y niñas beneficiarios de *Oportunidades/PROSPERA* que viven en estas comunidades, aún no han podido superar los problemas de desnutrición, por lo que se deben considerar intervenciones que permitan una adecuada vigilancia nutricional de los infantes menores de cinco años y poner atención no sólo en los problemas de desnutrición, sino también se deben considerar acciones para evitar el aumento significativo en la prevalencia de sobrepeso y obesidad que tuvieron, en este estudio, los hermanos de una generación a otra. La vigilancia nutricional de los niños debe ser integral, con la finalidad de lograr detectar en qué momento se empieza a presentar el problema de sobrepeso y obesidad. Además de tener presente que el problema de esta población es la baja talla, y que con el paso del tiempo cuando estén expuestos a un ambiente obesogénico estos niños comenzarán a ganar exceso de peso.

Agradecimientos

Los autores desean agradecer a Dr. Alain Basail Rodríguez y al Dr. Raúl Molina Salazar por sus comentarios sobre el análisis preliminar y estamos en deuda con todas las familias de los niños que han participado en esta investigación. Este proyecto no habría sido posible sin el entusiasmo de todo el equipo de investigación.

Conflicto de intereses

Los autores declaran no tener conflictos de intereses.

Referencias

1. Consejo Nacional de Evaluación de la Política de Desarrollo Social. CONEVAL. Informe de Evaluación de la Política de Desarrollo Social en México 2012; México D.F: 28-47.
2. Instituto Nacional de Salud Pública. Encuesta Nacional de Nutrición (ENN) 1988. Dirección General de Epidemiología. Cuernavaca, Morelos, México.

3. Instituto Nacional de Salud Pública. Encuesta Nacional de Nutrición (ENN) 1999. Dirección General de Epidemiología. Cuernavaca, Morelos, México.
4. Instituto Nacional de Salud Pública de México. Encuesta Nacional de Salud y Nutrición 2006. Cuernavaca, Morelos, México.
5. Instituto Nacional de Salud Pública de México. Encuesta Nacional de Salud y Nutrición 2012. Cuernavaca, Morelos, México.
6. Fernald L. & Neufeld L. Overweight with concurrent stunting in very young children from rural Mexico: prevalence and associated factors. *Eur J Clin Nutr*. 2000; 61(5): 623-32.
7. Barquera S, Campos-Nonato I, Hernández-Barrera L, Flores M, Durazo-Arvizu R, Kanter R. Obesity and central adiposity in Mexican adults: results from the Mexican National Health and Nutrition Survey 2006. *Salud Publica Mex* 2009; 51:S595-S603.
8. Barquera S, Rivera-Dommarco J, Gasca-García A. Políticas y programas de alimentación y nutrición en México. *Salud Pública Mex* 2006; 43 (5): 464-477.
9. Espinosa F, Ruiz C, Valiente S. Programas de intervención alimentario nutricional en América Latina y el Caribe entre 1970 y 1984. *Food Nutr Bull*. 1986; 8:17-23.
10. Organización Panamericana de Salud. Estudio sobre intervenciones alimentario-nutricionales para poblaciones de bajos ingresos en Latinoamérica y el Caribe. Washington D.C.: OPS; 1990.
11. Levy S, Rodríguez E. Sin herencia de pobreza: El Programa-Oportunidades de México. Banco Interamericano, 2005. Edit. Planeta Mexicana, SA. de CV. Washington, D.C.20577. EUA.
12. Sariago-Rodríguez J L. Evaluación externa del Programa Oportunidades 2008. A diez años de intervención en zonas rurales (1997-2007). Secretaría de Desarrollo Social, 2008:128-138.
13. Secretaría de Desarrollo Social. Diagnóstico de los Programas de Desarrollo Social. SEDESOL, 2009. Disponible en:http://www.sedesol.gob.mx/en/SEDESOL/Diagnosticos_de_los_Programas_de_Development_Social
14. Consejo Nacional de Evaluación de la Política de Desarrollo Social. Informe de Pobreza en México. CONEVAL 2008. Disponible en: <http://www.coneval.gob.mx/Medicion/Paginas/Medici%C3%B3n/Informe-de-pobreza-multidimensional-en-Mexico-2008.aspx>
15. Instituto Nacional de Estadística y Geografía. Panorama Sociodemográfico de Chiapas, México. INEGI, 2012.
16. Consejo Nacional de Población. Chiapas, región norte. Grado de marginación por municipio, 2010. Disponible en: <http://cuentame.inegi.org.mx/monografias/informacion/chis/default.aspx?tema=me&e=07>
17. Secretaría de Desarrollo Social. Municipios de muy alta, alta y media marginación (MMAM) SEDESOL 2012.
18. Habicht. Standardization of anthropometric methods in the field. *PHAO Bull* 1974; 76:375-38.
19. Lohman T, Roche A, Martorell R. Standardization reference manual. Champaign, IL, Human Kinetics 1988.
20. World Health Organization. Multicentre Growth Reference Study Group. Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva: WHO, 2006.
21. De Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ* 2007; 85:660-667.
22. World Health Organization. Anthro for personal computers, version 3.2.2, 2011: Software for assessing growth and development of the world's children. Geneva: WHO, 2010. Disponible en: <http://www.who.int/childgrowth/software/en/>.
23. Sánchez H, Hernán MA, Ríos A, Arana M, Navarro A, Ford D, et al. Malnutrition among children younger than 5 years-old in conflict zones of Chiapas, Mexico. *Am J Public Health* 2007. 97(2):229-32.
24. Ochoa H, García R, García E. Analysing Mexico's Oportunidades from health system research perspective: The case of the rural state of Chiapas SOUTH México. Reports on 9th° Global Forum for Health Research: Poverty, Equity and Health Research, Mumbai, India 2005:12-16.
25. Rivera-Dommarco JA, Cuevas-Nasu L, González de Cosío T, Shamah-Levy T, García-Feregrino R. Desnutrición crónica en México en el último cuarto de siglo: análisis de cuatro encuestas nacionales. *Salud Pública Mex* 2013; 55 supl 2:S161-S169.
26. Fondo de las Naciones Unidas para la Infancia. Progreso para la Infancia: un mundo apropiado para los niños y niñas. Base mundial de datos UNICEF, 2006. Disponible en: <http://www.unicef.org/spanish/progressforchildren/2007n6/>
27. Coyote N. Trastornos de la alimentación. Obesidad en niños. *Gac Méd Méx*. 2009; 145(4):313-7.
28. Rivera J, Barquera S, Campirano F, Campos I, Safdie M, Tovar V. Epidemiological and nutritional transition in Mexico: rapid increase of non-communicable chronic diseases and obesity. *Public Health Nutr* 2002; 5:113-22.
29. Victora C, Adair L, Fall C, Hallal P, Martorell R, Richter L. et al. Maternal and child undernutrition: consequences for adult health and human capital. *Lancet* 2008; 371: 340-357.
30. Camilleri AP. The obstetric significance of short stature. *European Journal of Obstetrics & Gynecology and Reproductive Biology* 1981; 12:347-356.
31. Martorell R, Melgar P, Maluccio J, Ayreh D, Rivera J. The nutrition intervention improved adult human capital and economic productivity. *J Nutr* 2010; 140: 411-414.
32. Gertler, Paul. Do Conditional Cash Transfers Improve Child Health? Evidence from PROGRESA's Control Randomized Experiment. *American Economic Review* 2004; 94(2):336-341.
33. Behrman, Jere R, John Hoddinott. Programme Evaluation with Unobserved Heterogeneity and Selective Implementation: The Mexican PROGRESA Impact on Child Nutrition. *Oxford Bulletin of Economics and Statistics* 2005; 67(4): 547-569.
34. Rivera J, Sotres-Alvarez D, Habicht J P, Shamah T, Villalpando S. Impact of the Mexican Program for Education, Health, and Nutrition (Progres) on Rates of Growth and Anemia in Infants and Young Children. A randomized effectiveness study. *American Medical Association* 2004; JAMA; 291(21):2563-2570.
35. Neufeld, L, Sotres D, Gertler P, Tolentino L, Jimenez J, Fernald L, et al. Villalpando S, Shamah T, Rivera J. Impact of Oportunidades on Child Growth and Nutritional Status in Rural Communities. External Evaluation of the Impact of the Human Development Program Oportunidades, *Instituto Nacional de Salud Publica* 2004.
36. Fernald L, Gertler P, Neufeld L. 10-year effect of Oportunidades, Mexico's conditional cash transfer programme, on child growth, cognition, language, and behaviour: a longitudinal follow-up study. *LANCET*; 2009; 1997-2005
37. Kramer MS. Determinants of low birth weight: methodological assessment and meta-analysis. *Bull World Health Organ* 1987; 65(5):663-737.
38. Estado Mundial de la Infancia. Ginebra: UNICEF; 1998: 98-10.
39. Leroy JL, Habicht JP, González de Cosío T, R MT. Maternal Education Mitigates the Negative Effects of Higher Income on the Double Burden of Child Stunting and Maternal Overweight in Rural Mexico *J. Nutr* 2014; 144: 765-770.
40. Doak C, Adair L, Bentley M, Monteiro C, Popkin B. The dual burden household and the nutrition transition paradox. *International Journal of Obesity* 2005; 29:129-136.
41. Gurri FD. La doble carga de la transición nutrimental en zonas rurales de la Península de Yucatán, ¿consecuencia de la alteración de los sistemas agrícolas de subsistencia tradicionales en la segunda mitad del siglo XX? En: Muñoz- Cano JM Obesidad: Problema Multifactorial. (Coord) Septiembre 2011:65-84.
42. Arroyo P, Fernandez V, Loria A, Pardio J, Laviaga H, Vargas-Ancona L, Ward R. Obesity, body morphology, and blood pressure in urban and rural population groups of Yucatan. *Salud Publica de Mex* 2007; 49:274-285.
43. Malina et al., 2007. Malina R, Peña M, Tan S, Buschang P, Little B. Overweight and obesity in rural Amerindian population in Oaxaca, southern Mexico, 1968-2000. *American Journal of Human Biology* 2007; 19:711-721.



Original/Otros

Design of quality indicators for oral nutritional therapy

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Abstract

Objective: quality indicators in nutritional therapy (NT) have been proposed as useful tools to improve clinical NT. This study was conducted to develop feasible quality indicators in oral nutritional therapy (QIONTs) to aid quality control.

Methods: a Clinical Nutrition Task Force composed of Brazilian NT experts from the International Life Science Institute (ILSI) developed QIONTs. In an internet-based psychometric survey, 40 independent Brazilian NT practitioners assessed four attributes (simplicity, utility, objectivity, and low cost) of each QIONT using a five-point Likert scale.

Results: independent NT experts consistently classified all 12 QIONTs developed by the ILSI team as good (mean Cronbach's alpha = 0.84). In ranked order, the QIONTs enable assessment of the frequency of nutritional screening, oral nutritional supplementation (ONS) prescription to malnourished patients receiving an oral diet, ONS prescription to patients receiving an oral diet but at risk of malnutrition, nutritional assessment, adherence to ONS regime, hospitalized patients with insufficient oral dietary intake and ONS prescription, ICU patients with insufficient oral dietary intake and ONS prescription, oral intake assessment in ICU patients, oral intake assessment in ward patients, oral supplement volume intolerance due to inappropriate offering time, ONS flavor intolerance, and ONS volume intolerance.

Conclusion: twelve potentially feasible new QIONTs were developed and approved for clinical practice by experts.

(Nutr Hosp. 2015;31:2692-2695)

DOI:10.3305/nh.2015.31.6.8735

Key words: *Quality indicator. Oral nutritional therapy. Expert opinion. Critical illness.*

DISEÑO DE INDICADORES DE CALIDAD PARA TERAPIA NUTRICIONAL ORAL

Resumen

Objetivo: los indicadores de calidad en la terapia nutricional han sido propuestos como herramientas útiles para mejorar la terapia nutricional (TN). Este estudio pretende diseñar indicadores de calidad de terapia nutricional oral (ICTNO) factibles en el control de calidad de TN oral.

Métodos: el diseño de ICTNO fue realizado por una comisión de nutrición clínica compuesta por brasileños expertos en TN del International Life Science Institute (ILSI). Más tarde, la aprobación de estos ICTNO fue valorada con análisis psicométricos recogiendo las opiniones de otros brasileños dedicados independientemente a la TN (n = 40) vía SurveyMonkey (encuesta por internet). Esta consistió en cuatro atributos valorando cada ICTNO (simplicidad, utilidad, objetividad y bajo precio) seguida de una escala Likert con cinco puntos.

Resultados: los expertos en TN de ILSI proporcionaron el diseño de 12 QIONT, que fueron todos consistentemente (Alfa de Cronbach = 0,84) clasificados como válidos por expertos independientes en NT. Por orden de relevancia, los nuevos ICTNO valoraron: la frecuencia de screening nutricional, la prescripción de suplementos de nutrición oral para pacientes desnutridos que ya reciben dieta oral, la prescripción de suplementos de nutrición oral para pacientes con bajo riesgo nutricional que ya reciben dieta oral, el consejo nutricional, la adhesión al suplemento nutricional oral, los pacientes hospitalizados con dieta oral insuficiente y prescripción de suplementos nutricionales orales, los pacientes de UCI con dieta oral insuficiente y prescripción de suplementos nutricionales orales, el consejo de nutrición oral en pacientes de UCI, el consejo de nutrición oral en pacientes en planta, la intolerancia al volumen de suplemento oral debido a dosificación inadecuada, la intolerancia al sabor del suplemento oral y la intolerancia al volumen de suplemento oral.

Conclusión: según la opinión experta, 12 potenciales y factibles nuevos ICTNO fueron diseñados y aprobados para la práctica clínica.

(Nutr Hosp. 2015;31:2692-2695)

DOI:10.3305/nh.2015.31.6.8735

Palabras clave: *Indicadores de calidad. Terapia nutricional oral. Opinión experta. Enfermedad crítica.*

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Recibido: 29-I-2015.
Aceptado: 3-III-2015.

Introduction

Oral feeding should be the first-choice intervention for hospitalized eutrophic patients. When oral food intake meets only 60–80% of a patient's nutritional needs, however, oral nutritional supplementation (ONS) should be considered¹. ONS is particularly relevant for patients who are losing weight or cannot ingest a sufficient amount of food 5–7 days after hospitalization, but it must be prescribed only to patients with adequate ability to swallow and no esophageal or gastric obstruction².

ONS may provide complete nutritional requirements or, more often, supplement the oral diet when a patient is unwilling or unable to consume sufficient food to meet these requirements¹. Although ONS has been shown to efficiently improve nutritional intake in older adults and patients with various health and eating-related problems, its acceptability and intake are suboptimal in many patients. A variety of factors, such as low appetite level or poor palatability, may interfere with ONS intake^{2,3}.

Quality indicators in oral nutritional therapy (QIONTs) can be used to minimize or better control such variables. QIONTs are important tools for the evaluation of treatment and monitoring of its efficacy, as they enable the identification of possible difficulties and failures related to nutritional care protocols^{4,5}. In this study, QIONTs were developed and assessed with the aim of improving the quality of ONT provided to hospitalized patients.

Methods

This study was performed in two distinct phases.

Phase 1: Development of QIONTs

QIONTs were developed during a meeting of the Clinical Nutrition Task Force, composed of Brazilian experts in NT. This task force is part of the Nutritional Committee of the International Life Science Institute (ILSI), a nonprofit science organization created to “improve public health and well-being by engaging academic, government, and industry scientists in a neutral forum to advance scientific understanding in the areas related to nutrition, food safety, risk assessment, and environment.” These specialists focused on designing feasible QIONTs that could improve compliance with the recommendations of available protocols and guidelines (European, American, and Canadian)^{6–8} for the planning of ONT.

Phase 2: Assessment of QIONTs

Psychometric analysis⁹ was used to assess the QIONTs designed by the ILSI task force. The opinions of 40 independent Brazilian experts and NT practitioners were solicited using an internet-based Survey Monkey designed

specifically for this purpose. Respondents were asked to assess four attributes (simplicity, utility, objectivity, and low cost) of each QIONT using a five-point Likert scale (0 = very bad, 1 = bad, 2 = indifferent, 3 = good, 4 = very good)¹⁰. The final score for each QIONT was obtained by summing scores for the four attributes. Finally, averages values were calculated and each QIONT was classified according to mean attribute values that were up to 25%, 45%, 65%, 85%, and 100% of the total score (4.0) as very bad (0–1.05), bad (1.06–1.85), acceptable (1.86–2.65), good (2.66–3.45), or very good (3.46–4.0), respectively. The consistency and reliability of expert opinions for each indicator were assessed using Cronbach's alpha coefficient with values ≥ 0.5 considered to indicate good concordance¹¹.

Results

Phase 1: Development of QIONTs

The NT specialists developed the following 12 QIONTs: frequency of (1) nutritional screening of hospitalized patients, (2) nutritional assessment of hospitalized patients, (3) oral intake assessment of ward patients, (4) oral intake assessment of intensive care unit (ICU) patients, (5) hospitalized patients with insufficient oral dietary intake and ONS prescription, (6) ONS prescription to patients consuming an oral diet but at risk of malnutrition, (7) ONS prescription to malnourished patients receiving an oral diet, (8) ICU patients with insufficient oral dietary intake and ONS prescription, (9) adherence to ONS regime, (10) ONS flavor intolerance, (11) ONS volume intolerance, and (12) ONS volume intolerance due inappropriate offering time.

Phase 2: Assessment of QIONTs

Independent NT experts classified all 12 QIONTs as very good (first and second ranked QIONTs) or good (Table I). The experts' assessment of QIONT attributes was consistent (Cronbach's $\alpha \geq 0.74$; mean = 0.84).

Discussion

QIONTs may be useful tools for the monitoring of effectiveness of adherence to nutritional protocols and procedures. Effective QIONTs must be objective and easy to apply, and are preferably low cost to allow clinical use¹². In this study, MT experts developed 12 QIONTs and 40 Brazilian specialist NT practitioners assessed their simplicity, utility, objectivity, and low cost.

The Likert scale was used for the assessment of QIONT attributes, to enable QIONT ranking and classification. This method is sensitive for the identifica-

Table I
Evaluation of oral nutritional supplementation quality indicators

<i>Description</i>	<i>Average score</i>	<i>Mean score</i>	<i>Assessment</i>	<i>Cronbach's alpha</i>
Frequency of caring out nutrition screening of hospitalized patients	14.17	3.5	VG	0.78
Frequency of the prescription of oral nutrition supplements for malnourished patients receiving oral diet	13.92	3.48	VG	0.82
Frequency of the prescription of oral nutrition supplements for patients under nutritional risk receiving oral diet	13.80	3.45	G	0.82
Frequency of nutritional assessment in hospitalized patients	13.47	3.37	G	0.74
Frequency of oral nutrition supplement adhesion	13.45	3.37	G	0.80
Frequency of hospitalized patients with insufficient intake of oral diet and prescription of oral nutrition supplements	13.42	3.35	G	0.81
Frequency of ICU patients with insufficient intake of oral diet and prescription of oral nutrition supplements	13.32	3.33	G	0.86
Frequency of oral intake assessment in ICU patients	12.75	3.19	G	0.85
Frequency of oral intake assessment in ward patients	12.45	3.11	G	0.89
Frequency of oral supplement intolerance due inappropriate offering time	11.55	2.89	G	0.93
Frequency of oral supplement's flavor intolerance	11.53	2.88	G	0.84
Frequency of oral supplement's volume intolerance	11.50	2.87	G	0.91

Note: VG = very good; G = good.

tion of opposing ratings, gradients, and intermediate situations, with an adequate balance between the precision and accuracy of measurement¹⁰. Cronbach's alpha coefficient was used to assess the consistency and reliability of QIONT attribute scores obtained from psychometric tests¹¹.

NT specialists considered all QIONTs developed in this study to be adequate; "frequency of nutritional screening of hospitalized patients" was ranked first among QIONTs. Over a 10-year period, the Brazilian National Survey of Nutrition¹³ identified prevalent (48.1%) malnutrition among hospitalized patients, associated with high morbidity and mortality rates similar to those reported globally^{14,15}. This situation may explain NT practitioners' consideration of nutritional screening and nutritional assessment (ranked fourth among QIONTs) to be main concerns. In a previous study involving the selection of the top 10 QIONTs for parenteral and enteral NT¹², experts similarly ranked nutritional screening first and considered nutritional assessment to be important. The main advantage of nutritional screening over nutritional assessment may be the ability of screening to detect nutritional risk in patients with apparently adequate nutritional status¹⁶.

NT specialists also considered QIONTs related to ONS prescription to be relevant, ranking them second (for malnourished patients), third (for patients at risk of malnutrition), and fifth (adhesion to ONS regime)

among QIONTs. ONS may benefit malnourished patients, those receiving an oral diet but at risk of malnutrition, and eutrophic patients meeting <60% of their nutritional needs by oral intake¹⁷. However, lack of compliance with ONS intake has been reported worldwide^{18,19}. Thus, QIONTs designed to monitor this nutritional variable may significantly impact patient outcomes.

ONS should be prescribed to any patient with inadequate oral food and fluid intake^{1,2}. Several factors, such as dysphagia, neurological disturbance, and low appetite level, may reduce the oral dietary intake of hospitalized patients²⁰. Assessment of the frequency of hospitalized and ICU patients with insufficient oral dietary intake and ONS prescription (ranked sixth and seventh, respectively, among QIONTs) can be used to correct oral ingestion, achieve nutritional needs, and avoid malnutrition and malnutrition-related complications^{2,3}.

Determination of the frequency of oral intake assessment in ICU and ward patients (ranked eighth and ninth among QIONTs, respectively) were also chosen to compound QIONTs, probably because oral supplementation may negatively impact food intake. Fiatarone (1994) found no increase in total energy intake after 10 weeks in participants receiving ONS compared with control subjects. The authors stated that a high level of compliance with ONS was offset by a reduc-

tion in normal food intake. This intake reduction can negatively impact the effectiveness of NT, and these two QIONTs reflect a main concern regarding the control of food intake in different clinical settings²¹.

Several ONS-related variables may affect patients' tolerance of supplementation hampering the achievement of energy and nutrient targets. These variables include the period in which ONS is offered, the amount of ONS administered, and supplement flavor. To improve patients' tolerance and dietary intake, ONS should be provided between meals (not at meal times), be palatable (milky vanilla-, coffee-, and strawberry/raspberry-flavored supplements are well rated), and be concentrated in a small volume (providing only a short-term satiety effect)^{17,22,24}. As the success of ONT is strongly dependent on patient tolerance^{17,24}, NT specialists considered the assessment of intolerance frequency in relation to offering time, flavor, and volume (ranked tenth, eleventh, and twelfth among QIONTs, respectively) to be of value.

In conclusion, the QIONTs developed in this study can be used to assess the main factors relevant to ONT quality. Given the complexity of ONT, the proposed QIONTs are not meant to address all aspects that may interfere with the quality of this therapy. However, they allow NT practitioners to assess and control factors that can definitely impact the quality of ONT and are constant targets of guidelines, which may explain their consistently good evaluation by the experts consulted.

Acknowledgement

The authors thanks the ILSI Brasil, Clinical Nutrition Task Force, for the continuous support and useful insights.

Declaration of Conflict of Interest

The authors thereby assigned affirm do not have any Conflict of Interest to declare.

References

1. Scott A. Acting on screening results: a guide to treating malnutrition in the community. *Br J Community Nurs* 2008 Oct;13(10):450-6.
2. Milne AC, Potter J, Vivanti A, Avenell A. Protein and energy supplementation in elderly people at risk from malnutrition. *Cochrane Database Syst Rev* 2009; 15: CD003288.
3. Nieuwenhuizen WF, Weenen H, Rigby P, Hetherington MM. Older adults and patients in need of nutritional support: review of current treatment options and factors influencing nutritional intake. *Clin Nutr* 2010 Apr;29(2):160-9.
4. Donabedian A. The quality of care. How can it be assessed? *JAMA* 1988 Sep 23-30;260(12):1743-8. Review.
5. Martín FT, Alvarez HJ, Burgos PR, Celaya PS, Calvo HMV, García de Lorenzo A, et al; Grupo de Trabajo de Gestión

- de SENPE. Analysis of therelevance and feasibility of quality indicators in nutrition support. *Nutr Hosp* 2012 Jan-Feb;27(1):198-204.
6. Singer P, Berger MM, Van den Berghe G, Biolo G, Calder P, Forbes A, et al. ESPEN Guidelines on Parenteral Nutrition: Intensive care. *Clin Nutr* 2009 Aug;28(4):387-400
7. Guenter P. Safe practices for enteral nutrition in critically ill patients. *Crit Care Nurs Clin North Am* 2010 Jun;22(2):197-208
8. Heyland DK, Cahill NE, Dhaliwal R, Sun X, Day AG, McClave SA. Impact of enteral feeding protocols on enteral nutrition delivery: results of a multicenter observational study. *JPEN J Parenter Enteral Nutr* 2010 Nov-Dec;34(6):675-84
9. Braga CG, da Cruz Dde A. Psychometric contributions to the assessment of psychosocial responses in nursing. *Rev Esc Enferm USP* 2006;40(1):98-104.
10. Hulley SB, Cummings SR, Browner WS, Grady DG, Newman TB. Delineando a pesquisa clínica. Uma abordagem epidemiológica. 3. Ed. Porto Alegre: Artmed, 2008. 384p.
11. Bland JM, Altman DG. Cronbach's alpha. *BMJ* 1997;314(7080):572
12. Verotti CC, Torrinhas RS, Cecconello I, Waitzberg DL. Selection of top 10 quality indicators for nutrition therapy. *Nutr Clin Pract* 2012 Apr;27(2):261-7.
13. Waitzberg DL, Caiaffa WT, Correia MI. Hospital malnutrition: the Brazilian national survey (IBRANUTRI): a study of 4000 patients. *Nutrition*. 2001
14. Vanderwee K, Clays E, Bocquaert I, Gobert M, Folens B, Defloor T. Malnutrition and associated factors in elderly hospital patients: A Belgian cross-sectional, multi-centre study. *Clin Nutr* 2010;29:469-76.
15. Pirlich M, Schutz T, Norman K, Gastell S, Lübke HJ, Bischoff SC, et al. The German hospital malnutrition study. *Clin Nutr* 2006;25:563-72
16. Raslan M, Gonzalez MC, Dias MC, Nascimento M, Castro M, Marques P, et al. Comparison of nutritional risk screening tools for predicting clinical outcomes in hospitalized patients. *Nutrition* 2010 Jul-Aug;26(7-8):721-6
17. Weimann A, Braga M, Harsanyi L, Laviano A, Ljungqvist O, Soeters P; DGEM (German Society for Nutritional Medicine), Jauch KW, Kemen M, Hiesmayr JM, Horbach T, Kuse ER, Vestweber KH; ESPEN (European Society for Parenteral and Enteral Nutrition). ESPEN Guidelines on Enteral Nutrition: Surgery including organ transplantation. *Clin Nutr* 2006 Apr;25(2):224-44.
18. Stratton RJ, Bowyer G, Elia M. Food snacks or liquid oral supplements as a first-line treatment for malnutrition in postoperative patients? *Proc Nutr Soc* 2006; 65:4A
19. Hubbard GP, Elia M, Holdoway A, Stratton RJ. A systematic review of compliance to oral nutritional supplements. *Clin Nutr* 2012 Jun;31(3):293-312.
20. Baldwin C, Parsons TJ. Dietary advice and nutritional supplements in the management of illness-related malnutrition: systematic review. *Clin Nutr* 2004;Dec;23(6):1267-79. Review.
21. Fiatarone MA, O'Neill EF, Ryan ND, Clements KM, Solares GR, Nelson ME, Roberts SB, Kehayias JJ, Lipsitz LA, Evans WJ. Exercise training and nutritional supplementation for physical frailty in very elderly people. *N Engl J Med* 1994 Jun 23;330(25):1769-75.
22. Darmon P, Karsegard VL, Nardo P, Dupertuis YM, Pichard C. Oral nutritional supplements and taste preferences: 545 days of clinical testing in malnourished in-patients. *Clin Nutr* 2008 Aug;27(4):660-5.
23. Stubbs RJ, Johnstone AM, Mazlan N, Mbaia SE, Ferris S. Effect of altering the variety of sensorially distinct foods, of the same macronutrient content, on food intake and body weight in men. *Eur J Clin Nutr* 2001 Jan;55(1):19-28.
24. van Nie NC, Meijers JM, Schols JM, Lohrmann C, Spreeuwenberg M, Halfens RJ. Do structural quality indicators of nutritional care influence malnutrition prevalence in Dutch, German, and Austrian nursing homes? *Nutrition* 2014 Nov-Dec;30(11-12):1384-90.



Original/Otros

Asociación entre comportamiento alimentario e hipercolesterolemia-LDL en jóvenes universitarios

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Resumen

Introducción: la hipercolesterolemia-LDL (H-LDL) se asocia a mayor riesgo de enfermedad cardiovascular. La asociación entre H-LDL y alimentación se ha centrado en aspectos nutrimentales. El estudio de la asociación entre el comportamiento alimentario (CA) y la H-LDL en estudiantes universitarios podría brindar elementos de corrección y/o prevención nutricional en esta población.

Objetivo: evaluar la asociación entre CA e H-LDL en estudiantes universitarios.

Métodos: estudio transversal realizado en una muestra de 167 estudiantes de la Universidad Autónoma de Guerrero, México. Se midió el colesterol-LDL sérico, considerándose hipercolesterolemia una concentración ≥ 100 mg/dL. El CA se evaluó mediante un cuestionario previamente validado. La asociación entre CA e H-LDL se determinó con una regresión logística bivariada, ajustando por sexo, edad, nivel socioeconómico, tabaquismo, ingesta de energía, actividad física, presencia o no de obesidad y antecedentes familiares.

Resultados: consumir el almuerzo (colación matutina) se asoció con un 63% de menos riesgo de H-LDL (OR 0,37; 95% IC 0,15, 0,90). Ingerir alimentos fuera de casa una o dos veces a la semana, se asoció con cuatro veces más riesgo de H-LDL (R 5,14; 95% IC 1,12, 23,62). Los sujetos que referían consumir alimentos en exceso (1 o 2, y 3 o más veces/semana) tuvieron mayor riesgo de H-LDL (OR 3,26; 95% IC 1,10, 9,64 y OR 10,52; 95% IC 2,66, 41,60, respectivamente).

Conclusiones: algunos CA habituales de los estudiantes universitarios de Guerrero implican mayor riesgo de

ASSOCIATION BETWEEN FOOD BEHAVIOR AND HYPERCHOLESTEROLEMIA-LDL IN UNIVERSITY STUDENTS

Abstract

Introduction: hypercholesterolemia-LDL (H-LDL) is associated with increased risk of cardiovascular disease. The association between H-LDL and feeding has focused on nutritional aspects. The study of the association between eating behavior (EB) and H-LDL in university students, could provide nutritional elements for correction and/or prevention in this population.

Objective: to assess the association between EB and H-LDL in university students.

Methods: a cross-sectional study was carried out in a sample of 167 students from the Autonomous University of Guerrero, Mexico. LDL cholesterol in serum was measured and a concentration ≥ 100 mg / dL was considered hypercholesterolemia. The EB was assessed using a previously validated questionnaire. The association between EB and H-LDL was determined with a bivariate logistic regression, adjusting for sex, age, socioeconomic status, smoking, energy intake, physical activity, presence or absence of obesity and family history.

Results: eating lunch (morning snack) was related with 63% lower risk of H-LDL (OR 0.37; 95% CI 0.15, 0.90). Take food away from home once or twice a week was associated with a fourfold increased risk of H-LDL (R 5.14; 95% CI 1.12, 23.62). Subjects who reported consuming excess food (1 or 2, and 3 or more times/week) had higher risk of H-LDL (OR 3.26; 95% CI 1.10, 9.64 and OR 10.52; 95% CI 2.66, 41.60 respectively).

Conclusions: some usual EB of the university students (Guerrero, Mexico) involve greater risk of H-LDL. To

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Recibido: 19-II-2015.

Aceptado: 23-III-2015.

H-LDL. Por ello, promover acciones correctivas y/o preventivas centradas en estos CA podría mejorar la salud de esta población.

(*Nutr Hosp.* 2015;31:2696-2702)

DOI:10.3305/nh.2015.31.6.8806

Palabras clave: *Comportamiento alimentario. Hipercolesterolemia. Colesterol-LDL. Estudiantes universitarios.*

encourage actions corrective and/or preventive focused on these EB, could improve the health of this population.

(*Nutr Hosp.* 2015;31:2696-2702)

DOI:10.3305/nh.2015.31.6.8806

Key words: *Food behavior. Hypercholesterolemia. LDL cholesterol. College students.*

Abreviaturas

CA: Comportamiento alimentario.
c-LDL: Colesterol-LDL.
IMC: Índice de Masa Corporal.
H-LDL: Hipercolesterolemia-LDL.
LDL: Del inglés *Low Density Lipoproteins*.

Introducción

Estudios epidemiológicos previos muestran que el aumento en la concentración sanguínea de LDL (del inglés *Low Density Lipoproteins*) se asocia con riesgo elevado de infarto aterotrombótico o enfermedad coronaria¹⁻². El aumento en la concentración de c-LDL se encuentra mediado por factores tales como: sobrepeso, dieta, sedentarismo, consumo de tabaco y alcohol, entre otros². Recientemente, diversos componentes dietéticos se han asociado con alteraciones en la concentración de c-LDL, principalmente la proporción de macronutrientes, el consumo de diferentes patrones de alimentación y de algunos nutrientes específicos³⁻⁴; por ejemplo, la ingestión elevada de grasas saturadas y *trans*, así como la baja cantidad de fibra en la dieta, se han asociado con aumento en la concentración de c-LDL⁵. Sin embargo, la relación entre la concentración de c-LDL y el comportamiento alimentario (CA) ha sido poco estudiada. Específicamente se ha analizado la asociación entre la concentración de c-LDL y la omisión de tiempos de comida, el consumo de aperitivos y de comida en restaurantes⁶⁻¹⁴; solamente uno de los estudios que analiza esta asociación ha sido realizado en universitarios¹¹. La identificación de los comportamientos alimentarios asociados a alteraciones en el perfil metabólico en los estudiantes universitarios permitirá, en sinergia con los conocimientos derivados de los estudios nutrimentales, impulsar estrategias específicas para el desarrollo de programas de promoción a la salud, adecuados a esta población, con el fin de favorecer una alimentación más saludable y, consecuentemente lograr una población estudiantil sana a corto y largo plazo.

El objetivo de este estudio fue determinar la asociación entre el CA y la hipercolesterolemia-LDL (H-LDL) en estudiantes universitarios.

Métodos

Participantes y colección de datos

El presente estudio transversal colaborativo se realizó de mayo a octubre del 2012, en la Universidad Autónoma de Guerrero, México. Se invitó a participar a través de anuncios y módulos de información a todos los estudiantes que tuvieran entre 18 y 28 años de edad con un Índice de Masa Corporal (IMC) normal o con obesidad, según criterios de la Organización Mundial de la Salud¹⁵. La selección de la muestra fue no probabilística. El estudio fue aprobado por el comité de ética del Centro Universitario de Ciencias de la Salud de la Universidad de Guadalajara y todos los participantes firmaron un consentimiento bajo información.

Mediciones

A través de una entrevista, se obtuvieron datos sociodemográficos y antecedentes patológicos familiares y personales. La actividad física se evaluó mediante la versión corta auto-administrada en español del Cuestionario Internacional de Actividad Física¹⁶. El CA se valoró con un cuestionario auto-aplicable previamente validado¹⁷.

El peso se midió con ropa ligera, sin zapatos, en una báscula TANITA® modelo TBF 300A. La talla se midió con un estadímetro portátil marca SECA® BM-214. El IMC se calculó con el peso (kilogramos) dividido por el cuadrado de la talla (metros). A todos los participantes se les realizó una extracción de sangre tras ayuno de 12 horas y se determinó la concentración de colesterol-LDL mediante un método directo, enzimático colorimétrico (Spinreact®). Se consideró como hipercolesterolemia, un valor de LDL ≥ 100 mg/dL².

Análisis estadístico

El análisis estadístico se realizó con el programa SPSS versión 14.0 (Chicago, IL). Las variables cuantitativas se expresaron como media y desviación estándar y, las cualitativas como frecuencia y porcentaje. Se utilizó la prueba chi-cuadrada para valorar dife-

rencias entre las variables cualitativas y se consideró como significativo un valor de $p < 0.05$. La asociación entre CA e H-LDL se determinó a través de regresión logística bivariada, ajustando por sexo, edad, nivel socioeconómico, consumo de tabaco, ingesta total de energía, actividad física, presencia o no de obesidad y, antecedentes familiares de obesidad, dislipidemia y enfermedad cardiovascular. La asociación se consideró significativa cuando ambos valores del intervalo de confianza se encontraron por arriba o por debajo de la unidad.

Resultados

Características generales de la población

De 302 jóvenes que inicialmente cumplieron con los criterios de inclusión, 140 declinaron su participación, la mayoría por falta de tiempo, por lo que se incluyeron en el análisis 162 voluntarios.

Las características generales de los participantes en el estudio se muestran en la tabla I. La edad promedio de la muestra fue de 21 años. La mayoría de los participantes fueron mujeres (58.6%), solteros (96.2%) y de nivel socioeconómico medio (79.0%). El promedio de IMC fue 26.89 ± 6.74 ; la mayoría de los sujetos presentaron normopeso (59.9%) y el resto, obesidad. Los antecedentes patológicos familiares predominantes fueron: diabetes (64.8%), obesidad (56.2%), hipertensión arterial (42.0%) y dislipidemia (41.4%). Los antecedentes patológicos personales de mayor prevalencia fueron gastritis y estreñimiento (34.6% y 30.2%, respectivamente). La concentración media de LDL de los estudiantes fue 110.28 ± 39.97 mg/dL. Más de la mitad de los voluntarios (56.8%) presentó H-LDL (42.3% de los sujetos con normopeso vs 78.5% de los sujetos con obesidad, $p < 0.001$).

Asociación entre comportamiento alimentario e hipercolesterolemia-LDL

Los comportamientos alimentarios que se evaluaron fueron: el agrado por el consumo de diferentes alimentos, la bebida consumida en mayor cantidad durante el día, los alimentos consumidos entre las comidas principales, la auto-percepción del consumo de alimentos en exceso, la lectura de etiquetas nutrimentales, la preparación de alimentos (tipo y persona responsable), las comidas realizadas habitualmente, los horarios de comida, la configuración de las comidas, los minutos dedicados a cada tiempo de comida, los motivos para evitar el consumo de un alimento, el consumo de alimentos fuera de casa, el lugar de consulta de consejos de nutrición, el número de dietas realizadas para perder peso, la razón por la cual no se mejora la alimentación y, lo que se suele hacer al sentirse satisfecho después del consumo de alimentos.

Tabla I
Características generales de la población estudiada.

<i>Características</i>	<i>Total (n=167)</i>	
Edad (años)	21.04	2.00
Concentración de LDL (mg/dL)	110.28	39.97
IMC (kg/m ²)	26.89	6.74
IMC clasificado		
Normopeso	97	59.9
Obesidad	65	40.1
Sexo		
Femenino	95	58.6
Estado civil		
Soltero	156	96.2
Casado	3	1.9
Unión libre	3	1.9
Nivel socioeconómico*		
Medio	128	79.0
Bajo	34	21.0
Nivel de actividad física		
Sedentario	53	32.7
Moderado	83	51.3
Intenso	26	16.0
Antecedentes familiares		
Obesidad	91	56.2
Diabetes mellitus tipo 2	105	64.8
Hipertensión arterial	68	42.0
Enfermedad cardiovascular	35	21.6
Dislipidemia	67	41.4
Antecedentes personales		
Diabetes mellitus tipo 2	2	1.2
Dislipidemia	17	10.5
Hipertensión	5	3.1
Colitis	25	15.4
Gastritis	56	34.6
Estreñimiento	49	30.2
Hipercolesterolemia-LDL		
Muestra total	92	56.8
Sujetos con normopeso	41	42.3
Sujetos con obesidad	51	78.5

Las variables cuantitativas se expresan como media y desviación estándar. Las variables cualitativas se expresan en número y porcentaje. *Ningún estudiante puntuó como nivel socioeconómico alto.

Los estudiantes que reportaron sentir agrado por el consumo de lácteos, tuvieron 65% menos riesgo de presentar H-LDL (OR 0.35; 95% IC 0.14, 0.85) que aquellos que reportaron no sentir agrado por el consumo de los mismo (Tabla II).

Los estudiantes que preferían ingerir agua de fruta o sabor endulzada como bebida principal a lo largo del día, presentaron 2.7 veces más riesgo de tener H-LDL (OR 3.70; 95% IC 1.02, 13.36), comparado con los sujetos que preferían el consumo de agua natural. La selección de refrescos o jugos industrializados para su consumo como bebida principal a lo largo del día no se asoció con H-LDL (Tabla II).

Comparado con los sujetos que reportaron no consumir alimentos en exceso, aquellos que auto-reportaron su consumo en exceso en una frecuencia de una o dos y tres o más veces a la semana presentaron mayor riesgo de H-LDL (una o dos veces/semana OR 3.26; 95% IC 1.10, 9.64 y tres o más veces/semana OR 10.52; 95% IC 2.66, 41.60) (Tabla II).

Los sujetos que ingerían comida fuera de casa en una frecuencia de una o dos veces a la semana tuvieron cuatro veces más riesgo de presentar H-LDL (OR 5.14; 95% IC 1.12, 23.62), comparado con aquellos sujetos que consumían comida fuera de casa sólo una vez al mes (Tabla II).

Se observó que los sujetos que consumían habitualmente el almuerzo (colación matutina) presentaron significativamente menor riesgo de H-LDL (OR 0.37; 95% IC 0.15, 0.90) que los sujetos que no lo consumían. El consumo habitual del desayuno, comida, merienda (colación vespertina) o cena no se asoció con la H-LDL (Tabla II).

Los estudiantes que habían realizado una o dos dietas para perder peso a lo largo de su vida, tuvieron mayor riesgo de presentar H-LDL (OR 3.84; 95% IC 1.39, 10.60), que aquellos estudiantes que nunca habían realizado alguna dieta para perder peso (Tabla II).

Los estudiantes que consideraban que la razón por la que no mejoraban su alimentación era la falta de dinero tuvieron 77% menos riesgo de H-LDL (OR 0.23; 95% IC 0.06, 0.96), comparado con los estudiantes que consideraban que la razón era la falta de compromiso (Tabla II).

No se observaron asociaciones significativas entre la presencia de H-LDL y el resto de los comportamientos alimentarios evaluados (resultados no mostrados).

Discusión

En este estudio se encontró asociación entre el CA y la H-LDL después de ajustar por sexo, edad, nivel socioeconómico, consumo de tabaco, ingesta total de energía, actividad física, IMC y, antecedentes familiares de obesidad, dislipidemia y enfermedad cardiovascular. Entre estas variables de ajuste la actividad física se asoció negativamente y la presencia de obesidad y de antecedentes familiares de dislipidemia positiva-

mente, con la presencia de H-LDL. Algunos CA se asociaron con menor riesgo de H-LDL, estos fueron: el consumo habitual del almuerzo (colación matutina), tener agrado por el consumo de lácteos y percibir la falta de dinero como razón para no mejorar la alimentación. Por el contrario, el consumo de agua de fruta o sabor como bebida principal a lo largo del día, la auto-percepción del consumo de alimentos en exceso, la frecuencia de consumo fuera de casa y el haber realizado alguna dieta para bajar de peso, se asociaron con mayor riesgo de presentar H-LDL.

La asociación entre el CA y la salud ha sido previamente estudiada. Principalmente, se ha enfocado en la relación entre algunos CA (omisión del desayuno, consumo de aperitivos y de alimentos fuera de casa) y la obesidad en niños y adolescentes¹⁸⁻¹⁹. El presente trabajo, es uno de los primeros que analiza la asociación entre el CA y la presencia de alteraciones en las concentraciones de c-LDL en estudiantes universitarios¹¹.

Concretamente, este estudio es el primero que evidencia menor riesgo de H-LDL en aquellos estudiantes que consumen almuerzo (colación matutina) habitualmente. En la literatura hay estudios que han valorado el consumo de tiempos de comida y su asociación con la concentración de c-LDL^{6-7,10,12-14}, sin embargo, lo han hecho en otros grupos poblacionales, como adolescentes y adultos mayores de 40 años, y la mayoría se han centrado en el desayuno sin explorar otros tiempos de comida, encontrando resultados controvertidos (asociación positiva con la omisión del desayuno^{10,12-13} y de la cena⁷, no asociación con el consumo de desayuno^{6,7,14}, la comida o la merienda⁷). Uno de los mecanismos que podría explicar la asociación entre el consumo de almuerzo y la H-LDL es que al haber una mayor cantidad de tiempos de consumo regular de alimentos durante el día, disminuye la concentración sérica de insulina y secundariamente se reduce la actividad de la enzima hidroximetilglutaril CoA-reductasa; como resultado el organismo produce menos colesterol y el hígado produce más receptores de LDL disminuyendo así su concentración sérica²⁰⁻²².

Otro resultado relevante del presente trabajo, fue que se observó menor riesgo de H-LDL en aquellos sujetos que reportaron sentir preferencia o agrado por el consumo de lácteos. En la literatura no se encontraron publicaciones previas que hayan analizado esta asociación, no obstante los estudios que se han enfocado en la ingestión de lácteos y la concentración de c-LDL han observado en su mayoría falta de asociación²⁴⁻²⁷. A pesar de esto algunos autores han propuesto la posibilidad de que el consumo de lácteos favorezca la disminución en la concentración de c-LDL a través del aumento en la ingestión de calcio: al unirse el calcio a los ácidos grasos saturados o a los ácidos biliares en el intestino, disminuiría la absorción de ácidos grasos y, consecuentemente, la concentración de LDL sérica²⁸⁻²⁹.

En la misma línea, se encontró menor riesgo de H-LDL en aquellos sujetos que percibían la falta de di-

Tabla II
Comportamiento alimentario y su asociación con concentraciones elevadas de LDL-c.

<i>Comportamientos</i>	<i>Colesterol LDL elevado (LDL $\geq$ 100 mg/dL)</i>	
	<i>OR</i>	<i>95% IC</i>
^b Agrado por:		
Frutas	0.25	0.59, 1.10
Verduras	1.01	0.47, 2.17
Carnes	0.83	0.32, 2.14
Pescados y mariscos	1.09	0.52, 2.29
Lácteos	0.35	0.14, 0.85
Cereales	3.05	0.80, 11.70
Leguminosas	0.69	0.31, 1.54
Dulces, pasteles, chocolates	1.68	0.79, 3.58
Huevo	1.13	0.53, 2.42
Bebida que consume en mayor cantidad durante el día		
Agua natural ^a		
Agua de fruta o sabor endulzada	3.70	1.02, 13.36
Refresco, jugos industrializados	2.46	0.82, 7.33
Frecuencia de consumo de comida en exceso		
Nunca o casi nunca ^a		
Una o dos veces por semana	3.26	1.10, 9.64
Tres o más veces por semana	10.52	2.66, 41.60
^c Consumo de tiempos de comida:		
Desayuno	1.55	0.70, 3.42
Almuerzo (colación matutina)	0.37	0.15, 0.90
Comida	0.86	0.26, 2.85
Merienda (colación vespertina)	0.76	0.35, 1.69
Cena	1.13	0.53, 2.42
Frecuencia de consumo de comida fuera de casa		
Una vez al mes ^a		
5 o más veces a la semana	2.75	0.68, 11.08
3 a 4 veces a la semana	1.18	0.28, 4.89
1 ó 2 veces a la semana	5.14	1.12, 23.62
Una vez cada 15 días	2.51	0.50, 12.59
Número de dietas para bajar de peso que ha realizado a lo largo de su vida		
Ninguna ^a		
1 o 2	3.84	1.39, 10.60
3 o más	2.15	0.54, 8.51
Qué consideran que les falta para mejorar su alimentación		
Compromiso conmigo mismo ^a		
Más información	0.95	0.29, 3.14
Apoyo profesional	1.89	0.65, 5.51
Dinero	0.23	0.06, 0.96

Regresión logística bivariada ajustada por sexo, edad, nivel socioeconómico, consumo de tabaco, ingesta total de energía, actividad física, presencia o no de obesidad, y antecedentes familiares de obesidad, dislipidemia y enfermedad cardiovascular.

^aCategoría de referencia.

^bSe consideró como referencia el "no agrado" por cada uno de los alimentos.

^cSe consideró como referencia la omisión en ese tiempo de comida.

p<0.05 se consideró como significativa.

nero como razón por la cual no mejoraba su alimentación. La percepción de la falta de dinero podría implicar que los estudiantes no tienen suficientes recursos económicos para alimentarse, propiciando periodos de escasas alimentaria que conllevan una reducción en la ingesta de alimentos, energía total y nutrimentos, lo cual podría explicar al menos en parte el menor riesgo de H-LDL en estos sujetos³⁶.

En contraste, en el presente trabajo algunos comportamientos alimentarios fueron asociados con mayor riesgo de H-LDL. Se observó mayor riesgo de H-LDL en aquellos sujetos que seleccionaban el agua de fruta o sabor para su consumo como bebida principal durante el día. En algunos estudios previos se ha observado asociación positiva entre el consumo de bebidas azucaradas y la concentración de c-LDL³⁰⁻³¹. La ingestión de bebidas endulzadas se acompaña frecuentemente del consumo de patrones de alimentación poco saludables caracterizados por la elevada ingesta de comida rápida, bocadillos y alimentos ricos en energía y grasa, componentes de la alimentación que favorecen el aumento en la concentración de c-LDL^{2,32}.

El consumo de alimentos fuera de casa en una frecuencia de una a dos veces a la semana se asoció con mayor riesgo de H-LDL. En la literatura se encontraron dos estudios en los que se evaluó previamente la asociación entre el consumo fuera de casa y la concentración de c-LDL, en adultos mayores de 40 años, sin observar asociación significativa^{7,9}. La asociación encontrada en el presente trabajo podría deberse a que el consumo fuera de casa suele caracterizarse por la ingesta de alimentos procesados, con alto contenido de energía, grasa total de baja calidad (polinsaturada expuesta a altas temperaturas), así como con poca o nula cantidad de fibra y pobre densidad nutricional en general, estos factores de la alimentación han sido implicados en el aumento en la concentración sérica de c-LDL^{2,9,23}.

En la literatura, no se encontraron estudios que evalúen la asociación entre la H-LDL y la auto-percepción del consumo de comida en exceso y la realización de dietas para perder peso. En el presente trabajo se encontró asociación significativa en dichas relaciones en la población evaluada. El consumo de alimentos en exceso puede llevar a un consumo elevado de energía, grasa y azúcares generando mayor riesgo de H-LDL. Además, la gran mayoría de los sujetos que siguen dietas restrictivas para perder peso, sin un acompañamiento conductual adecuado, regresan rápidamente a sus pasados hábitos de alimentación³³, que en el caso de los jóvenes se caracterizan por el bajo consumo de frutas y verduras, así como por el elevado consumo de alimentos procesados y con altas cantidades de grasa y colesterol³⁴⁻³⁵, componentes de la alimentación que pueden favorecer el aumento en la concentración de c-LDL.

La principal limitación de este estudio es inherente al diseño de tipo transversal, la selección de los voluntarios y la representatividad de la población que no

permite establecer relaciones de causalidad entre el CA y la H-LDL. Futuros estudios de diseño prospectivo podrán confirmar o establecer relaciones más específicas entre el CA y la H-LDL. No obstante, la fortaleza y originalidad de este trabajo radica en la evaluación de asociaciones de comportamientos alimentarios e H-LDL antes poco exploradas, lo cual genera nuevos conocimientos de la población universitaria.

En conclusión, en este estudio diferentes comportamientos alimentarios se asociaron con la presencia de H-LDL. Al ser estos comportamientos modificables su evaluación en las instituciones universitarias direccionará el diseño e implementación de acciones de intervención alimentario-nutricional sencillas, prácticas y pertinentes para promover un CA más saludable en los estudiantes, no solo para Guerrero (uno de los estados de México con prevalencias altas de sobrepeso), sino para toda las comunidades universitarias con contextos similares. Estas acciones en sinergia con la implementación de programas de promoción de actividad física, podrían contribuir a la disminución de riesgos de presentar H-LDL y obesidad, factores que pueden favorecer el desarrollo de una enfermedad cardiovascular a mediano o largo plazo.

Agradecimientos

El presente estudio es fruto del trabajo colaborativo entre el Cuerpo Académico 454 (LEEN) del Departamento de Reproducción Humana, Crecimiento y Desarrollo Infantil del CUCS de la UdG y el Laboratorio de Investigación en Obesidad y Diabetes de la Unidad Académica de Ciencias Químico Biológicas de la UAG.

Agradecemos al Fondo Mixto CONACYT (*Consejo Nacional de Ciencia y Tecnología*)-Estado de Guerrero, que brindó el financiamiento para la realización de esta investigación en el marco del proyecto de Fortalecimiento del Doctorado en Ciencias Biomédicas de la UAG, para su ingreso al Programa Nacional de Posgrados de Calidad en el año 2010. Asimismo, agradecemos al Comité de Ética del CUCS de la UdG por la evaluación del presente proyecto.

Este proyecto no hubiera podido realizarse sin la valiosa colaboración de Mónica Miramontes Salazar (UdG) y de Luz Elena Ramos Arellano (UAG) así como de todos los colaboradores del Laboratorio de Investigación en Obesidad y Diabetes que aportaron su invaluable apoyo para la realización del trabajo de campo del proyecto. Obviamente, reiteramos nuestro agradecimiento a todos los participantes voluntarios que completaron las pruebas solicitadas.

Referencias

1. Imamura T, Doi Y, Arima H, Yonemoto K, Hata J, Kubo M. LDL colesterol and the development of stroke subtypes and

- coronary heart disease in a general Japanese population: the Hisayama study. *Stroke* 2009;40(2):382-8.
2. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third report of the National Education (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation* 2002;106(25):3143-421.
3. Kelishadi R, Pour MH, Zadegan NS, Kahbazi M, Sadry G, Amani A, et al. Dietary fat intake and lipid profiles of Iranian adolescents: Isfahan Healthy Heart Program--Heart Health Promotion from Childhood. *Prev Med* 2004;39(4):760-6.
4. Olinto MTA, Gigante DP, Horta B, Silveira V, Oliveira I, Willett W. Major dietary patterns and cardiovascular risk factors among young Brazilian adults. *Eur J Nutr* 2012;51(3):281-91.
5. Brouwer IA, Wanders AJ, Katan MB. Effect of animal and industrial trans fatty acids on HDL and LDL cholesterol levels in humans--a quantitative review. *PLoS One*. 2010;5(3):e9434.
6. Nakanishi N, Nakamura K, Suzuki K, Tatara K. Lifestyle and the development of dyslipidemia: a 4-year follow-up study of middle-aged Japanese male office workers. *Environ Health Prev Med* 1999;4(3):140-5.
7. Overby NC, Margeirsdottir HD, Brunborg C, Dahl-Jorgensen K, Andersen LF, Norwegian Study Group for Childhood Diabetes. Sweets, snacking habits, and skipping meals in children and adolescents on intensive insulin treatment. *Pediatr Diabetes* 2008;9(4 Pt 2):393-400.
8. Duffey KJ, Gordon-Larsen P, Steffen LM, Jacobs DR Jr, Popkin BM. Regular consumption from fast food establishments relative to other restaurants is differentially associated with metabolic outcomes in young adults. *J Nutr* 2009;139(11):2113-8.
9. Smith KJ, Blizzard L, McNaughton SA, Gall SL, Dwyer T, Venn AJ. Takeaway food consumption and cardio-metabolic risk factors in young adults. *Eur J Clin Nutr* 2012;66(5):577-84.
10. Smith KJ, Gall SL, McNaughton SA, Blizzard L, Dwyer T, Venn AJ. Skipping breakfast: longitudinal associations with cardiometabolic risk factors in the Childhood Determinants of Adult Health Study. *Am J Clin Nutr* 2010;92(6):1316-25.
11. Vergetaki A, Linardakis M, Papadaki, Kafatos A. Presence of metabolic syndrome and cardiovascular risk factors in adolescents and University students in Crete (Greece), according to different levels of snack consumption. *Appetite* 2011;57(1):278-85.
12. Deshmukh-Taskar P, Nicklas TA, Radcliffe JD, O'Neil CE, Liu Y. The relationship of breakfast skipping and type of breakfast consumed with overweight/obesity, abdominal obesity, other cardiometabolic risk factors and the metabolic syndrome in young adults. The National Health and Nutrition Examination Survey (NHANES): 1999-2006. *Public Health Nutr* 2013;16(11):2073-82.
13. Hallström L, Labayen I, Ruiz JR, Patterson E, Vereecken CA, Breidenassel C, et al. Breakfast consumption and CVD risk factors in European adolescents: the HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) Study. *Public Health Nutr* 2013;16(7):1296-1305.
14. Shafiee G, Kelishadi R, Qorbani M, Motlagh ME, Taheri M, Ardalan G, et al. Association of breakfast intake with cardiometabolic risk factors. *J Pediatr (Rio J)* 2013;89(6):575-82.
15. WHO: Global database on body mass index and interactive surveillance tool for monitoring nutritional transition [Internet]. Ginebra: World Health Organization. BMI classification; actualizado 17 Sep 2014 [citado 17 sep 2014]; [aproximadamente 3 pantallas]. Disponible en: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html
16. IPAQ: Downloadable questionnaires [Internet]. Estocolmo: International Physical Activity Questionnaire. IPAQ Spanish self-administered short: actualizado 23 ene 2011 [citado 13 sep 2014]; [aproximadamente 6 pantallas]. Disponible en: https://sites.google.com/site/theipaq/questionnaire_links
17. Márquez-Sandoval YF, Salazar-Ruiz EN, Macedo-Ojeda G, Altamirano-Martínez MO, Bernal-Orozco MF, Salas-Salva-
- dó, et al. Diseño y validación de un cuestionario para evaluar el comportamiento alimentario en estudiantes mexicanos del área de la salud. *Nutr Hosp* 2014;30(1):153-64.
18. Mesas AE, Muñoz-Pareja M, López-García E, Rodríguez-Artalejo F. Selected eating behaviours and excess body weight: a systematic review. *Obes Rev* 2012;13(2):106-35.
19. Thibault H, Carrière C, Langevin C, Kossi Déti E, Barberger-Gateau P, Maurice S. Prevalence and factors associated with overweight and obesity in French primary-school children. *Public Health Nutr* 2013;16(2):193-201.
20. Arnold LM, Ball MJ, Duncan AW, Mann J. Effect of isoenergetic intake of three or nine meals on plasma lipoproteins and glucose metabolism. *Am J Clin Nutr* 1993;57(3):446-51.
21. Mann J. Meal frequency and plasma lipids and lipoproteins. *Br J Nutr* 1997;77(Suppl 1):S83-90.
22. Farshchi HR, Taylor MA, Macdonald IA. Regular meal frequency creates more appropriate insulin sensitivity and lipid profiles compared with irregular meal frequency in healthy lean women. *Eur J Clin Nutr* 2004;58(7):1071-7.
23. Lachat C, Nago E, Verstraeten R, Roberfroid D, Van Camp J, Kolsteren P. Eating out of home and its association with dietary intake: a systematic review of the evidence. *Obes Rev* 2012;13(4):329-46.
24. Kai SHY, Bongard V, Simon C, Ruidavets JR, Arveiler D, Dallongeville J, et al. Low-fat and high-fat dairy products are differently related to blood lipids and cardiovascular risk score. *Eur J Prev Cardiol* 2013; Epub ahead of print.
25. Benatar JR, Sidhu K, Stewart RA. Effects of high and low fat dairy food on cardio-metabolic risk factors: a meta-analysis of randomized studies. *PLoS One* 2013;8(10):e76480.
26. Fornés NS, Martins IS, Hernan M, Velásquez-Meléndez G, Asherio A. Frequency of food consumption and lipoprotein serum levels in the population of an urban area, Brazil. *Rev Saude Publica*. 2000;34(4):380-7. Fe de erratas en: *Rev Saude Publica* 2006;40(3):558.
27. Chi D, Nakano M, Yamamoto K. Milk and milk products consumption in relation to serum lipid levels: a community-based study of middle-aged and older population in Japan. *Cent Eur J Public Health* 2004;12(2):84-7.
28. Denke MA, Fox MM, Schulte MC. Short-term dietary calcium fortification increases fecal saturated fat content and reduces serum lipids in men. *J Nutr* 1993;123(6):1047-53.
29. van Meijl LE, Vrolix R, Mensink RP. Dairy product consumption and the metabolic syndrome. *Nutr Res Rev* 2008;21(2):148-57.
30. Duffey KJ, Gordon-Larsen P, Steffen LM, Jacobs DR Jr, Popkin BM. Drinking caloric beverages increases the risk of adverse cardiometabolic outcomes in the Coronary Artery Risk Development in Young Adults (CARDIA) Study. *Am J Clin Nutr* 2010;92(4):954-9.
31. Bortsov AV, Liese AD, Bell RA, Dabelea D, D'Agostino RB Jr, Hamman RF, et al. Sugar-sweetened and diet beverage consumption is associated with cardiovascular risk factor profile in youth with type 1 diabetes. *Acta Diabetol* 2011;48(4):275-82.
32. Duffey KJ, Popkin BM. Adults with healthier dietary patterns have healthier beverage patterns. *J Nutr* 2006;136(11):2901-7. Fe de erratas en: *J Nutr* 2010;140(6):1189.
33. Hill JO, Thompson H, Wyatt H. Weight maintenance: what's missing?. *J Am Diet Assoc* 2005; 105(5 Suppl 1):S63-6.
34. Martínez-Roldán C, Herreros V, López de Andrés A, Cobos-Sanz JM, Carbajal-Azcona A. Evaluación del estado nutricional de un grupo de estudiantes universitarios mediante parámetros dietéticos y de composición corporal. *Nutr Hosp* 2005;20(3):197-203.
35. Becerra-Bulla F, Pinzón-Villate G, Vargas-Zárate M. Estado nutricional y consumo de alimentos de estudiantes universitarios admitidos a la carrera de medicina. *Rev Fac Med* 2012;60(Suppl 1):S3-12.
36. Shariff ZM, Sulaiman N, Jalil RA, Yen WC, Yaw YH, Taib MN, et al. Food insecurity and the metabolic syndrome among women from low income communities in Malaysia. *Asia Pac J Clin Nutr* 2014;23(1):138-47.



Original/Otros

The understanding, attitude and use of nutrition label among consumers (China)

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Abstract

Objective: the aim of this study was to investigate the understanding, attitude and use of nutrition label among consumers in china.

Methods: a cross-sectional survey with a self-structured questionnaire was conducted among 1153 consumers, who were recruited from different supermarkets during March to May 2014 in Wuhu city of china.

Results: the result shows that the subjective understanding of nutrition labels was moderate (62.8% of respondents) but the objective understanding was varied. The attitudes toward nutrition label was positive in participates who had a higher confidence and satisfaction of nutrition label. 59.2% of the respondents indicated 'sometimes' and 28.7% 'always' reading nutrition label. The most frequently reading of nutrition label food was milk (57.5%), followed by infant food (33.3%), and nutrient was protein 51.5%, vitamin (49.8%) and fat (29.4%). None of demographic characteristics was associated with the understanding, attitude and use of nutrition label except education.

Conclusions: participates of our study had a moderate understanding, positive attitude and higher frequent using nutrition label. Although the code of nutrition label became mandatory, more additional strategies for nutrition label are still needed, so as to improve consumers' the cognition of nutrition label.

(Nutr Hosp. 2015;31:2703-2710)

DOI:10.3305/nh.2015.31.6.8791

Key words: Nutrition label. Understanding. Attitude. Use.

EL CONOCIMIENTO, LA ACTITUD Y EL USO DE LA ETIQUETA NUTRICIONAL ENTRE LOS CONSUMIDORES (CHINA)

Resumen

Objetivo: el objetivo de este estudio fue investigar el conocimiento, la actitud y el uso de la etiqueta nutricional entre los consumidores en China.

Métodos: estudio transversal con un cuestionario estructurado que fue realizada entre 1.153 consumidores, que fueron reclutados a partir de diferentes supermercados durante marzo a mayo de 2014 en la ciudad de Wuhu de China.

Resultados: el resultado muestra que la comprensión subjetiva de las etiquetas nutricionales fue moderada (el 62,8% de los encuestados), pero el objetivo entendimiento fue variado. Las actitudes hacia la etiqueta nutricional fueron positivas en aquellos participantes con mayor confianza y satisfacción en las mismas. Respecto a la lectura de las etiquetas, el 59,2 % de los encuestados contestó que "a veces" y el 28,7 % que "siempre". La lectura de la etiqueta nutricional de alimentos que con mayor frecuencia se realizó fue la de la leche (57,5%), seguida por la alimentación infantil (33,3%), proteínas y nutrientes (51,5%), vitaminas (49,8%) y grasas (29,4%). Ninguna de las características demográficas se asoció con el conocimiento, la actitud y el uso de la etiqueta nutricional, excepto la educación.

Conclusiones: Las personas que participaron en nuestro estudio tenían una comprensión moderada, mostrando una actitud más positiva aquellos que la utilizan con más frecuencia. Aunque la etiqueta nutricional se convirtió en obligatoria, aún son necesarias estrategias adicionales, así como fomentar su conocimiento por parte de los consumidores.

(Nutr Hosp. 2015;31:2703-2710)

DOI:10.3305/nh.2015.31.6.8791

Palabras clave: Etiqueta nutricional. La actitud de comprensión.

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Recibido: 31-I-2015.
Aceptado: 3-III-2015.

Introduction

Recent years, because of the growing prevalence of diet-related diseases such as obesity, diabetes and cardiovascular disease, the prevention and management of these diseases has become an important public health issue in China. In order to reduce the incidence rate of diet-related diseases, the governments and food manufacturers promote nutritional labels to help consumers making healthier food choices. Globally, many countries have introduced policies nutrition label to improve food purchase behavior of the public¹. However, previous studies shown that understanding and using of nutrition label among consumers is not optimistic. Few consumers can fully understand nutrition label although they always reading nutrition label when purchasing food^{2,3}. The first Chinese Food Nutrition Labeling Regulation was published in 2008 (MOH, 2008). In 2011 China's Ministry of Health released the National Food Safety Standard for Nutrition Labeling of Pre-packaged Foods (GB 28050-2011). From 1st of January 2013 this national standard for mandatory nutrition labeling went into force⁴. The government expects that consumer would be benefited from the legislation, which may protect their right and make a health diets. Few study reported that weather consumers' understanding, attitude and use of nutrition label was changed after the standard of nutrition label became mandatory. This study access the status of consumer towards nutrition label in order to promote nutrition education and reduce prevalence of diet-related diseases.

Methods

Participants

According to the administrative zone, participants were selected from 3 different areas based on convenience sampling. The Medical College of Research Ethics Committee granted approval for the research and prior consent was obtained from all participants. Before investigation, all participants were identified volunteers and aged 18 years or more. Eligible participants were recruited from different supermarkets in the area. Of the 1153 subjects, who had different age, income, education and occupation were included. Detailed general socio-demographic characteristics of respondents are provided in [table I](#).

Questionnaire

With the previous references⁵⁻⁷, a self-structured questionnaire was conducted. The first section of questionnaire was socio-demographic characteristics of respondents, such as age and sex. The second section aimed to assess understanding of food nutritional labels of participants by using the following 2 methods: a subjective measure that used a question that asked parti-

cipants: do you know the nutritional labels? A 3-point Likert scale (1=poor, 2=somewhat, 3=a great deal) was used to evaluate the answer; an objective measure that used a model of nutritional labels, participants are required to choose what he considered. The answers include nutritional facts table, the nutritional claim, functional claim, and ingredient list, all content and unclear. Then, a 3-point Likert scale (1=poor, 2=sometimes, 3=always) was used to assess the attitude of participants toward the nutritional labels by the following questions: 1) whether the nutritional information on food package affects your decision to purchase? 2) Do you trust the nutritional information on the food package? 3) Are you satisfied with the food nutrition label? Finally, the purchasing intention of participants was measured by the following 2 questions; 1) How often do you read nutritional information on a food package when you purchase food? A 3-point Likert scale (1=poor, 2=sometimes, 3=always) was used to assess the frequency. 2) What kind of food do you read nutritional information carefully when you purchase, with answering possibilities drinks, milk, beans, biscuits, bread, meat, infant food, fortified food and others. 3) What nutrients are you concerned when you read the list of ingredient? Nutrients include energy, protein, fat, cholesterol, carbohydrate, dietary fiber, vitamin, sodium, calcium and others. The respondents were allowed to choose more than one answer for the second and third questions. Reliability of the questionnaire was furthermore ensured and improved by discussions and revision after pre-testing.

Data collection

According to previous study⁸, a cross-sectional survey was conducted during March to May in 2014. Sample was selected by stratified randomly. Firstly, 3 district was selected as the sampling area, based on the administrative division of Wuhu, and then, 5 supermarkets in each district for the investigation were randomly selected, finally, 80 consumers of one supermarket were selected randomly as object. A trained investigator conducted interviews to collect the data at three periods of shopping time (9:30-11:30, 14:30-17:00, and 18:30-20:30) on weekend. In order to ensure the diversity of samples, sample was selected randomly at the exit of supermarket. The interview begins after informed consent was provided by every consumer.

Data analysis

The database was established by EpiData 3.1 software. The eligible data was analyzed by SPSS 20.0 software after checking. Descriptive analysis was conducted to analyze the general characteristics of the participants on nutrition label, include understanding, use, faith and satisfaction by percentages. The chi-square test was conducted to test the differences of understand-

Table I
Socio-demographic Characteristics of the respondents with the understanding of Nutrition Labels based on a subjective questions (n, %)

Variable	Socio-demographic characteristics	Do you know the nutritional labels?			P
		poor	somewhat	a great deal	
Gender					
Male	528(45.8)	119(22.5)	327(61.9)	82(15.5)	0.223
Female	625(54.2)	117(18.7)	397(63.5)	111(17.8)	
Area					
City	547(47.4)	104(19.0)	350(64.0)	93(17.0)	0.508
Countryside	606(52.6)	132(21.8)	374(61.7)	100(16.5)	
Educational level					
Elementary school	360(31.2)	84(23.3)	203(56.4)	73(20.3)	0.000
Middle school	368(32.0)	68(18.5)	257(69.8)	43(11.7)	
College	344(29.8)	74(21.5)	193(56.1)	77(22.4)	
Advanced degree	81(7.0)	10(12.3)	71(87.7)	0(0.0)	
Age (years)					
18~	257(22.3)	46(17.9)	160(62.3)	51(19.8)	0.323
30~	444(38.5)	87(19.6)	288(64.9)	69(15.5)	
50~	452(38.2)	103(22.8)	276(61.1)	73(16.2)	
Occupation					
Employed	610(52.9)	132(21.6)	379(62.1)	99(16.2)	0.835
Unemployed	306(26.5)	56(18.3)	194(63.4)	56(18.3)	
Student	87(7.6)	19(21.8)	52(59.8)	16(18.4)	
Retired	150(13.0)	29(19.3)	99(66.0)	22(14.7)	
Frequency of shopping					
Never	201(17.4)	42(20.9)	120(59.7)	39(19.4)	0.335
Occasionally	206(17.9)	51(24.8)	123(59.7)	32(15.5)	
Frequently	246(21.3)	55(22.4)	153(62.2)	38(15.4)	
Always	500(43.4)	88(17.6)	328(65.6)	84(16.8)	

ding, use and attitudes of food nutrition label among socio-demographic groups. A p-value <0.05 was considered as significant.

Results

Participants

A total of 1153 valid questionnaires were recovered and analyzed. The based characteristics of the participants are shown in table I. The majority of respondents were women (54.2%) because of they were the main shopper in the household. The average age of subjective was 43.48±15.00. Among all participates, 64.7% of respondents said they always (43.4%) or often (21.3%)

were responsible for purchasing in the household. Of all respondents, 32.9% of subjects reported that their family member or they were suffered from chronic diseases.

Understanding of Nutritional Labels

On the whole, more than half of respondents (62.8%) indicated that the level of understanding on nutritional labels was general. Only 16.7% respondents claimed 'unclear' and 20.5% respondents represented 'a great deal'. The understanding of nutritional labels was not significantly different by demographic characteristics (sex, area, age, occupation and frequency of shopping). However, it was significant differences was obtained between different education groups ($P<0.05$).

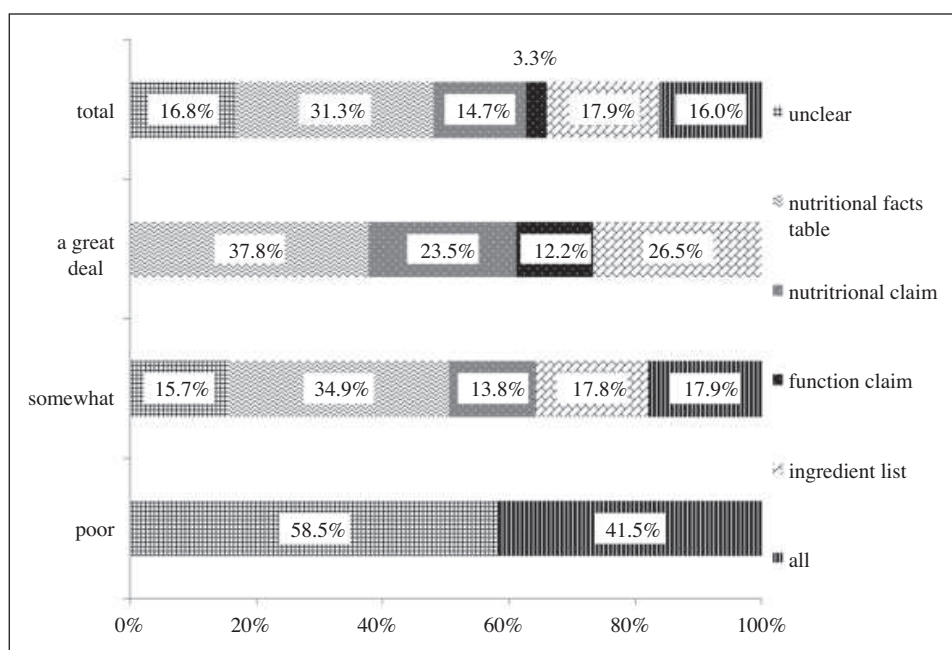


Fig. 1.—The percentages of objective understanding towards nutrition label. (The classification of variables was based on the above subjective measure. First, participants were asked that whether they knew nutrition label, then to point out which section was nutrition label they considered.)

As figure 1 show, a total of 16.8% of consumers indicated they weren't sure which section of food package are nutritional labels, so they were classified into unclear group. Most of these consumers (58.5%) reported that they know nutrition label little, and 41.5% of consumers chose the option 'all options on the package'. On the whole, 31.3% of respondents considered the nutrition label as nutritional facts table. It was the largest proportion of answers whether in 'somewhat group (34.9%)' or 'a great deal group (37.8%)'. The rate of nutritional claim and list of ingredients was 14.7% and 17.9%, respectively. 16.0% of respondents choose the option that includes all symbols on the food package. In the little and somewhat group, no one considered the function claim is one section of nutrition label. The percentage of function claim was the lowest, only 3.3% on the whole.

Attitudes towards Nutrition label

To assess attitude towards nutrition label by following questions (Table II), 42.4% of respondents indicated they were always influenced by nutritional

information on food package when purchasing, and 28.1% of respondents indicated poor. Meanwhile, the confidence and satisfaction of nutrition label was optimistic, 44.6% of respondents reported always trust the nutritional information on the package, only 10.3% of respondents reported poor. On the satisfaction of nutrition label, the percentage of always was 50.5% and poor was 20.2%. Statistical differences of attitude towards nutrition label was only focus on education, it was insignificant on others socio-demographic characteristics of the respondents.

The frequency of reading toward nutrition label

The frequency of label reading was analyzed with the answer 'poor', 'sometimes' and 'always' read. As table III shows, 12.1% of the respondents indicated they 'poor' read labels, whereas 59.2% of the respondents 'sometimes' read labels, with 28.7% of the respondents reported that they 'always' read nutritional information on food labels. The result on relationship between frequency of label reading and their demogra-

Table II
The Attitudes of Nutrition Labels among respondents (n, %)

	Poor	Sometimes	Always
Whether the nutritional information on food package affects your decision of purchasing?	150(28.1)	339(29.5)	340(42.4)
Do you trust the nutritional information on the food package?	514(10.3)	520(45.1)	119(44.6)
Are you satisfied with the food nutrition label?	582(20.2)	338(29.3)	233(50.5)

Table III
The Use of Nutrition Labels among respondents (n, %)

Variable	How often do you read nutritional information on a food package when you purchase food?			P
	Poor	Sometimes	Always	
Gender				
Male	58(11.0)	316(59.8)	154(29.2)	0.589
Female	81(13.0)	367(58.7)	177(28.3)	
Area				
City	71(13.0)	322(58.9)	154(28.2)	0.646
Countryside	68(11.2)	361(59.6)	177(29.2)	
Educational level				
Elementary school	46(12.8)	209(58.1)	105(29.2)	0.003
Middle school	60(16.3)	209(56.8)	99(26.9)	
College	30(8.7)	205(59.6)	109(31.7)	
Advanced degree	3(3.7)	60(74.1)	18(22.2)	
Age (years)				
18~	29(11.3)	149(58.0)	79(30.7)	0.896
30~	57(12.8)	265(59.7)	122(27.5)	
50~	53(11.7)	269(59.5)	130(28.8)	
Occupation				
Employed	70(11.5)	362(59.3)	178(29.2)	0.899
Unemployed	40(13.1)	179(58.5)	87(28.4)	
Student	11(12.6)	56(64.4)	20(23.0)	
Retired	18(12.0)	86(57.3)	46(30.7)	
Frequency of shopping				
Never	68(13.6)	289(57.8)	143(28.6)	0.754
Occasionally	25(10.2)	153(62.2)	68(27.6)	
Frequently	25(12.1)	124(60.2)	57(27.7)	
Always	21(10.4)	117(58.2)	63(31.3)	

phic characteristics shows that only educational level was statistical significance ($P=0.003$). It implies that the respondent's frequency of label reading was increased with the level of respondent's education.

The frequency of reading toward different food

As [figure 2](#) shows, the percentage of reading nutritional information was great difference among different food. Most of consumers (57.5%) would read nutritional information carefully when they purchase milk, followed by infant food (the rate of reading was 33.3%) and biscuits or bread (the rate of reading was 32.3%). The frequency of beans was 6.9% which was the lowest among all food. Significant demographic

differences on the reading toward different food have been noted.

The frequency of reading toward different nutrients

As [figure 3](#) shows that protein (stated by 51.5% of respondents), vitamin (stated by 49.8% of respondents) and fat (stated by 29.4% of respondents) were the most frequently reading nutrient among all nutrients. Only 5.8% of respondents indicated they read carefully the information of sodium when purchasing food. In addition, 30.1% of respondents reported they would read other nutrients such as iron, zinc and so on. The relationship between the respondents' demographic characteristics (sex, age and education) and

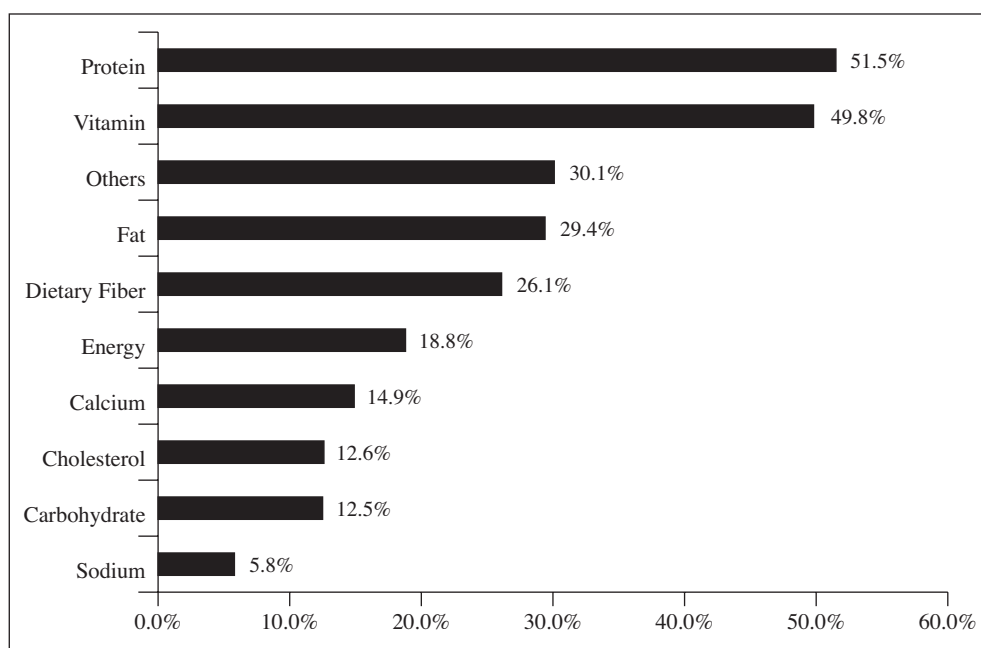


Fig. 2.—The percentage of reading nutritional information responses to the question: what kind of food do you read nutritional information carefully when you purchase?

frequency of reading on different food was significant. For example, the women's frequency of reading was higher than men when purchase milk, bread, biscuits and infant food. The similar result was found among nutrients' frequency of reading, also it was significant among sex, age, education and occupation.

Discussion

The nutrition label was standardized after the code of nutrition label became mandatory, and also, more

and more people were aware of it's not importance attribute to purchase safely and health food. To study the understanding, attitude and use of nutrition label among consumers is helpful to promote healthy diet in the future. The result shows that the subjective understanding of nutrition labels is moderate (62.8% of respondents), however the objective understanding isn't optimistic. Only education of participates is related with the understanding of nutrition labels was found in our study. Also, participates' attitude towards nutrition labels is negative by the degree of impact on shopping behavior, trust and satisfaction of nutrition label.

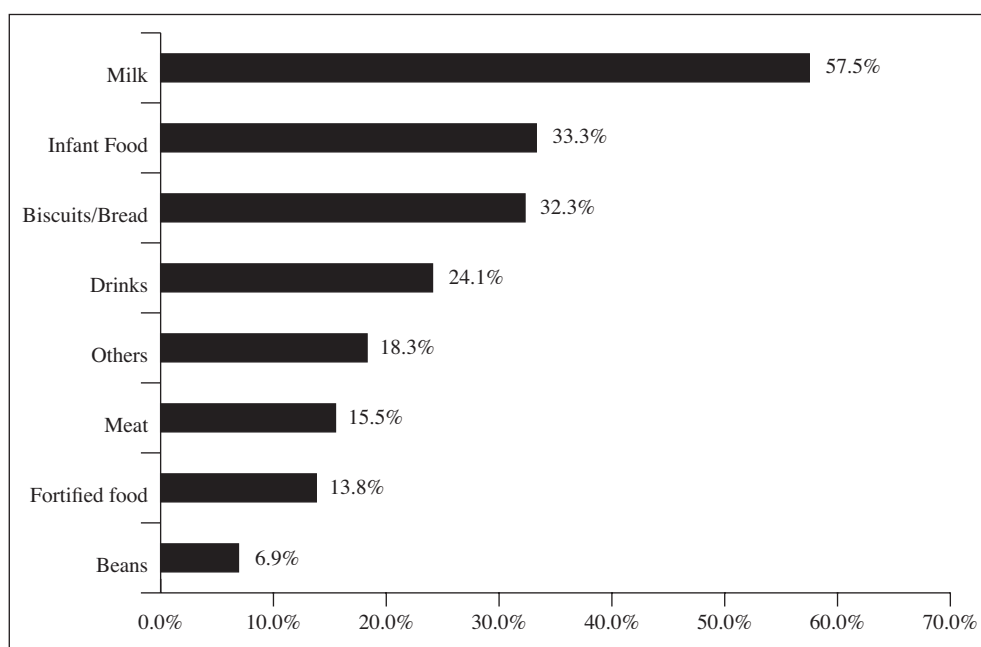


Fig. 3.—The percentage of nutrients responses to the question: what nutrients are you concerned when you read the list of ingredient?

Fortunately, the frequency of reading nutrition label wasn't very low, 59.2% of the respondents indicated 'sometimes' and 28.7% of the respondents indicated 'always'. Similarly, the attitude and use of nutrition labels didn't depend on the different demographic characteristics except education. The focus of consumer about food and nutrients was variable among different people when they read nutrition label.

The result shown that participants' understanding of nutrition label was in accordance with the findings of Liu et al⁴, who reported that participants had a moderate level of subjective understanding of the nutrient terms presented on nutrition labels. Compared with other studies⁹, the degree of understanding was higher, but it was lower than the others^{7,10,11}. It was explained that each of study was great different by method, participants, time, scene and so on, also there may have some degree of selection bias in our study. The objective understanding of nutritional claim and functional claim was difficult to understand for the words are professional, only 3.3% of respondents correctly indicated the functional claim. It was in line with Jacobs's study that difficult terminology, small font size and inability to understand nutritional labels are the major problems encountered by the consumers¹².

On the other hand, individual characteristics and nutritional knowledge of participants maybe affect the understanding and usage of nutrition label, as shown in previous studies^{9,10,13}. Only education was positively associated with subjective understanding of nutrition labels in our study, which was different from most of studies whose results shown age^{4,10}, sex^{2,5,10}, occupation^{10,14} and household income^{2,14} were main effect factors. The answer of subjective understanding was categorized into three groups (little, somewhat and a great deal) may cause the results was inconsistent, so the relationship between the demographic characteristics and understanding of nutrition label was needed to be analyzed further more. Based on the results, participants have a positive attitude towards nutrition label that was similar to other studies^{11,15}. Most of customers indicated they were always influenced when purchasing, and had a high level of trust and satisfaction about nutrition label. According to previous studies, the attitude of nutrition label was associated with demographic characteristics^{2,16} and label formats^{5,17,18}, et al.

However, a higher percentage of consumers who indicated reading nutrition label, which was similar to previous studies^{7,11}, significantly greater than result of Zeng in 2011(40.4%)¹⁹. It might be explained by the subjective and self-reported measures may lead to over reporting^{6,20}. In spite of this, consumers may don't not fully understand the content of nutrition label. Because individual characteristics, nutritional knowledge, understanding and the attitude towards nutrition label maybe both affect the use of nutrition label^{2,4,16}, so the usage of nutrition label should be combined with other factors. In addition, the form and content of nutrition label also determines behavior of consumers,

that implied the standard and easy to understand of label maybe improve the utilization, as was confirmed in previous studies^{6,18,21,22}.

The result shows that the degree of nutrition labels' concern was variable when consumers purchase food. The nutrition label of milk was the most read frequently following by infant food, biscuits/bread, and other. Also it was different on the attention of nutrients by socio-demographic, vitamin was the highest concerned. The reason may be that consumer's purchase different food for varied considerations, so they would focus on the food or nutrients which was they needed. For example, the consumer may be focused on sodium on the package of food when purchasing if he or families had blood pressure disease. As result shown, the milk and protein was the most concerned maybe because it was the most commonly eaten and familiar, which was similarly to the studies of Tang⁷, Zhang¹⁵ and Hong⁸. According to previous studies^{1,23}, the purpose of purchasing can affect the usage of nutrition label, also did the individual character such as age, sex and education of participants. Because of each person's liking and needs for food was different, they always focus on the most familiar foods or nutrients and failed to others. As previous results shown^{1,24}, the incidence of metabolic diseases can be obviously reduced if consumers can often read and correctly understanding nutrition labels. However, a few of people can correctly use nutrition label to make a healthy choices for purchasing because of poor understanding. Thus, influencing factors of understanding, attitude and use of nutrition label should be further studied.

Our study has some limitations. First, some demographics were not investigated such as families and marriage of participants which were related with understanding attitude and use of nutrition label. Second, the questionnaire are mainly subjective and results were self-reported may lead to bias. Finally, although our study had a larger of sample, it may still limit the representative of people. Despite these limitations, the results of this study are worth for the education of nutrition label, as it reported the understanding, attitude and use of nutrition label among Chinese consumers. In future studies, more influencing factors would be considered such as nutritional knowledge, and also objectively measures would be used.

Conclusions

The code of Nutrition Labeling of Pre-packaged Foods became mandatory in china which was not only the need of food safety, as an important measure for reducing chronic disease risk of peoples. More and more people begin to pay attention to the safety and nutrition of food as the concept of diet is changing and proportion of pre-packaged food is increasing. This study accessed the understanding, attitude and use of nutrition label. The results showed that participants had

a moderate understanding, positive attitude and over self-reported use of nutrition label. Only education affected understanding and attitude towards nutrition label in this study, other factors should be further studied. The study towards nutrition label is important for future education and policies of nutrition label. Since consumers can benefit from reading nutrition label, i.e. reduce prevalence of diet-related diseases, more additional strategies that enhance to spread knowledge of nutrition label.

Acknowledgements

This research was supported by Social science research foundation for middle-youth of Wannan Medical College (WK201311). All authors contributed to the investigation and analysis of the data.

Author disclosure statement

The authors declare no conflicts of interest.

References

- Hong SW, Oh SW, Lee C, Kwon H, Hyeon JH, Gwak JS: Association between Nutrition Label Use and Chronic Disease in Korean Adults: The Fourth Korea National Health and Nutrition Examination Survey 2008-2009. *J Korean Med Sci* 2014, 29(11): 1457-63.
- Gregori D, Ballali S, Vogeles C, Gafare CE, Stefanini G, Widhalm K: Evaluating food front-of-pack labelling: a pan-European survey on consumers' attitudes toward food labelling. *Int J Food Sci Nutr* 2014, 65(2): 177-86.
- Wills JM, Storcksdieck genannt Bonsmann S, Kolka M, Grunert KG: European consumers and health claims: attitudes, understanding and purchasing behaviour. *Proc Nutr Soc* 2012, 71(2): 229-36.
- Liu RD, Hoeffkens C, Verbeke W: Chinese consumers' understanding and use of a food nutrition label and their determinants. *Food Quality and Preference* 2015, 41: 103-11.
- Mejean C, Macouillard P, Peneau S, Hercberg S, Castetbon K: Consumer acceptability and understanding of front-of-pack nutrition labels. *J Hum Nutr Diet* 2013, 26(5): 494-503.
- Besler HT, Buyuktuncer Z, Uyar MF: Consumer understanding and use of food and nutrition labeling in Turkey. *J Nutr Educ Behav* 2012, 44(6): 584-91.
- Tang HY, Ma LL, SS C: Consumers' understanding and use of nutrition labels on pre-packaged food in Taiyuan. *Carcinogenesis, terato genesis & muta genesis* 2013, 25(6): 443-53.
- Hong ZH, Wang SF, Liu M, Yang YP, Chen Y, Liu QM *et al*: Study on knowledge, attitudes and use of the pre-packaged food nutrition labeling in Hangzhou supermarket consumers in 2010. *Chinese Journal of Epidemiology* 2011, 32(7): 657-60.
- Cannoosamy K, Pugo-Gunsam P, Jeewon R: Consumer Knowledge and Attitudes Toward Nutritional Labels. *Journal of Nutrition Education and Behavior* 2014, 46(5): 334-40.
- Mejean C, Macouillard P, Peneau S, Hercberg S, Castetbon K: Perception of front-of-pack labels according to social characteristics, nutritional knowledge and food purchasing habits. *Public health nutrition* 2013, 16(3): 392-402.
- Zhang RJ, Zhang DX, YU YQ, Fan SQ, Peng YY, XC L: Investigation on nutrition labeling of prepackaged foods and consumer's knowledge about nutrition labeling of food in Guangzhou. *Modern Preventive Medicine* 2014, 41(13): 2342-44.
- Jacobs SA, de Beer H, Larney M: Adult consumers' understanding and use of information on food labels: a study among consumers living in the Potchefstroom and Klerksdorp regions, South Africa. *Public Health Nutr* 2011, 14(3): 510-22.
- van der Merwe D, Bosman M, Ellis S, de Beer H, Mielmann A: Consumers' knowledge of food label information: an exploratory investigation in Potchefstroom, South Africa. *Public Health Nutr* 2013, 16(3): 403-8.
- Roberto CA, Bragg MA, Seamans MJ, Mechulan RL, Novak N, Brownell KD: Evaluation of consumer understanding of different front-of-package nutrition labels, 2010-2011. *Prev Chronic Dis* 2012, 9: E149.
- Zhang DX, Zhang RJ, Peng YY, Fan SQ, Yu YQ, Lu XC: Investigation on nutrition labeling of food among consumers in Guangzhou. *Journal of Hygiene Research* 2014, 43(4): 650-52.
- Cooke R, Papadaki A: Nutrition label use mediates the positive relationship between nutrition knowledge and attitudes towards healthy eating with dietary quality among university students in the UK. *Appetite* 2014, 83: 297-303.
- Aschemann-Witzel J, Grunert KG, van Trijp HCM, Bialkova S, Raats MM, Hodgkins C *et al*: Effects of nutrition label format and product assortment on the healthfulness of food choice. *Appetite* 2013, 71: 63-74.
- Babio N, Lopez L, Salas-Salvado J: Capacity analysis of health food choice by reference to consumers in two models of nutritional labeling: crossover study. *Nutr Hosp* 2013, 28(1): 173-81.
- Zeng QQ, Cao WN, Ji Y, C C: Nutrition label reading and its influence factors research in five cities. *Journal of Hygiene Research* 2013, 42(4): 600-4.
- Cowburn G, Stockley L: Consumer understanding and use of nutrition labelling: a systematic review. *Public Health Nutr* 2005, 8(1): 21-8.
- Van Loo EJ, Diem MN, Pieniak Z, Verbeke W: Consumer attitudes, knowledge, and consumption of organic yogurt. *Journal of dairy science* 2013, 96(4): 2118-29.
- Roseman MG, Mathe-Soulek K, Higgins JA: Relationships among grocery nutrition label users and consumers' attitudes and behavior toward restaurant menu labeling. *Appetite* 2013, 71: 274-8.
- Wong CL, Arcand J, Mendoza J, Henson SJ, Qi Y, Lou W *et al*: Consumer attitudes and understanding of low-sodium claims on food: an analysis of healthy and hypertensive individuals. *Am J Clin Nutr* 2013, 97(6): 1288-98.
- Piron J, Smith LV, Simon P, Cummings PL, Kuo T: Knowledge, attitudes and potential response to menu labelling in an urban public health clinic population. *Public health nutrition* 2010, 13(4): 550-5.



Original/Otros

Sistema de análisis de costes; su lugar dentro de un programa de intervención alimentaria, nutrimental y metabólica

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Resumen

Toda acción médico-quirúrgica implica costes. Los costes de las prestaciones de salud deben traducirse en beneficios tangibles y, por ende, medibles, para el estado de salud del enfermo. Las terapias de apoyo nutricional pueden incrementar los costes de las prestaciones de salud, pero se espera que la implementación de las mismas redunde en menores tasas de morbi-mortalidad y acortamiento de la estada hospitalaria, todo lo cual produciría ahorros importantes. Se hace necesario entonces la inculcación de herramientas de análisis de costes para la mejor gestión de las terapias de apoyo nutricional. En este artículo se expone la propuesta de diseño del SHACOST (Sistema Hospitalario de Análisis de Costes) de las intervenciones que se realicen en un enfermo de acuerdo con las pautas recogidas en el PRINUMA, (Programa de Intervención Alimentaria, Nutrimental y Metabólica). En virtud de ello, se describen las estrategias para la estimación de los costes de una intervención especificada. Asimismo, se muestran rudimentos de análisis de coste-efectividad (ACE) y coste-efectividad incremental (ACEI) mediante ejemplos tomados de la experiencia de los autores en la provisión de cuidados nutricionales al paciente operado electivamente de cáncer colorrectal. Finalmente, se describen los costes del tratamiento quirúrgico de un tumor de mandíbula, y se discute cómo se hubiera logrado un mejor impacto de la conducta quirúrgica adoptada sin incrementos considerables de los costes totales de la misma de haber incluido un programa de apoyo nutricional perioperatorio. La implementación del SHACOST puede proveer a los grupos básicos de trabajo de las herramientas contables indispensables para evaluar la efectividad de los esquemas hospitalarios de apoyo nutricional, decidir sobre la adquisición e introducción de nuevas tecnologías, y medir el impacto de la actuación de las formas hospitalarias de provisión de cui-

COSTS ANALYSIS SYSTEM; ITS LOCATION WITHIN A PROGRAM FOR FOOD, NUTRITION AND METABOLIC INTERVENTION

Abstract

Every medical surgical action implies costs. Costs of medical provisions should be translated into tangible, and thus, measurable, benefits for the health status of the patient. Nutritional support therapies might increase the costs of medical provisions, but it is expected their implementation to result in lower morbidity and mortality rates as well as shortening of hospital stay, all of them leading to important savings. It is then required the assimilation of tools for costs analysis for a better management of nutritional support therapies. A proposal for the design of a hospital system (regarded anywhere in this text as SHACOST) for the analysis of the costs of interventions conducted in a patient in accordance with the guidelines included in the Metabolic, Nutrient and Food Intervention Program (referred everywhere for its Spanish acronym PRINUMA) is presented in this article. Hence, strategies are described to estimate the costs of a specified intervention. In addition, a primer on cost-effectiveness (ACE) and incremental cost-effectiveness (ACEI) analyses is shown relying on examples taken from the authors's experience in the provision of nutritional care to patients electively operated for a colorectal cancer. Finally, costs of surgical treatment of a mandibular tumor are described, followed by a discussion on how a better impact of the adopted surgical action could be achieved without considerable increases in total costs should a perioperative nutritional support program be included. Implementation of SHACOST can provide the medical care teams with accounting tools required to assess the effectiveness of hospital nutritional support schemes, decide whether to acquire and introduce new technologies, and measure the impact of the performance of hospital forms for provision of nutritional care upon

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Recibido: 17-III-2015.
Aceptado: 18-IV-2015.

Presentado en forma de Tema dentro del Panel de Expertos "Programas de Intervención en Nutrición Hospitalaria", como parte de las actividades del IX Congreso Latinoamericano de Nutrición Parenteral y Enteral, celebrado en La Habana (Cuba), entre los días 24 – 27 de Junio del 2003.

Introducción

La provisión de cuidados alimentarios y nutricionales al paciente hospitalizado no está desligada de la realidad económica dentro de la cual actúa la institución de salud^[1]. La adopción de uno u otro esquema de intervención alimentaria, nutrimental y metabólica implica el uso de recursos bajo la forma de insumos, equipos, tiempo e incluso energía humana, y todos ellos tienen un coste^[2] que no puede ser ignorado. El sostén del estado nutricional del paciente sujeto a cualquier tratamiento médico-quirúrgico se puede lograr mediante esquemas de intervención nutricional filosóficamente diferentes entre sí, pero todos justificables fisiológicamente. Sin embargo, será siempre el coste inherente a cualquiera de ellos el que en última instancia determine el esquema a elegir, implementar y conducir^[3].

Por todo lo anterior, el PRINUMA Programa de Intervención Alimentaria, Nutrimental y Metabólica debe incluir un Sistema de Análisis de Costes^[4] de los cuidados alimentarios y nutrimentales provistos al paciente que sirva tanto para estimar el coste de las intervenciones alimentarias, nutricionales y metabólicas conducidas, y los beneficios de cualquier tipo que la intervención adoptada pudiera traer sobre la futura evolución del enfermo (incluida la calidad de vida del mismo); como para emitir juicios de valor sobre la adopción de una u otra intervención en el paciente.

En este artículo se presenta el diseño y la estructura del Sistema SHACOST de Análisis de Costes de la provisión de cuidados alimentarios y nutricionales al paciente atendido en un ámbito hospitalario. Similares consideraciones podrían hacerse para enfermos atendidos ambulatoriamente.

Material y método

Definición de una estructura de costes

La conducción de una acción médico-quirúrgica especificada implica el uso/consumo de recursos de índole variada. Algunos de estos recursos se consumen durante la acción realizada sobre el paciente, por lo que no se recuperan una vez completada la misma. Tal sería el caso de jeringuillas, guantes quirúrgicos, medicamentos, bolsas de sangre, láminas de rayos X, soluciones de nutrientes, catéteres y sondas nasointestinales; entre otros. Otros recursos se pueden usar en varios pacientes que se atienden consecutivamente hasta que llega el momento de la renovación/sustitución de los mismos, como sería el caso de la tecnología médica y la edificación civil que la contiene.

La prestación de la acción médico quirúrgica también conlleva el uso de bienes que aparentemente no se consumen durante el acto médico quirúrgico, pero que son necesarios para el completamiento del mismo, como el agua y la electricidad. Sobre todo lo anterior, se superpone la energía humana necesaria para convertir los recursos disponibles en el resultado esperado de la acción propiamente dicha^[5]. Luego, en una primera aproximación, se puede plantear un modelo general de la estructura del coste de una acción médico quirúrgica cualquiera como sigue^[6]:

Modelo 1

Modelo 1						
Costes de la acción médico quirúrgica	=	Coste de los recursos consumidos/gastados durante la acción	+	Coste de la energía humana	+	Costes de los recursos no cuantificables física o directamente

Los costes de los recursos consumidos/gastados durante la acción médico quirúrgica se pueden obtener directamente de la inspección hecha durante la conducción del proceso correspondiente que pauta la acción. El

- 1 Organización: Conjunto de elementos que interactúan entre sí con la intención de cumplir un propósito. Los elementos que componen la organización se relacionan entre sí a través de/mediante la función administrativa, que es la que transforma los esfuerzos humanos y los recursos materiales en bienes y servicios que, a su vez, son producidos/tienen como fin cubrir las necesidades de los consumidores¹.
- 2 Coste: Recurso otorgado/asignado/entregado a cambio de lograr un objetivo específico. En un sentido restringido, la suma o cantidad de dinero que se ha de entregar/pagar para adquirir productos, bienes o servicios².
- 3 Estructura: Forma y disposición de, e interrelación entre, las partes que constituyen una organización¹.
- 4 Análisis de costes: Transformación en valores financieros (léase monetarios) de los valores empleados/usados/utilizados/consumidos/gastados en la cadena de producción/servicios².

- 5 De aquí se deriva un primer sistema de clasificación de los costes de las acciones médico quirúrgicas: Costes totales = Costes tangibles + Costes intangibles. Los costes tangibles se refieren tanto a los propios de los recursos que se consumen durante la prestación de salud, como los que se deprecian transcurrido un tiempo especificado. Por su parte, los costes intangibles comprenden los de los recursos que no se consumen durante la prestación de salud, pero sin los cuales ésta no se puede administrar.
- 6 El modelo presentado de la estructura del coste de la acción médico quirúrgica se puede trazar hasta el modelo económico clásico que prescribe: Coste del producto = Costes de materias primas + Coste de la mano de obra + Otros costes no tangibles/no cuantificables directamente (y que se corresponderían con los denominados costes indirectos).

coste de la energía humana consumida/gastada durante el completamiento de la acción médico quirúrgica se puede determinar del tiempo aportado por el(los) operario(s) involucrado(s) en la misma, o, si ello no es posible, como fracciones del salario que se le paga diariamente al(los) operario(s) por la conducción de tal acción.

Se han propuesto varias estrategias de cálculo de los costes de los recursos no cuantificables física o directamente, pero la efectividad de una u otra dependerá del conocimiento que se tenga de los mismos, y cómo participan/influyen en el coste de la acción médico quirúrgica. Llegado este punto, se puede afirmar que los costes de los recursos necesarios para el completamiento de la acción médico quirúrgica (pero que no son directamente cuantificables) pudieran ser una función de los costes de los recursos no renovables que se consumen/gastan durante la conducción de la acción. Según los teóricos que proponen este enfoque, cualquier acción médico quirúrgica conducida en el enfermo debería resultar en ingresos monetarios tales que permitan recuperar los recursos consumidos/gastados en ella, pagar los salarios de aquellos involucrados en el completamiento de la acción, y contribuir al mantenimiento/ renovación/sustitución de la tecnología médica empleada, y la instalación que la contiene^[7]. De acuerdo con este enfoque, entonces los costes de una acción médico quirúrgica especificada pueden depender directa o indirectamente de la asistencia que se le brinde al enfermo en la institución, como se muestra en la figura 1.

Los *costes indirectos* de la acción médico quirúrgica no guardarían relación alguna con la prestación de cuidados de salud al paciente, e incluso serían independientes de esta actividad^[8]. Por el contrario, los *costes directos* de la acción médico quirúrgica estarían determinados por los costes de los procesos de diagnóstico, tratamiento y cuidado del enfermo. A su vez, los costes directos de la acción médica se pueden particionar ulteriormente según el número de pacientes atendidos en la unidad de tiempo. Los *costes directos variables* son proporcionales al número de pacientes atendidos por hora: a mayor número de pacientes atendidos, mayor cantidad de recursos consumidos, mayores los costes directos variables. Por su parte, los *costes directos fijos* se hacen corresponder con erogaciones constantes por cada paciente atendido. Así, se tiene un segundo modelo de la estructura del coste de la acción médico quirúrgica como sigue:

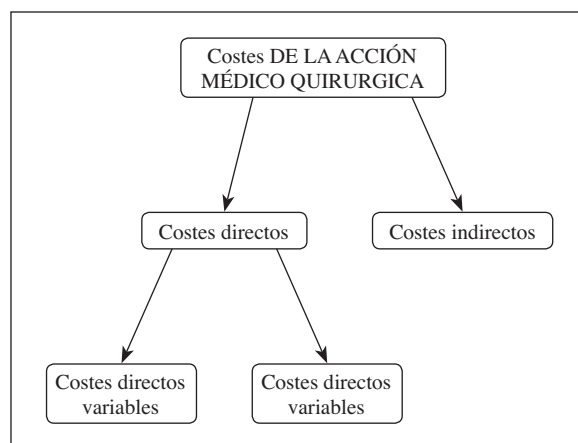


Fig. 1.—Estructura del coste de una acción médico-quirúrgica.

Modelo 2				
Costes de la acción médico quirúrgica	=	Costes directos variables	+	Costes directos fijos + Costes indirectos

Los costes directos variables se estimarían como los costes de los recursos consumidos/gastados en el completamiento de la acción médico quirúrgica especificada, de acuerdo con el modelo 1, y que se exponen en la tabla I. Los costes directos fijos se calcularían de los resultantes de 3 fuentes: energía humana, energía no humana, y amortización de equipos. Por último, los costes indirectos se podrían estimar de los costes de operación de las áreas hospitalarias no relacionadas con la prestación de salud al enfermo, como serían los departamentos hospitalarios de Economía, Contabilidad, Finanzas, e Informática; y los servicios básicos de operación/mantenimiento/renovación de la instalación.

Aún con la estructura de costes expuesta en el modelo (2), muchas veces no se tiene información suficiente sobre el tamaño de otros costes que no sean los directos variables. Pero tampoco es relevante un conocimiento tan íntimo de la estructura de los costes hospitalarios a los fines del presente trabajo. En la literatura consultada, se tiene el término *overhead*, que representa la suma de los costes directos fijos y los costes indirectos. Luego, se puede proponer un modelo simplificado de la estructura de los costes de la acción médico quirúrgica como sigue en (3):

Modelo 3			
Costes de la acción médico quirúrgica	=	Costes directos variables	+ Overhead

Así, el coste de la acción médico quirúrgica de interés resulta de los costes directos variables relacionados con los insumos que se consumen/gastan en el completamiento de la misma, incrementados en una cuantía fija que resulta de la reunión en una única figura de los costes directos fijos y los indirectos. De acuerdo con la propuesta mostrada en la figura 2, se tendría entonces el modelo expuesto en la expresión (3).

7 Según este enfoque, alguien debería pagar por la acción médico quirúrgica conducida, sea éste el propio paciente, el apoderado/ representante del mismo, la compañía aseguradora, o cualquier figura que honre la factura que se le presente por la acción conducida en el enfermo. El análisis de costes de la acción médico quirúrgica en un entorno estatizado (donde es el propio Estado el que brinda y paga la acción) merece otras consideraciones que están fuera del alcance del presente manuscrito.

8 De hecho, aún cuando no se atiendan enfermos, un centro cualquiera de salud sigue incurriendo en costes de operación tales como el suministro eléctrico, los servicios de climatización, acueducto y alcantarillado, y los salarios del personal encargado de la operación de los sistemas básicos de la instalación, por solo citar algunos aspectos, y sin pretender agotarlos todos.

Tabla I
Modelo de estimación de los componentes del coste de una acción médico quirúrgica especificada

<i>Modelo (2)</i>	<i>Modelo (1)</i>
Costes directos variables	Costes de los recursos consumidos/gastados en el completamiento de la acción médico quirúrgica
Costes directos fijos	Costes de la energía humana = Fracción del salario pagado diariamente al(los) operario(s) encargado(s) de convertir los recursos disponibles/asignados en el resultado de la acción médico quirúrgica especificada Costes de mantenimiento/sustitución/renovación de los equipos empleados en la conducción de la acción médico quirúrgica Costes de los portadores energéticos consumidos/ gastados en el completamiento de la acción médico quirúrgica: agua/electricidad
Costes indirectos	Costes de operación de los departamentos hospitalarios de Economía, Contabilidad y Finanzas Costes de operación de los departamentos hospitalarios de Informática médica Costes de los servicios de operación/mantenimiento/ renovación de la instalación Otros

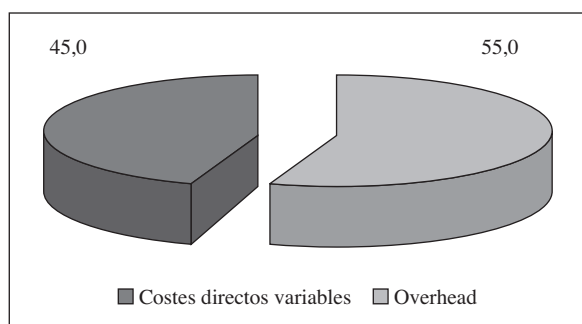


Fig. 2.—Modelo de estimación de los costes de una acción médico quirúrgica especificada como la suma de los costes directos variables y el “overhead”. Para más detalles: Consulte la Sección “Definición de una estructura de costes” de este artículo.

Modelo 3

$$\text{Costes de la acción médico quirúrgica} = \text{Costes directos variables} * 1,82$$

Conocidos los costes de las acciones médico quirúrgicas conducidas en el paciente, se puede entonces evaluar la solvencia contable de la institución de salud. En el entorno en el que la institución se ve obligada a operar, las acciones médico quirúrgicas completadas durante la ventana determinada de tiempo deben resultar en ingresos que cubran los costes de las prestaciones de salud, así como los de operación/mantenimiento/renovación de la tecnología médica; permitan además pagar los salarios del personal empleado; y encima de todo ello, generar utilidades⁹. De otra manera, la institución caería automáticamente en bancarrota, y se vería obligada a cesar operaciones, e incluso extinguirse¹⁰.

9 Valor: Proporción en que se cambia un objeto por otro, o una determinada cantidad de un producto por una determinada cantidad de otro producto³. Valor = Coste + Factor incremental. Este factor incremental puede representar la plusvalía, según la teoría marxista de la Economía. En otros modelos económicos el factor incremental se denomina como “utilidad”.

10 En los sistemas públicos de Salud pública, donde el Estado cubre los costes de operación de la institución de salud mediante el

Costes y características operacionales de la acción médico quirúrgica

El conocimiento de los costes de la acción médico quirúrgica puede servir también para evaluar la efectividad¹¹ de la misma. Toda acción médico quirúrgica se orienta a un fin concreto que en su forma más sencilla se puede expresar como sigue: restaurar el estado de salud del enfermo. Luego, se espera que la acción que se conduzca en el enfermo resulte en el logro del objetivo propuesto. No se justifica éticamente, y mucho menos económicamente, que se conduzcan en el enfermo acciones costosas que no se traduzcan en beneficios para el estado de salud del mismo. Tampoco se justifica económicamente que, si se dispone de 2 tipos diferentes de acciones médico quirúrgicas que resulten en beneficios similares para el paciente, se elija la más costosa de ellas para la implementación en el enfermo.

El análisis ACE coste-efectividad vincula, dentro de la misma plataforma de evaluación, el conocimiento de los costes de la acción médico quirúrgica especificada con la capacidad de lograr el fin propuesto, esto es, la efectividad:

Modelo 4

$$\text{ACE} = \frac{\text{Costes}}{\text{Efectividad}}$$

otorgamiento de créditos y presupuestos correspondientes, no se puede incluir el componente “utilidades” en la estructura de los costes de la acción médico quirúrgica. El análisis de costes en estos entornos subsidiados está orientado primariamente a la contención de los costes de las prestaciones, y la maximización del número de pacientes atendidos para el presupuesto/crédito asignado.

11 Efectividad: Capacidad para lograr el fin propuesto. Efectividad = Utilidad + Seguridad. Utilidad: Capacidad para producir beneficios. Capacidad para alcanzar los objetivos propuestos, dentro de la mejor relación posible de costes. Seguridad: Capacidad para prevenir complicaciones. Capacidad para evitar que el paciente sufra complicaciones adicionales durante la actuación médico quirúrgica debido/achacadas a la conducción del proceso de cuidados alimentarios y nutricionales.

Como quiera que la efectividad es una característica operacional^[12] de la acción médico quirúrgica, entonces el ACE es relevante solo en términos poblacionales, según la ecuación siguiente:

$$\text{ACE} = \frac{\text{Modelo 5}}{\text{Costes totales de la acción médico quirúrgica}} \div \frac{\text{Número de pacientes beneficiados de la acción médico quirúrgica conducida}}{\text{Número de pacientes beneficiados de la acción médico quirúrgica conducida}}$$

El ACE es un modelo de análisis de costes versátil en numerosos escenarios. Se pueden proponer variaciones del ACE, pero la exposición podría desbordar los límites propios de este artículo.

Costes y efectividad de las intervenciones alimentarias, nutrimentales y metabólicas

Las intervenciones alimentarias, nutrimentales y metabólicas constituyen un acápito singular de la acción médico quirúrgica. Durante la estancia hospitalaria, el enfermo debe recibir los nutrientes necesarios para el sostén del estado nutricional (y con ello, el de salud) en forma de una bandeja de alimentos como resultado de la conducción del proceso de la prescripción dietética. Las deficiencias nutrimentales encontradas en el enfermo tras el examen clínico deben ser remediadas mediante la intervención nutricional adecuada, sea ésta la suplementación vitamino-mineral, la Nutrición enteral (volitiva/no volitiva) o la Nutrición parenteral⁵⁻⁹. En la misma cuerda, se pueden lograr cambios en la maquinaria metabólica del enfermo mediante paradigmas como la Inmunonutrición^{10,11}. Todas estas intervenciones se suman a las acciones médico quirúrgicas que componen el programa de tratamiento del paciente, y por consiguiente, contribuyen a incrementar los costes de las prestaciones de salud (en virtud de la relación presentada en la ecuación 3), sin que ello se acompañe forzosamente de una efectividad superior. Esto es: el beneficio esperado se pudiera realizar pero a costa de una mayor erogación de recursos. Luego, las intervenciones alimentarias, nutrimentales y metabólicas conducidas en el enfermo se justificarían solo si resultaran en una mayor efectividad: el denominado paradigma del apoyo nutricional¹².

El Análisis ACEI Coste-Efectividad Incremental sirve para evaluar si se justifican los costes adicionales de las intervenciones alimentarias, nutrimentales y metabólicas dado el incremento observado en la efectividad del programa de tratamiento adoptado en el enfermo:

$$\text{ACEI} = \frac{\text{Modelo 6}}{\Delta \text{ Costes del tratamiento médico quirúrgico}} \div \frac{\Delta \text{ Efectividad del tratamiento}}{\Delta \text{ Efectividad del tratamiento}}$$

En la ecuación (6), el numerador representa el incremento en los costes del tratamiento médico quirúrgico

12 Característica operacional: Propiedad dependiente del operario⁴.

gico si se incorpora el paquete de apoyo nutricional (que puede extenderse hasta la provisión de alimentos) dentro del programa de cuidados generales del enfermo, mientras que el denominador explica si la incorporación del paquete de apoyo nutricional ha resultado en mejoría de los indicadores de efectividad del tratamiento, tales como el número de enfermos que egresan vivos, sin complicarse, en el tiempo programado, tras el completamiento de la acción médico quirúrgica.

Presentación del Sistema de Análisis de Costes de las intervenciones alimentarias, nutrimentales y metabólicas

El Sistema de Análisis de Costes solo puede desplegarse si los otros componentes del PRINUMA se encuentran en operación, como se muestra en la figura 3. La documentación exhaustiva de la acción médico quirúrgica que se conduzca en el enfermo en el correspondiente PNO Procedimiento Normalizado de Operación constituye el primer paso en la estimación del coste de la misma¹³. En el PNO deben quedar recogidos los insumos necesarios para el completamiento de la acción médico quirúrgica de interés^[13]. A cada uno de estos insumos se le debe asignar un coste, de acuerdo con el nomenclador hospitalario de costes.

La ficha de costes constituye la herramienta registral donde se recogen las acciones conducidas en el enfermo (incluidas las intervenciones alimentarias, nutrimentales y metabólicas), los recursos utilizados/consumidos, y el coste propio de cada uno de ellos. Completada la ficha, los costes del programa de tratamiento se pueden obtener de la suma de los propios de cada ítem de la ficha. Los costes totales del programa de tratamiento se derivarían como la suma de tantas fichas de costes como pacientes en los que se ha completado el tratamiento, o un múltiplo de una ficha-prototipo. Obtenidos los costes totales del tratamiento médico quirúrgico, entonces se seleccionaría el modelo de análisis de ajuste de costes según el indicador deseado de efectividad y la hipótesis a demostrar.

Presentación de casos-estudio para la aplicación de los métodos descritos de análisis de costes

Los métodos de análisis de costes que se han descrito en este trabajo se aplicaron en la solución de 3 casos originados durante la actuación del GAN Grupo de Apoyo Nutricional en el Hospital Clínico quirúrgico "Herminio Ameijeiras" (La Habana, Cuba): *Primer caso*: Costes de las intervenciones alimentarias, nutrimentales y metabólicas; *Segundo caso*: Ahorros de conducirse un

13 En la estructura prototipo del PNO se incluyen los acápites E y F separados para la declaración de los equipos a emplear en el completamiento de la acción médico quirúrgica, y los materiales y reactivos a gastar durante la ejecución del proceso descrito en el PNO¹³.

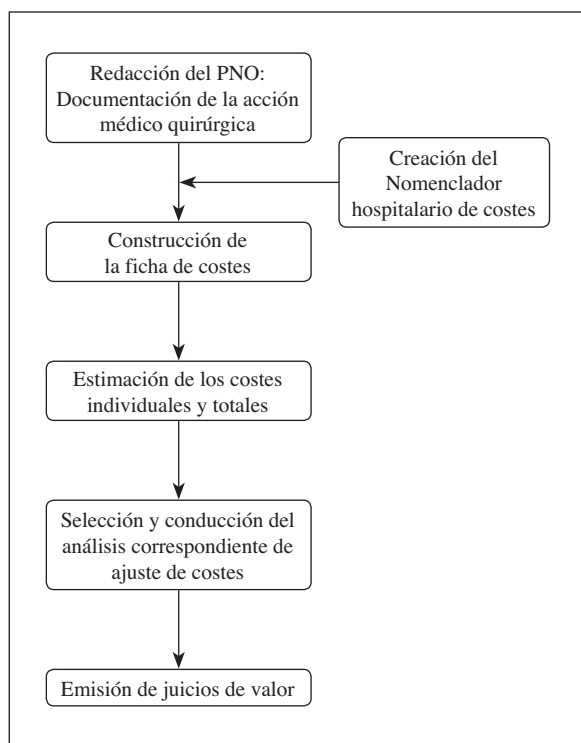


Fig. 3.—Flujograma para la estimación de los costes de las acciones médico quirúrgicas y nutricionales descritas en el manuscrito.

programa de apoyo nutricional en un enfermo tratado por una neoplasia de la mandíbula; y *Tercer caso*: Costes de la incorporación de un paquete de apoyo nutricional perioperatorio en el tratamiento quirúrgico electivo del cáncer colorrectal.

Respecto del primer caso de estudio, el sostén del estado nutricional del enfermo hospitalizado implica el aporte de energía suficiente. Interesó entonces el coste de la unidad de energía aportada mediante cualquiera de las siguientes intervenciones: Aporte de alimentos sin restricciones sobre la textura/consistencia de los mismos, ni sobre la composición nutrimental; aporte de nutrientes mediante un esquema de Nutrición enteral; y aporte de nutrientes mediante un esquema de Nutrición parenteral.

En lo que corresponde al segundo caso de estudio, se estimaron los costes de las acciones médico quirúrgicas en un paciente que fue operado electivamente de un tumor de la hemimandíbula izquierda, y que sufrió varias complicaciones post-quirúrgicas, incluyendo una fístula orocutánea que obligó al retiro de una prótesis previamente colocada. La figura 4 muestra los problemas de salud registrados en este paciente.

Atendiendo a las características clínicas de este caso, se estimaron los costes de una ruta alternativa de tratamiento médico quirúrgica que incluiría la colocación de una gastrostomía percutánea y la articulación de un programa de apoyo nutricional combinando técnicas de alimentación asistida por sonda y nutrición enteral no

Problemas de salud

Pr 1. Tabaquismo
Pr 2. Alcoholismo
Pr 3. Tumor de mandíbula izquierda
→ Ingreso hospitalario (Día 0)
→ Hemimandibulectomía izquierda (Día +8)
→ Colocación de prótesis (Día +8)
→ Colocación de traqueostomía (Día +8)
→ Colocación de sonda nasogástrica (Día +8)
→ Conducción de un esquema de Nutrición Enteral no Volitiva con un nutriente enteral sin fibra energéticamente denso: 1.000 mL $\equiv$ 1.500 kilocalorías
Pr 4. SPO complicado de Hemimandibulectomía izquierda
sPr 4,1 Traqueobronquitis aguda
→ Cultivo de secreciones traqueobronquiales: *Enterobacter cloacae* (Día +20)
→ ATB: Ciprofloxacino: 2 g diarios por vía oral (Día +20)
sPr 4,2 Fístula orocutánea
sPr 4,3 Infección de la herida quirúrgica
→ Cultivo de secreciones de la herida quirúrgica: *Staphylococcus aureus* (Día +32)
→ ATB: Vancomicina: 2 g diarios por vía endovenosa después de diluidos en vehículo acuoso (Día +32)
→ Retiro de la prótesis (Día +66)
→ Fistulectomía (Día +66)

Fig. 4.—Relación de los problemas de salud presentes en el caso clínico empleado para la estimación de los ahorros logrados con la implementación de un programa perioperatorio de apoyo nutricional.

volitiva con un nutriente polimérico, sin fibra. Los costes de ambas rutas de tratamiento (Actual vs. Simulada) fueron comparados para evaluar si ocurrirían ahorros significativos.

Finalmente, y para responder a los objetivos propuestos con el tercer caso de estudio, se estimaron los costes de un paquete de apoyo nutricional administrado al enfermo operado electivamente de cáncer colorrectal, y que incluyó técnicas de Nutrición enteral volitiva (NEV), Nutrición enteral no volitiva (NENV), Nutrición Parenteral Periférica (NPP) y Nutrición Parenteral Central (NPC), según muestra la figura 5. Para ello, se seleccionaron 24 pacientes operados electivamente en la institución de pertenencia de los autores entre Diciembre del 1998 y Diciembre del 2012 según el orden alfabético del nombre de pila. En caso de que no fuera posible encontrar un caso apropiado en la letra correspondiente, se procedió a sortear los pacientes en la siguiente letra del alfabeto. En algunas instancias se sortearon varios pacientes dentro de una misma letra hasta lograr el efectivo muestral requerido. Según la fase de la conducta quirúrgica, las intervenciones nutricionales fueron como sigue: *Preoperatorio*: NEV: 54,2%; NPP: 16,7%; NPC: 4,2%; *Post-operatorio*: NEV: 41,7%; NPC Hipóergica: Dextrosa 10% + Micronutrientes selectos: 62,5%; NPC: Dextrosa 10% + Aminoácidos 5% + Lípidos 10%: 4,2%. En el 54,2% de estos pacientes se condujeron intervenciones nutricionales tanto en la fase preoperatoria como en la post-operatoria.

	<i>Enteral</i>	<i>Día de Evolución</i>	<i>Parenteral</i>
Preoperatorio	Vía oral conservada Dieta pobre en residuo Suplementos de ovoalbúmina: 3 huevos/día NEV: Dietas poliméricas sin fibra: 300 – 600 Kcal/día	-14 ... -1	Nutrición Parenteral Central I: Dextrosa 10%: 800 – 1200 Kcal/24 horas Micronutrientes seleccionados: c.s.p. Nutrición Parenteral Central II: Dextrosa 10%: 800 – 1200 Kcal/24 horas Aminoácidos: 25 gramos/día Micronutrientes seleccionados: c.s.p, Nutrición Parenteral Central III: Dextrosa 10%: 800 – 1200 Kcal/24 horas Lípidos: 500 Kcal/24 horas Aminoácidos: 25 gramos/día Micro-nutrientes seleccionados: c.s.p,
Transoperatorio	Cierre de la vía oral Colocación de sonda nasogástrica	Día 0	Colocación de un acceso venoso profundo Reposición hidroelectrolítica
Post-operatorio	Vía oral cerrada Retiro de la sonda nasogástrica Reapertura de la vía oral NEV: Dietas poliméricas sin fibra: 300 – 600 Kcal/día	0 ... +3 +4 ... +7	Nutrición Parenteral Central Hipoérgica I: Dextrosa 10%: 800 – 1200 Kcal/24 horas Micronutrientes seleccionados: c.s.p. Nutrición Parenteral Central Hipoérgica II: Dextrosa 10%: 800 – 1200 Kcal/24 horas Lípidos: 500 Kcal/24 horas Aminoácidos: 25 gramos/día Micro-nutrientes seleccionados: c.s.p,

Fig. 5.—Conducta seguida en la intervención alimentaria y nutrimental integrada dentro de la cirugía colorrectal electiva.

Los costes de las acciones médico quirúrgicas en los 24 casos intervenidos fueron comparados con otros 24 casos en los que la conducta alimentaria se limitó a la prescripción dietética.

La provisión de alimentos no restringidos en textura o consistencia ni composición nutrimental se ha documentado en el PNO 4.101.98: “Dieta general”, del Manual de Procedimientos del Grupo de Apoyo Nutricional del Hospital Clínico quirúrgico “Hermanos Ameijeiras” (La Habana, Cuba). Las características de los esquemas de Nutrición enteral se han descrito en los procedimientos PNO 2.018.98: “Modos enterales de Alimentación y Nutrición”, y 2.020.98: “Instalación, mantenimiento y retiro de sondas nasointerales”. Las características de los esquemas de Nutrición parenteral se han documentado en los procedimientos PNO 2.021.98: “Nutrición parenteral”, y 2.025.01: “Instalación, mantenimiento y retiro de líneas de acceso venoso”.

Para cada uno de los casos de estudio se creó la correspondiente ficha de costes contentiva de los recursos consumidos durante la ejecución de las acciones contempladas, según el flujograma expuesto en la figura 3. Las fuentes de los costes de los recursos utilizados en cada una de las acciones conducidas provinieron del Viceministerio de Economía del MINSAP Ministerio de Salud Pública; la Empresa Farmacéutica “Juan Ramón Franco”, de la Industria Químico Farmacéutica de Cuba; el Ministerio de Comercio Interior; el Departamento de Desarrollo Social del Ministerio de Economía y Planificación; y el Departamento de Economía del Hospital

Clínico quirúrgico “Hermanos Ameijeiras”. Los costes se expresaron en pesos cubanos (CUP)^[14].

Resultados

Primer caso: Costes de las intervenciones alimentarias, nutrimentales y metabólicas.

Interesó primeramente conocer cuál era el coste de la kilocaloría^[15]: la unidad elemental de energía alimentaria | nutricional, provista indistintamente mediante una bandeja de alimentos, una orden de Nutrición enteral, o una orden de Nutrición parenteral.

La tabla II muestra los costes de un menú prescrito sin restricciones en la textura/consistencia ni la composición nutrimental de los alimentos. El coste de 1 kilocaloría de energía alimentaria (esto es: aportada mediante alimentos) es de 0,006 CUP. Por consiguiente, aportar 2.000 Kcal costaría entonces 12,00 CUP en un entorno hospitalario.

La NEV se diseña para el aporte de soluciones especificadas de nutrientes enterales por vía oral como complemento de la prescripción dietética⁶. El coste de 1 kilocaloría de energía nutricional aportada mediante un esquema de NEV que prescriba el uso de un nutriente enteral polimérico sin fibra (Frasco de 500 mL = 9,75 CUP) es de 0,02 CUP. Luego, aportar 750 Kcal (= 750 mL del nutriente) costaría 14,63 CUP en un entorno hospitalario.

14 1,00 CUP = 0,80 USD.

15 1 Kilocaloría = 4,2 Kilojoule.

Tabla II

Ficha de costes del menú semanal prescrito para una dieta hospitalaria libre de restricciones de la textura | consistencia de los alimentos, y la composición nutrimental de los alimentos. La columna "Total" presenta la suma de los costes diarios y (entre paréntesis) el coste de la unidad de energía (kilocaloría) alimentaria. La propuesta de menú semanal se presenta en el Anexo a este artículo

	Contenido energético (Kcal)	Costes						Total
		Desayuno	Merienda	Almuerzo	Merienda	Comida	Merienda	
Lunes	2230	0,35	0,25	5,51	1,25	5,81	0,24	13,41 (0,006)
Martes	2240	0,35	0,25	7,02	1,25	3,37	0,24	12,48 (0,006)
Miércoles	2265	0,35	0,25	4,82	1,25	5,07	0,24	11,98 (0,005)
Jueves	2155	0,35	0,25	6,21	1,25	3,85	0,24	12,15 (0,006)
Viernes	2260	0,35	0,25	5,24	1,25	3,38	0,24	10,71 (0,005)
Sábado	2075	0,35	0,25	4,58	1,25	2,81	0,24	9,48 (0,005)
Domingo	2000	0,35	0,25	5,16	1,25	4,97	0,24	12,22 (0,006)
Promedio	2175							11,77 (0,006)

La NENV implica el aporte de soluciones especificadas de nutrientes enterales mediante un acceso enteral que puede representar desde una sonda nasointestinal hasta una ostomía⁶. La tabla III muestra los costes de un esquema NENV para el aporte de cantidades suficientes de un nutriente enteral polimérico sin fibra mediante una sonda nasogástrica. En este caso, los costes se estimaron de la expresión (7):

Modelo 7

Costes de implementación		
+		
Costes	= Costes de la administración de	Costes de la administración de las
totales	las primeras 2.000 kilocalorías de energía nutricional	siguientes 2.000 kilocalorías

Los costes de implementación del esquema NENV y de administración de las primeras 2.000 kilocalorías ascienden a 300,32 CUP. Por su parte, los costes diarios de administración de las siguientes 2.000 kilocalorías son de 200,95 CUP. De esta manera, el coste de la unidad de energía nutricional administrada durante las primeras 24 horas es de 0,15 CUP; mientras que el coste de la misma unidad de energía administrada en las siguientes 24 horas es de 0,10 CUP.

Llegado este punto, interesó conocer los costes del esquema NENV expuesto más arriba si la sonda nasogástrica era sustituida por una gastrostomía **percutánea** como vía de acceso para el aporte de las soluciones de nutrientes. Apelando a la ecuación presentada en (7), los costes de implementación del esquema y de administración de las primeras 2.000 kilocalorías es de 410,13 CUP, mientras que los costes diarios de administración de las siguientes 2.000 kilocalorías es de 200,95 CUP. Por consiguiente, el coste de la unidad de energía nutricional administrada durante las primeras 24 horas es de 0,21 CUP: un incremento de 0,06 CUP respecto de la primera variante de los esquemas NENV. Sin embargo, el coste de la unidad de ener-

gía nutricional administrada en las siguientes 24 horas permanece sin cambios, a razón de 0,10 CUP por cada kilocaloría administrada de nutriente enteral.

Si se decidiera colocar la sonda de gastrostomía mediante una laparotomía, entonces el coste de la unidad de energía nutricional administrada durante las primeras 24 horas de operación del esquema NENV es de 0,38 CUP ($\Delta = +0,23$ CUP respecto de la primera variante). No obstante, el coste de la unidad de energía nutricional administrada en las siguientes 24 horas sigue siendo de 0,10 CUP por cada kilocaloría.

La Nutrición Parenteral es aquella alternativa de apoyo nutricional mediante la cual se infunden soluciones químicamente definidas de nutrientes en un territorio venoso especificado mediante un dispositivo adecuado⁷⁻⁹. Dentro de los confines de este artículo, interés conocer los costes de un esquema de Nutrición Parenteral Central (NPC) que aportara diariamente 2.000 kilocalorías de energía nutricional.

La tabla III muestra también la ficha de costes de tal esquema de apoyo nutricional. Recurriendo a la expresión colocada en (7), los costes de implementación del esquema NPC, incluyendo la administración de las primeras 2.000 kilocalorías, son de 283,89 CUP; mientras que los costes de la administración de las siguientes 2.000 kilocalorías ascienden a 216,00 CUP. Así, el coste unitario de las primeras 2.000 kilocalorías administradas es de 0,14 CUP, mientras que el coste unitario de las siguientes 2.000 kilocalorías es de 0,10 CUP.

De forma interesante, la corrección de los costes estimados (que bien pudieran corresponderse en su mayor parte con los costes variables directos) por el factor 1,82 no incrementa apreciablemente el coste unitario de la energía nutricional administrada, excepción hecha del esquema NENV administrado a través de una gastrostomía laparotómica.

Tabla III

*Costes de la provisión de una unidad de energía nutricional mediante las diferentes opciones de intervención nutricional.
Para más detalles: Consulte el texto del presente artículo*

Coste x día x paciente	Nutrición enteral a través de una sonda nasogástrica	Nutrición enteral a través de una gastrostomía percutánea	Nutrición enteral a través de una gastrostomía laparotómica	Nutrición parenteral a través de un acceso venoso central
Implementación	- Asignación de la sonda nasogástrica: 7,60 CUP - Derecho de uso de salón de Endoscopia: 45,08 CUP - Colocación de la sonda nasogástrica en un salón de Endoscopia: 33,89 CUP - Verificación de la posición mediante un Rayos X comprobatorio: 12,80 CUP	- Asignación del kit de gastrostomía: 152,18 CUP - Derecho de uso de salón de Endoscopia: 45,08 CUP - Colocación de la gastrostomía por vía percutánea en un salón de Endoscopia: 11,92 CUP	- Asignación del kit de gastrostomía: 152,18 CUP - Derecho de uso del salón de operaciones: 223,07 CUP - Colocación de la gastrostomía en un salón de operaciones: 177,28 CUP	- Asignación del catéter venoso central: 11,41 CUP - Colocación del catéter venoso central: 43,68 CUP - Verificación de la posición mediante un Rayos X comprobatorio: 12,80 CUP
	99,37 CUP	209,18 CUP	552,53 CUP	67,89 CUP
Mantenimiento	- Conducción del esquema: Frascos + Bolsa + Kit de infusión: 49,48 CUP - Día de hospitalización en una sala abierta: 141,78 CUP			- Conducción del esquema: Frascos + Electrolitos + Minerales + Oligoelementos + Vitaminas + Kit de infusión: 59,97 CUP - Día de hospitalización en una sala abierta: 141,78 CUP - Curación del catéter: 4,56 CUP
	191,26 CUP			206,31 CUP
Otros costes ^a	Recambio de la bolsa de infusión: 8,69 CUP			Recambio de la bolsa de infusión: 9,56 CUP
Otros costes	Depreciación horaria de la bomba de infusión: 0,32 CUP			
	Para 24 horas de operación: 7,68 CUP			
Otros costes: Consumo eléctrico	Electricidad consumida: w.h ⁻¹ : 700 Para 24 horas de operación: 16,8 kw.24 horas ⁻¹ Coste de la electricidad: CUP.kw ⁻¹ : 0,12 CUP			
	Para 24 horas de operación: 2,01 CUP			
Coste de las primeras 2000 kilocalorías, CUP	300,32 (0,15)	410,13 (0,20)	753,48 (0,37)	283,89 (0,14)
Coste de las siguientes 2000 kilocalorías, CUP	200,95 (0,10)	200,95 (0,10)	200,95 (0,10)	216,00 (0,10)
Coste total de las primeras 2000 kilocalorías, CUP ^b	546,58 (0,27)	754,63 (0,37)	1.371,33 (0,68)	516,67 (0,25)
Coste total de las primeras 2000 kilocalorías, CUP ^b	365,73 (0,18)	365,73 (0,18)	365,73 (0,18)	393,12 (0,19)

^aSe incluye en los costes de hospitalización. ^bDeterminados mediante la expresión (3).

Segundo caso: Ahorros de conducirse un programa de apoyo nutricional en un enfermo tratado por una neoplasia de la mandíbula

La intervención del GAN en el caso de un paciente complicado con una fístula orocutánea tras la realización de una hemimandibulectomía izquierda seguida de colocación de una prótesis a causa de un tumor de la mandíbula izquierda fue propicia para estimar el impacto de un programa perioperatorio de apoyo nutricional sobre la gestión hospitalaria. La figura 4 muestra los problemas de salud del enfermo, y las acciones realizadas correspondientemente. En el día +8 se resecó la hemimandíbula tumoral, y se colocó una prótesis de acrílico. En el día +12 se inició un esquema de NENV con la infusión diaria de 1.000 mL de un nutriente polimérico energéticamente denso (= 1.500 kilocalorías). En el día +38 se modificó la prescripción nutrimental para incluir el aporte de alimentos modificados en textura y consistencia por la sonda nasogástrica, suplementados con un nutriente enteral polimérico que incorporaba fibra dietética (1.200 mL = 1.200 kilocalorías diarias). En el día +50 se instaló una gastrostomía laparotómica ante la imposibilidad de la reapertura a corto plazo de la vía oral, y la prolongada permanencia de la sonda nasogástrica. Cumplido este proceder, se implementó un esquema de alimentación asistida por sonda de gastrostomía combinada con suplementación, primero con 1.200 mL diarios de un nutriente polimérico con fibra (= 1.200 kilocalorías); y después, con 60 gramos (6 cucharadas) diarios de un nutriente polimérico sin fibra (= 177 kilocalorías). Esta última variante del esquema se condujo hasta el egreso del paciente en el día +147, a la conclusión de la radioterapia adyuvante.

Examinado la evolución del paciente, y la respuesta al tratamiento quirúrgico, cabría proponer una actuación alternativa por medio de la cual se colocara una gastrostomía laparoscópica en el día +3 del ingreso, y se implementara un esquema combinado de alimentación asistida por sonda de gastrostomía (que previera la administración de alimentos energéticamente densos como huevo: 3 unidades diarias, aceite vegetal: 2 cucharadas diarias, y leche entera fluida: 3 tomas diarias de 250 mL cada una) junto con la suplementación con 60 gramos (6 cucharadas) diarios de un nutriente polimérico sin fibra (= 177 kilocalorías); esquema éste que se conduciría hasta el egreso hospitalario, una vez concluida la radioterapia adyuvante.

La tabla IV muestra los costes de las rutas de tratamiento consideradas en el paciente. El coste de la ruta seguida por el grupo básico de trabajo que asistió al enfermo fue de 59.626,84 CUP, coste explicado (en parte) por la prolongada estadía hospitalaria. Si, por el contrario, se hubiera adoptado la ruta alternativa, se podría hipotetizar que se hubieran logrado ahorros por 42.467,96 CUP en el mejor de los casos posibles, en ausencia de infección o complicación post-quirúrgica. Los costes incurridos en la implementación y conduc-

ción del programa perioperatorio de apoyo nutricional hubieran representado apenas el 0,5% de los costes totales del tratamiento médico-quirúrgico.

Tercer caso: Costes de la incorporación de un paquete de apoyo nutricional perioperatorio en el tratamiento quirúrgico del cáncer colorrectal

La tabla V muestra los costes de las acciones médico quirúrgicas (incluidas las conducidas como parte de los programas perioperatorios de apoyo nutricional) en 24 pacientes operados electivamente de cáncer colorrectal. Los costes promedio de las acciones médico quirúrgicas fueron superiores en los pacientes intervenidos nutricionalmente: *No intervenidos*: 11.234,59 CUP vs. *Intervenidos*: 11.845,63 CUP ($\Delta = +611,04$). La implementación del paquete de apoyo nutricional resultó en 14.664,87 CUP añadidos sobre los costes totales de la conducta quirúrgica tradicional. Las intervenciones nutricionales se asociaron a una estadía hospitalaria más prolongada (*No intervenidos*: 26,04 $\pm$ 11,10 días vs. *Intervenidos nutricionalmente*: 28,91 $\pm$ 11,75 días; $t = +2,90$; $p < 0,05$; test de comparación de medias independientes); y menores tasas de complicaciones (*No intervenidos*: 45,8% vs. *Intervenidos nutricionalmente*: 33,3%; $\Delta = +12,50$; $p > 0,05$; test de comparación de proporciones independientes) y mortalidad (*No intervenidos*: 12,5% vs. *Intervenidos nutricionalmente*: 8,3%; $\Delta = +4,20$; $p > 0,05$; test de comparación de proporciones independientes).

Si se conduce el análisis coste-efectividad según la ecuación (5), y si se toman como medidas de la efectividad tanto el número de pacientes que egresan vivos como el incremento en la tasa de supervivencia, entonces las intervenciones nutricionales representarían un coste de 12.922,50 CUP por cada egresado vivo ($\Delta = +82,97$ CUP adicionales respecto de los sujetos no intervenidos nutricionalmente) y 3.101,40 CUP por cada incremento en la tasa de supervivencia ($\Delta = +19,91$ CUP adicionales respecto de los no intervenidos).

El ACE se complementó con el ACEI empleando para ello los costes totales de las intervenciones nutricionales hasta el momento en que se reabre la vía oral, y antes de que ocurra la primera complicación¹⁶. Los resultados del ACEI se muestran en la tabla VI. Los costes totales de las acciones médico quirúrgicas hasta la ocurrencia de la primera complicación ascendieron a 194.857,72 CUP en los sujetos intervenidos nutricionalmente ($\Delta = +87.793,04$ CUP). Incrementar en 12,5 puntos porcentuales la tasa de éxitos implicó erogar 1.314,93 CUP ($= \{194.857,72 - 163.269,44\} / 24$)

16 Complicación: Evento inesperado (si bien predecible) en la historia natural de una acción médico-quirúrgica, y que puede afectar al éxito de la misma, y/o poner en peligro la vida del paciente. El tratamiento de la complicación obliga a nuevas acciones médico-quirúrgicas. La complicación puede dejar (o no) secuelas en el estado de salud del paciente¹³.

Tabla IV
Costes de la actuación médico-quirúrgica en el caso expuesto del paciente aquejado de un tumor de la hemimandíbula izquierda. Los costes se expresan en CUP. Para más detalles: Consulte la sección "Resultados" de este artículo

	Caso real	Caso hipotético
Días de estadía	147	40
Costes:		
Estancia hospitalaria	29.491,14	8.024,8
Procederes quirúrgicos	887,80	723,87
Complementarios diagnósticos	376,26	269,25
Antibióticos	1.219,20	
Vías de acceso	30,42	209,18
Radioterapia	179,20	179,20
Nutrientes enterales	401,50	10,25
Costes directos	32.762,80	9.427,96
Otros costes ^b	26.865,50	7.730,92
Costes totales ^a	59.626,84	17.158,88 [-42.467,96]

^aDeterminados mediante la expresión (3). ^bDeterminados de la diferencia Costes totales – Costes directos.

Tabla V
Análisis coste-efectividad de las intervenciones nutricionales en pacientes operados electivamente de cáncer colorrectal

	Conducta quirúrgica	
	Sin intervención nutricional	Con intervención nutricional
Número de pacientes	24	24
Días de estadía	26,04 ± 11,10	28,91 ± 11,75
Tasa de complicaciones	45,8	33,3 [-12,5]
Tasa de mortalidad	12,5	8,3 [-4,2]
Costes totales, CUP ^a	269.630,22	284.295,09 [+14.664,87]
Per paciente	11.234,59	11.845,63 [+611,04]
ACE		
Pacientes egresados vivos, CUP/paciente	12.839,53	12.922,50 [+82,97]
Tasa de supervivencia, CUP/porcentaje de supervivencia	3.081,49	3.101,40 [+19,91]

^aDeterminados mediante la expresión (3).

adicionales por cada de los 24 pacientes intervenidos nutricionalmente.

Cuando se toma como medida de la efectividad incremental el número de pacientes que egresan vivos sin complicarse, el egreso de un paciente sin complicarse implicó erogar 380,58 CUP menos que en los sujetos no intervenidos. Igualmente, cuando se toma

como medida de la efectividad incremental la tasa de éxitos (tenidos éstos como los sujetos que egresan sin complicarse), incrementar en un punto la tasa de éxitos significa erogar 91,33 CUP menos que en los sujetos no intervenidos. Luego, se pueden anticipar ahorros de hasta 380,58 CUP por cada paciente que se opere y no se complique.

Tabla VI
Análisis coste-efectividad incremental de las intervenciones nutricionales en pacientes operados electivamente de cáncer colorrectal

	Conducta quirúrgica	
	Sin intervención nutricional	Con intervención nutricional
Costes totales, CUP ^a	163.269,44	194.857,72 [+31.588,28]
Per paciente	6.802,89	8.119,07 [+1.316,18]
Complicaciones evitadas	13	16 [+3]
Tasa de éxitos, %	54,2	66,7 [+12,5]
ACEI		
Pacientes que egresan sin complicaciones, CUP/ paciente no complicado	12.559,19	12.178,60 [-380,59]
Incremento en la tasa de éxitos, CUP/porcentaje de éxito	3.014,21	2.922,87 [-91,34]

^aDeterminados mediante la expresión (3).

Adicionalmente, el coste-efectividad de evitar una complicación adicional mediante la implementación de un paquete de intervención nutricional resulta mucho menor que el coste-efectividad (promedio) de la acción médico quirúrgica en ausencia del mismo: *Sujetos no intervenidos nutricionalmente*: 12.839,53 CUP (= 269.630,22 CUP / 21 egresados vivos) vs. *Sujetos intervenidos*: 10.529,43 CUP (= {194857,72 – 163269,44} / {16 – 13} sujetos operados no complicados}; $\Delta = +1.520,02$ CUP). Luego, si bien la implementación de un paquete de intervención nutricional implica en una primera observación un incremento de los costes totales de la acción médico quirúrgica, lo cierto es que estos costes adicionales resultan en ahorros significativos por cada caso que se opera y egresa sin complicarse.

Discusión

En este trabajo se ha presentado un modelo para el diseño y la implementación de un sistema de análisis de los costes de la intervención nutricional conducida en los pacientes atendidos en un hospital terciario de la ciudad de La Habana. Pero independientemente del lugar que ocupe una institución hospitalaria dentro del Sistema Nacional de Salud, este modelo debe servir para estimar los costes de las intervenciones nutricionales hechas por las organizaciones hospitalarias encargadas de la provisión de cuidados alimentarios y nutricionales al paciente, y elaborar juicios de valor sobre la efectividad de las mismas y el impacto que tengan sobre las estadísticas de la gestión de la institución.

Mediante este modelo se pudo estimar el coste de la provisión de una unidad de energía alimenticia | nutricional mediante diferentes esquemas: el primer elemento que el proveedor de cuidados alimentarios y nutricionales debe tener en cuenta llegado el momento de la intervención. Si fuera provista mediante alimentos, la unidad de energía alimentaria costaría 0,006 CUP, lo que resultaría en 12,00 CUP para un menú tipificado de 2.000 kilocalorías. Un trabajo orientado a la planificación de menús alimentarios según los cánones de la “Dieta mediterránea” dirigidos a ancianos encontró que el coste rondaba los 5,00 € *pér cápita*¹⁴. Más allá de equiparaciones cambiarias, el trabajo citado y el presente concuerdan en que la oferta de alimentos debe ser la opción primaria de intervención por muchas razones, incluida la económica.

La presente investigación también ha demostrado cómo el método de implementación de la intervención nutricional puede influir en el coste de la unidad de energía administrada. El análisis de costes realizado pudiera servir entonces para desaconsejar la colocación de gastrostomías laparotómicas con fines de apoyo nutricional si se puede acceder a una gastrostomía percutánea. Igualmente, mediante este análisis también se demostró que, una vez instalado el esquema correspondiente, los costes de infusión de las siguientes 2.000 kilocalorías es esencialmente constante, y ello puede contribuir al “abaratamiento” de los esquemas de apoyo nutricional.

Por otro lado, el modelo descrito en este artículo ha servido para anticipar los ahorros que se hubieran logrado en un caso especificado si se hubiera seguido otra ruta diferente de tratamiento que incluyera un programa especificado de apoyo nutricional perioperatorio.

rio. Contra un incremento de apenas el 1,0% debido a la implementación del esquema de apoyo nutricional, los costes de las acciones médico quirúrgicas hubieran sido un 75% inferior a los observados.

Finalmente, el tercer caso de aplicación del sistema de análisis de costes descrito en este artículo, y extrapolado de la práctica clínica de uno de los autores, ha demostrado que si bien la implementación y conducción de un esquema de apoyo nutricional sobre una conducta médico quirúrgica puede parecer onerosa, se traduciría a mediano y largo plazos en ahorros notables al mejorar la tasa de éxitos, la tasa de supervivencia, y lograrse un egreso más temprano. De esta manera, se confirman observaciones hechas previamente^{15,16}. Estos resultados son relevantes por cuanto en un estudio retrospectivo de los resultados de la actuación médico-quirúrgica en el cáncer colorrectal se comprobó que la desnutrición asociada al cáncer colorrectal puede incrementar los costes *pér cápita* en 3.360,00 €, y gravar al sistema nacional de salud con 10 millones de euros¹⁷.

Desde sus orígenes, la terapia nutricional se ha conducido en diversos escenarios clínicos y quirúrgicos bajo la hipótesis de que los costes de acciones adicionales sobre el enfermo pueden revertirse en ahorros considerables¹⁸⁻²⁰. A pesar de los atractivos que encierra^{21,22}, esta hipótesis no ha podido realizarse fehacientemente, y ello, en parte, pudiera ser el resultado de la falla de los grupos básicos de trabajo en incorporar y aplicar creadoramente las herramientas de análisis de costes²³.

Por otro lado, la implementación de un sistema de análisis de costes de las intervenciones nutricionales no puede estar desligada de la existencia y operación de los otros sistemas incluidos dentro de un PRINUMA. La estimación de los costes de las acciones médico quirúrgica implica la existencia de registros trazables de las mismas. Es posible entonces que la pobre utilización de las técnicas de análisis de costes en la práctica de la terapia nutricional sea debida a políticas inadecuadas de documentación y registro de las intervenciones hechas por las organizaciones encargadas de la provisión de cuidados alimentarios y nutricionales al enfermo^{13,24}.

Se ha establecido fehacientemente que la desnutrición asociada a la enfermedad puede encarecer desproporcionadamente los costes de la actuación médico-quirúrgica. El Estudio PREDyCES reveló que la desnutrición que se precipita en un paciente durante la estadía hospitalaria puede incrementar en 5.829,00 € los costes de las prestaciones: un monto alarmante, más si se tiene en cuenta que la desnutrición suele presentarse en (como mínimo) la tercera parte de los hospitalizados en cualquier momento del ingreso²⁵. Otra encuesta concluida en hospitales de Noruega arribó a conclusiones parecidas²⁶. Los costes acumulados del tratamiento de los adultos hospitalizados que se desnutren pueden ser exorbitantes, aún para economías consideradas solventes²⁷.

Es necesario tener siempre presente que toda acción que se ejecute sobre un paciente implica erogaciones importantes en recursos humanos, diagnósticos y terapéuticos. Por lo tanto, debe ser una responsabilidad del equipo de salud saber cuánto le cuesta a la institución y al Sistema de Salud Pública la prestación de cuidados de salud al paciente (incluidos los alimentarios y nutricionales), a fin de que elaboren las estrategias pertinentes que resulten en ahorros tangibles, junto con una calidad mejor percibida de la asistencia médica.

En el caso particular de Cuba, las consideraciones sobre los costes en salud son absolutamente necesarias: los servicios de salud de nuestro país, a pesar de ser gratuitos para el que los recibe, exigen desembolsos importantes por parte del Estado. En el mundo como el presente, moldeado y marcado por las restricciones económicas y presupuestarias, es entonces tan importante conocer el valor monetario de los recursos consumidos como el número de unidades consumidas en el cuidado de un enfermo. Por consiguiente, la austeridad financiera y la eficacia en la utilización de los recursos diagnósticos y terapéuticos es el camino obligado para mantener y expandir los beneficios del Sistema Cubano de Salud. Bajo esta premisa, si bien es cierto que el apoyo nutricional de un enfermo puede resultar costoso, más lo será si el mismo se difiere. Por consiguiente, la introducción de un lenguaje económico en la práctica médica actual es indispensable tanto para contener los costes crecientes de la asistencia médica, como para asegurar la prestación de servicios médicos a un número cada vez mayor de personas.

En la misma cuerda, la conveniencia de la prestación de un servicio médico pasa por considerar tanto el coste de la misma, como la utilidad (beneficio) que reporta, y lo que es más importante: los ahorros que se obtendrían de su implementación en otros rubros de la actividad asistencial. En tal sentido, la terapia nutricional puede ser una intervención de salud redituable económicamente. El uso de suplementos nutricionales orales superpuesto sobre la prescripción dietética puede reducir el coste de la actuación médico-quirúrgica en casi 5.000,00 USD *pér cápita*²⁸. Pueden esperarse también ahorros monetarios importantes después del uso de terapias nutricionales con un alto valor científico y tecnológico agregado. El uso de inmunonutrientes en la cirugía gastrointestinal puede reducir los costes de la estadía hospitalaria en 1.500,00 € *pér cápita*²⁹. El uso de protocolos estandarizados de nutrición parenteral resultaría en ahorros anuales de 86.700,00 € *pér hospital*³⁰. Tales ahorros podrían reinvertirse en la provisión hospitalaria de los cuidados alimentarios y nutricionales, y sufragarían la introducción de las nuevas tecnologías de apoyo nutricional.

Conclusiones

Con la publicación de este trabajo culmina la serie de publicaciones orientadas a exponer las bases

para el diseño y la implementación de un PRINUMA en un ámbito hospitalario^{31,32}. Se espera que la incorporación de los postulados expuestos en las mismas sirva para asegurar que el paciente recibe los mejores cuidados alimentarios y nutricionales posibles, dentro de una relación coste-efectividad definida. Ello debe resultar en ahorros monetarios sensibles, una mejor gestión del recurso humano, y una superior calidad percibida de la atención médica.

Limitaciones del estudio

El presente trabajo ha expuesto algunas de las herramientas de análisis de costes que pueden aplicarse en el contexto de la práctica de la terapia nutricional. Para ello, se han utilizado casos clínicos seleccionados de entre los atendidos por el Grupo hospitalario de Apoyo Nutricional. Si bien se han adoptado las previsiones requeridas para asegurar la mejor representatividad de los casos, no puede dejar de observarse que pudieran haberse introducido sesgos debido a la selección *post-hoc* de los pacientes. Por otro lado, la heterogeneidad de los esquemas administrados de soporte nutricional pudiera convertirse en otra fuente de sesgos: inevitable en un escenario tan cambiante como lo es el de la provisión de cuidados alimentarios y nutricionales al enfermo. Sin embargo, la corrección de tal heterogeneidad hubiera implicado

afectación del efectivo muestral, y con ello, pérdida de la potencia de las herramientas de análisis. La conducción de ensayos prospectivos, aleatorizados, bajo el principio de “*Intention-To-Treat*” serviría para controlar todos estos sesgos, y así, confirmar los hallazgos de este trabajo.

Igualmente, las herramientas descritas se aplicaron a las medidas de apoyo nutricional conducidas durante la hospitalización del enfermo. Sería deseable en venideras investigaciones explorar el impacto (y los ahorros conseguidos) si los cuidados alimentarios y nutricionales se proveen ambulatoriamente: la premisa encerrada en el segundo caso clínico discutido. El hospital ha experimentado una profunda transformación como el ente articulador de los servicios de salud^{33,34}, y muchas de las acciones que antes hubieran requerido el ingreso del enfermo, hoy se conducen ambulatoriamente. Las herramientas de análisis de costes como las que se han descrito aquí pudieran ser instrumentales a la hora de decidir la externación de los cuidados alimentarios y nutricionales.

Finalmente, se ha discutido la aplicación de las herramientas de análisis de costes en la operación de un sistema de salud subsidiada dentro de una economía estatizada. Si bien los principios generales de uso de las mismas pueden ser independientes de las características del sistema particular de salud, se aconseja cautela en la extrapolación de los ejemplos colocados en este trabajo hacia otras economías de salud.

Anexo 1

Propuesta de menú semanal de una dieta general hospitalaria

	Lunes	Martes	Miércoles	Jueves	Viernes	Sábado	Domingo
Desayuno	Leche c/café (1 vaso) Pan (1 u) Mantequilla (2 cdtas)	Leche c/café (1 vaso) Pan (1 u) Mantequilla (2 cdtas)	Leche c/café (1 vaso) Pan (1 u) Mantequilla (2 cdtas)	Leche c/café (1 vaso) Pan (1 u) Mantequilla (2 cdtas)	Leche c/café (1 vaso) Pan (1 u) Mantequilla (2 cdtas)	Leche c/café (1 vaso) Pan (1 u) Mantequilla (2 cdtas)	Leche c/café (1 vaso) Pan (1u) Mantequilla (2 cdtas)
Merienda	Jugo de frutas (¾ taza)	Jugo de frutas (¾ taza)	Jugo de frutas (¾ taza)	Jugo de frutas (¾ taza)	Jugo de frutas (¾ taza)	Jugo de frutas (¾ taza)	Jugo de frutas (¾ taza)
Almuerzo	Frijoles negros (½ taza) Picadillo de carne de res (2 onzas) Arroz blanco (1 taza) Vianda hervida (½ taza) Ensalada de vegetales (1 taza) Mermelada de frutas (2 cdas) Queso (1 oz)	Sopa de pollo (1 Taza) Pollo guisado (1 oz) Arroz amarillo c/pollo (½ taza) Vianda hervida (½ taza) Ensalada de vegetales (1 taza) Mermelada de frutas (2 cdas) Queso (2 oz)	Chícharos (1 taza) Tronchos de Jurel (1 u) Arroz blanco (1 taza) Vianda hervida (½ taza) Ensalada de vegetales (1 taza) Mermelada de frutas (2 cdas) Queso (2 oz)	Hamburguesa de carne de res (1 u) Frijoles colorados (½ taza) Arroz blanco (1 taza) Vianda blanco (1 taza) Vianda hervida (½ taza) Ensalada de vegetales (1 taza) Mermelada de frutas (2 cdas) Queso (2 oz) Queso (2 oz)	Lengua guisada (2 onzas) Lentejas (½ taza) Arroz blanco (1 taza) Vianda hervida (½ taza) Ensalada de vegetales (1 taza) Mermelada de frutas (2 cdas) Queso (2 oz)	Perro caliente guisado (1 u) Judías (½ taza) Arroz blanco (1 taza) Vianda hervida (½ taza) Ensalada de vegetales (1 taza) Mermelada de frutas (2 cdas) Queso (2 oz)	Carne ripiada (2 onzas) Sopa de vegetales (½ taza) Arroz amarillo con vegetales (½ taza) Vianda hervida (½ taza) Ensalada de vegetales (1 taza) Mermelada de frutas (2 cdas) Queso (1 oz)

Anexo 2
Composición nutrimental de la propuesta de menú de la Dieta General

	Contenido energético (Kcal)	Carbohidratos (g)	Grasas (g)	Proteínas (g)	Distribución energética (%)		
					Carbohidratos	Grasas	Proteínas
Lunes	2230 (111,5%)	310	66	92 (115,0%)	56,0	27,0	17,0
Martes	2240 (112,0%)	299	74	96 (120,0%)	53,0	30,0	17,0
Miércoles	2265 (113,3%)	317	66	94 (117,5%)	56,0	26,0	17,0
Jueves	2155 (107,7%)	309	62	85 (106,3%)	57,0	26,0	16,0
Viernes	2260 (113,0%)	309	69	96 (120,0%)	55,0	27,0	17,0
Sábado	2075 (103,7%)	300	61	80 (100,0%)	58,0	26,0	15,0
Domingo	2000 (100,0%)	276	64	82 (102,5%)	55,0	29,0	16,0

Notas: El menú se elaboró teniendo como meta un ingreso energético de 2000 Kcal/24 horas, y proteico de 80 g de proteínas; respectivamente. Entre paréntesis, se muestra la adecuación de la dieta ajustada a la meta propuesta.

Referencias

- Dressler G. Organización y administración. Enfoque situacional. Prentice-Hall. New York: 1976.
- Ramírez Barba EJ, Hernández Aranda JC. Evaluación económica y nutrición. *Nutrición enteral y parenteral* (Editores: Arenas Márquez H, Anaya Prado R). McGraw-Hill Interamericana. Ciudad México: 2007. pp 586-591.
- Le Trosne. D l'intérêt social. Physiocrate P(4). Cd. Daire. París: 1846. pp 889.
- Lusted LB. Signal detectability and medical decision making. *Science* 1971; 171:1217-9.
- Murphy SP, White KK, Park SY. Multivitamin-multimineral supplements' effect on total nutrient intake. *Am J Clin Nutr* 2007;85(Suppl):280S-284S.
- Martínez González C, Santana Porbén S. Diseño e implementación de un esquema intrahospitalario de Nutrición enteral. *RCAN Rev Cubana Aliment Nutr* 2001; 15:130-8.
- Santana Porbén S, Barreto Penié J, Martínez González C, Borrás Espinosa A. Diseño e implementación de un esquema intrahospitalario de Nutrición Parenteral. I. Nutrición Parenteral Periférica. *RCAN Rev Cubana Aliment Nutr* 2007;17:186-208.
- Santana Porbén S, Barreto Penié J, Martínez González C, Borrás Espinosa A. Diseño e implementación de un esquema intrahospitalario de Nutrición Parenteral. II. Nutrición Parenteral Central. *RCAN Rev Cubana Aliment Nutr* 2008;18:93-125.
- Pinzón Espitia OL, Varón Vega ML. Protocolo listo para usar para el manejo de la Nutrición Parenteral Periférica en pacientes quirúrgicos. *Nutrición Hospitalaria España* 2015;31:1003-11.
- Culebras JM, De Paz R, Jorquera F, García de Lorenzo A. Nutrition in the surgical patient: Immunonutrition. *Nutr Hosp España* 2001;16:67-77.
- Martinuzzi ALN, Ferraresi E. Immunonutrición. *RCAN Rev Cubana Aliment Nutr* 2011;21:129-46.
- Nehme AE. Nutritional support of the hospitalized patient. *JAMA* 1980; 283:1906-8.
- Santana Porbén S. Sistema de Documentación y Registros. Su lugar dentro de un Programa de Intervención Alimentaria, Nutrimental y Metabólica. *Nutrición Hospitalaria España* 2005;20:331-42.
- San Mauro I, Cendón M, Soulas C, Rodríguez D; para el Grupo de Investigación NIPAH Nutrición en Inmigración, Pobreza y Ayuda Humanitaria. Meal planning in the elderly: Nutritional and economic aspects. *Nutrición Hospitalaria España* 2012; 27:2116-21.
- León Rodríguez R, Santana Porbén S, Collazo Herrera M, Barreto Penié J. Coste-efectividad de intervenciones alimentario-nutrimientales vs. tratamiento farmacológico en pacientes colorrectales. II parte. *Rev Cubana Farm* 2005;39(2):0-0. Disponible en: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0034-75152005000200009&lng=es&nrm=iso.
- León Rodríguez R, Santana Porbén S, Collazo Herrera M, Barreto Penié J. Coste-efectividad de intervenciones alimentario-nutrimientales vs. hospitalización en pacientes colorrectales. *Rev Cubana Farm* 2003;37(1):10-19. Disponible en: http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0034-75152003000100002&lng=es&nrm=iso.
- Melchior JC, Préaud E, Carles J, Bami M, Duru G, Fontaine E, Hébuterne X, Lukacs B, Zazzo JF, Panis Y, Nitenberg G. Clinical and economic impact of malnutrition per se on the postoperative course of colorectal cancer patients. *Clin Nutr* 2012;31:896-902. Erratum en: *Clin Nutr* 2014;33:927.
- Reilly JJ, Hull SF, Albert N, Waller A, Bringardener S. Economic impact of malnutrition: A model system for hospitalized patients. *JPEN J Parenter Enteral Nutr* 1988;12:371-6.
- Weinstein MC, Stasson WB. Foundations of cost-effectiveness analysis for health and medical practice. *N Engl J Med* 1977;296:716-21.
- Twomey PL, Patching SC. Cost effectiveness of nutritional support. *JPEN J Parenter Enteral Nutr* 1985;9:3-10.
- Tucker HN, Miguel SG. Cost containment through nutrition intervention. *Nutrition Reviews* 1996;54:111-21.
- Smith PE, Smith AE. High-quality nutritional interventions reduce costs. *Healthcare Financ Management* 1997;51:66-9.
- Taheri PA, Butz D, Griffes LC, Morlock DR, Greenfield LJ. Physician impact on the total cost of care. *Ann Surg* 2000; 231:432-5.
- Bruun LI, Bosaeus I, Bergstad L, Nygaard K. Prevalence of malnutrition in surgical patients: Evaluation of nutritional support and documentation. *Clin Nutr* 1999;18:141-7.
- Álvarez-Hernández J, Planas Vila M, León-Sanz M, García de Lorenzo A, Celaya Pérez S, García-Lorda P, Araujo K, Sarto Guerri B; a nombre de los investigadores de PREDyCES. Prevalence and costs of malnutrition in hospitalized patients; The PREDyCES Study. *Nutr Hosp*. 2012;27:1049-59.
- Tangvik RJ, Tell GS, Eisman JA, Guttormsen AB, Henriksen A, Nilsen RM, Øyen J, Ranhoff AH. The nutritional strategy: Four questions predict morbidity, mortality and health care costs. *Clinical Nutrition* 2014;33:634-41.
- Freijer K, Swan Tan S, Koopmanschap MC, Meijers JMM, Halfens RJG, Nuijten MJC. The economic costs of disease related malnutrition. *Clinical Nutrition* 2013;32: 136-41.
- Tappenden KA. The value of nutrition intervention Editorial. *JPEN J Parenter Enteral Nutr* 2013;37:160.
- Chevrou-Séverac H, Pinget C, Cerantola Y, Demartines N, Wasserfallen JB, Schäfer M. Cost-effectiveness analysis of

- immune-modulating nutritional support for gastrointestinal cancer patients. *Clinical Nutrition* 2014;33:649-54.
30. Berlana D, Barraquer A, Sabin P, Chicharro L, Pérez A, Puiggrós C, Burgos R, Martínez Cutillas J. Impact of parenteral nutrition standardization on costs and quality in adult patients. *Nutrición Hospitalaria España* 2014;30:351-8.
 31. Barreto Penié J, Martínez González C, Santana Porbén S. Programa de Intervención Alimentaria, Nutrimental y Metabólica. *RCAN Rev Cubana Aliment Nutr* 1999;13:137-44.
 32. Santana Porbén S, Barreto Penié J. Programa de Intervención en Nutrición hospitalaria: Acciones, diseño, componentes, implementación. *Nutrición Hospitalaria España* 2005;20:351-7.
 33. McKee M, Healy J. The role of the hospital in a changing environment. *Bull World Health Organ* 2000; 78:803-10.
 34. Preker A, Harding A. The economics of hospital reform: From hierarchical to market-based incentives. *World Hosp Health Serv* 2003;39:3-10,42,44.



Original/Otros

Intervención activa en la hipercolesterolemia de pacientes con riesgo cardiovascular alto de Atención Primaria; estudio ESPROCOL

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Resumen

Introducción: la hipercolesterolemia es uno de los principales factores de riesgo modificables de la enfermedad cardiovascular (ECV). Su reducción disminuye la morbimortalidad por cardiopatía isquémica y ECV en general, en prevención primaria y, especialmente, en prevención secundaria.

Objetivo: comprobar si una práctica clínica protocolizada e intensiva permite vencer la inercia y alcanzar el objetivo terapéutico (OT) de c-LDL < 100 mg/dL en pacientes de alto riesgo asistidos en Atención Primaria (AP) de nuestro país.

Metodología: estudio epidemiológico, prospectivo, multicéntrico, realizado en centros de AP de diferentes CC. AA. Mediante muestreo consecutivo se incluyeron 310 pacientes de alto riesgo cardiovascular (diabéticos o con ECV establecida), tratados previamente con estatinas, que no alcanzaban el OT de c-LDL.

Resultados: los sujetos del estudio tenían una edad media de 65,2 años, de los que el 60,32 % eran varones. El 41,64 % presentaban un EVC previo, infarto agudo de miocardio (20,33 %), angina (16,07 %), ictus/AIT (9,19 %), artropatía (5,25 %), diabetes (70,87 %), hipertensión (71,01 %) y obesidad abdominal (69,62 %). El 43,57 % (IC95 %: 37,21; 50,08) de los pacientes que realizaron la segunda visita (241) consiguieron el OT. El 62,50 % (IC95 %: 55,68; 68,98) de los que realizaron la tercera (216) consiguieron el OT. Finalmente, el 77,56 % (IC95 %: 72,13; 83,08) de los pacientes que realizaron la última visita (205) consiguieron el OT. A lo largo del estudio hubo una reducción de los niveles de c-LDL desde los 135,6 mg/dL en la visita basal, 107,4 mg/dL en la segunda visita, 97,3 mg/dL en la tercera visita, hasta los 90,7 mg/dL en la visita final ($p < 0,0001$). El incremento de c-HDL entre la visita basal (50,9 mg/dL) y la final (53,6 mg/dL) también fue significativo ($p = 0,013$).

ACTIVE INTERVENTIONS IN HYPERCHOLESTEROLEMIA PATIENTS WITH HIGH CARDIOVASCULAR RISK IN PRIMARY CARE; ESTUDIO ESPROCOL

Abstract

Introduction: hypercholesterolemia is a major modifiable risk factors for cardiovascular disease (CVD). Its reduction reduces morbidity and mortality from ischemic heart disease and CVD in general, primary prevention and secondary prevention especially.

Objective: to determine whether a notarized and intensive clinical practice can overcome inertia and achieve the therapeutic goal (OT) LDL-C <100 mg / dL in high-risk patients attended in Primary Care (PC) in our country.

Methodology: epidemiological, prospective, multicenter study conducted in centers of different ACs By AP consecutive sampling 310 patients at high cardiovascular risk (diabetic or established CVD) previously treated with statins, which did not reach the OT included c-LDL.

Results: the study subjects had a mean age of 65.2 years, of which 60.32 % were male. The 41.64 % had a previous EVC, acute myocardial infarction (20.33 %), angina (16.07 %), stroke / TIA (9.19 %), arthropathy (5.25 %), diabetes (70.87 %), hypertension (71.01 %), and abdominal obesity (69.62 %). The 43.57 % (95 % CI: 37.21; 50.08) of patients who performed the 2nd visit (241) got the OT. 62.50 % (95 % CI: 55.68, 68.98) of those who took the 3rd (216) got the OT. Finally, 77.56 % (95 % CI: 72.13, 83.08) patients who performed the last visit (205) got the OT. Throughout the study there was a reduction in LDL-C levels from 135.6 mg / dL at baseline, 107.4 mg / dL in the 2nd visit, 97.3 mg / dL in the 3rd visit, up to 90.7 mg / dL at the final visit ($p < 0.0001$) The increase in HDL-C from baseline (50.9 mg / dL) and final (53.6 mg / dL) was also significant ($p = 0.013$).

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Recibido: 23-III-2015.
Aceptado: 23-IV-2015.

Conclusiones: la reevaluación e intensificación del tratamiento en pacientes de alto riesgo cardiovascular atendidos en Atención Primaria, aplicando las indicaciones de las guías, permite alcanzar el OT en más de las tres cuartas partes de los previamente no controlados en el plazo de medio año. Estos resultados nos deben estimular a superar la inercia terapéutica en el control de la ECV mediante una actuación precoz y enérgica ante la hipercolesterolemia.

(*Nutr Hosp.* 2015;31:2727-2734)

DOI:10.3305/nh.2015.31.5.8998

Palabras clave: *Prevención secundaria. Control de la hipercolesterolemia. Inercia terapéutica.*

Introducción

Las enfermedades cardiovasculares (ECV) constituyen la causa más frecuente de mortalidad en los países desarrollados, tanto la patología de las coronarias como de las cerebrales, son origen de una gran morbi-mortalidad. La prevalencia de estos procesos aumenta con la edad¹⁻³ y se espera que aumente considerablemente en las próximas décadas⁴. El proceso responsable de la enfermedad es común (arteriosclerosis), pero sus factores de riesgo son múltiples y sus manifestaciones clínicas, diferentes, dependiendo del territorio vascular afecto.

Los factores de riesgo cardiovascular modificables mejor caracterizados hasta la actualidad son la hipertensión arterial (HTA), la diabetes mellitus (DM), el tabaquismo, la obesidad, la dislipemia y el sedentarismo.

Tanto en su prevención primaria como en la secundaria, esta enfermedad ocupa una gran parte de la actividad diaria del médico de atención primaria y especializada, y consume una importante proporción de tiempo y recursos. El objetivo principal en la atención de este tipo de pacientes consiste en identificar e intervenir sobre todos los factores de riesgo para intentar controlarlos, dado el indudable beneficio de ello, tanto mayor cuanto mayor sea el riesgo absoluto del paciente.

La asociación entre niveles de colesterol y ECV está asimismo influida por la presencia de otros factores de riesgo cardiovasculares asociados a la dislipidemia. La presencia de diabetes o de niveles altos de triglicéridos, o de niveles bajos de colesterol HDL agrava los efectos del colesterol total aunque sus niveles estén tan sólo ligeramente elevados. Este motivo es fundamental para la estimación global del riesgo CV. La presencia de unos niveles de triglicéridos > 1,7 mmol/l (150 mg/dl) es uno de los criterios utilizados en la definición de síndrome metabólico.

Existen multitud de estudios sobre los beneficios en la reducción del cLDL en la prevención secundaria al igual que la intervención sobre el cHDL por tanto las guías de prevención van encaminadas a la reducción del primero y el aumento del segundo combinadas así con el control de otros factores de riesgo CV.

Conclusions: the reassessment and intensification of treatment in patients at high cardiovascular risk treated in primary care, applying the indications of the guides, achieves the OT in more than three quarters of the previously uncontrolled within half a year. These results should encourage us to overcome the therapeutic inertia in the control of CVD by early and energetic performance against hypercholesterolemia.

(*Nutr Hosp.* 2015;31:2727-2734)

DOI:10.3305/nh.2015.31.5.8998

Key words: *Secondary prevention. Control of hypercholesterolemia. Therapeutic inertia.*

A pesar de las evidencias existentes sobre el beneficio de controlar los factores de riesgo, los resultados de los estudios que evalúan el grado de control de cada uno de ellos en estos pacientes han sido decepcionantes, tanto en prevención primaria como secundaria. A pesar de que tanto la hipertensión arterial (HTA) y/o la diabetes mellitus (DM) están presentes en la génesis de la mayor parte de las ECV^{5,6}, cuando evaluamos dichos procesos, encontramos que están muy lejos^{7,8} de alcanzar los objetivos de tratamiento⁹, si bien últimamente están en discusión los objetivos establecidos tan estrictos en el caso de la HTA¹⁰⁻¹³. Sin embargo está fuera de discusión que los pacientes con mayor riesgo de desarrollar un nuevo evento CV son los que ya lo han padecido previamente, sobre todo si además son pacientes diabéticos¹⁴ por lo que serían éstos los que deberían ser objeto de nuestro mayor esfuerzo (prevención secundaria) en el trabajo cotidiano. En el estudio EUROASPIRE II, que hace referencia al grado de control en pacientes con enfermedad coronaria recogidos durante los años 1999 y 2000 en diferentes países europeos, incluido España, se constata que el grado de control de la HTA era tan sólo del 50 %, el 72 % de los diabéticos no estaban controlados, el 58 % no tenían sus cifras de colesterol controladas, el 21 % eran fumadores activos y el 31 % eran obesos. Los datos existentes se refieren al grado de control de cada uno de los factores de riesgo por separado; sin embargo, no existen datos sobre el porcentaje de pacientes que tienen controlados simultáneamente todos sus factores de riesgo, es decir, los pacientes que presentan un control integral, que, en definitiva, es el objetivo terapéutico real. Es esperable que, ya que el análisis individual sobre el grado de control de cada factor de riesgo en España ha demostrado ser pobre, aún lo sea más el control simultáneo de todos ellos. Esto ocurriría incluso en los pacientes de riesgo más elevado, en quienes es indudable el beneficio de la intervención. Los factores implicados en la falta de control son múltiples e incluyen desde deficiencias en la adherencia al tratamiento a actitudes por parte del médico poco intervencionistas o la falta de coordinación entre niveles asistenciales. Desgraciadamente, esta situación se da a pesar de un aparente consumo elevado de recursos.

Este trabajo pretende confirmar el porcentaje de los pacientes dislipémicos confirmados diabéticos y/o con enfermedad CV que alcanzan el objetivo terapéutico de c-LDL < 100 mg/dl (OT-cLDL) al aplicar recomendaciones clínicas seleccionadas de las Guías de Práctica Clínica.

Material y métodos:

Estudio epidemiológico, prospectivo, multicéntrico, realizado en el ámbito de Atención Primaria (AP). La duración del estudio fue de 24 ± 2 semanas, con 4 visitas bimestrales.

Población de estudio: pacientes de alto riesgo cardiovascular [diabéticos o con enfermedad cardiovascular (ECV)] que no alcanzaban el objetivo terapéutico (OT) de c-LDL < 100 mg/dL. Mediante muestreo consecutivo se incluyeron en el estudio 321 pacientes, de los cuales, 11 no cumplían criterios de inclusión (Figura 1). Los sujetos de estudio tenían una edad media de $65,2 \pm 11,1$ (DT) años, de los que el 60,32 % eran varones. Los FRCVs y enfermedades asociadas de la población estudiada se describen en las tablas I y II. El 99,34 % de la población estaba en tratamiento basal hipolipemiante con estatinas, el 3,93 % con inhi-

bidor de la absorción intestinal de colesterol, el 3,40 % con resinas, fibratos o ácido nicotínico, y el 9,03 % con fitoterapia.

El objetivo principal fue conocer el porcentaje de pacientes diabéticos o con ECV que alcanzan el OT de c-LDL < 100 mg/dL al aplicar en la práctica clínica las recomendaciones de la Adaptación Española de las Guías Europeas de Prevención Cardiovascular.

Resultados

La edad media de la población de estudio fue de $65,2 \pm 11,1$ (DT) años. La visita basal (VB) la realizaron 310 pacientes, 249 realizaron la visita 1 (V1), 227 realizaron la visita 2 (V2) y 213 realizaron la visita final (VF).

El 43,57 % (IC95 %: 37,21; 50,08) de los pacientes que realizaron la V2 (241) consiguieron el OT. El 62,50 % (IC95 %: 55,68; 68,98) de los pacientes que realizaron la V3 (216) consiguieron el OT. Finalmente, el 77,56 % (IC95 %: 72,13; 83,08) de los pacientes que realizaron la VF (205) consiguieron el OT.

A lo largo del estudio, todas las diferencias de los porcentajes de cumplimiento del OT en las V2, V3 y VF con respecto a las visitas previas fueron estadísti-

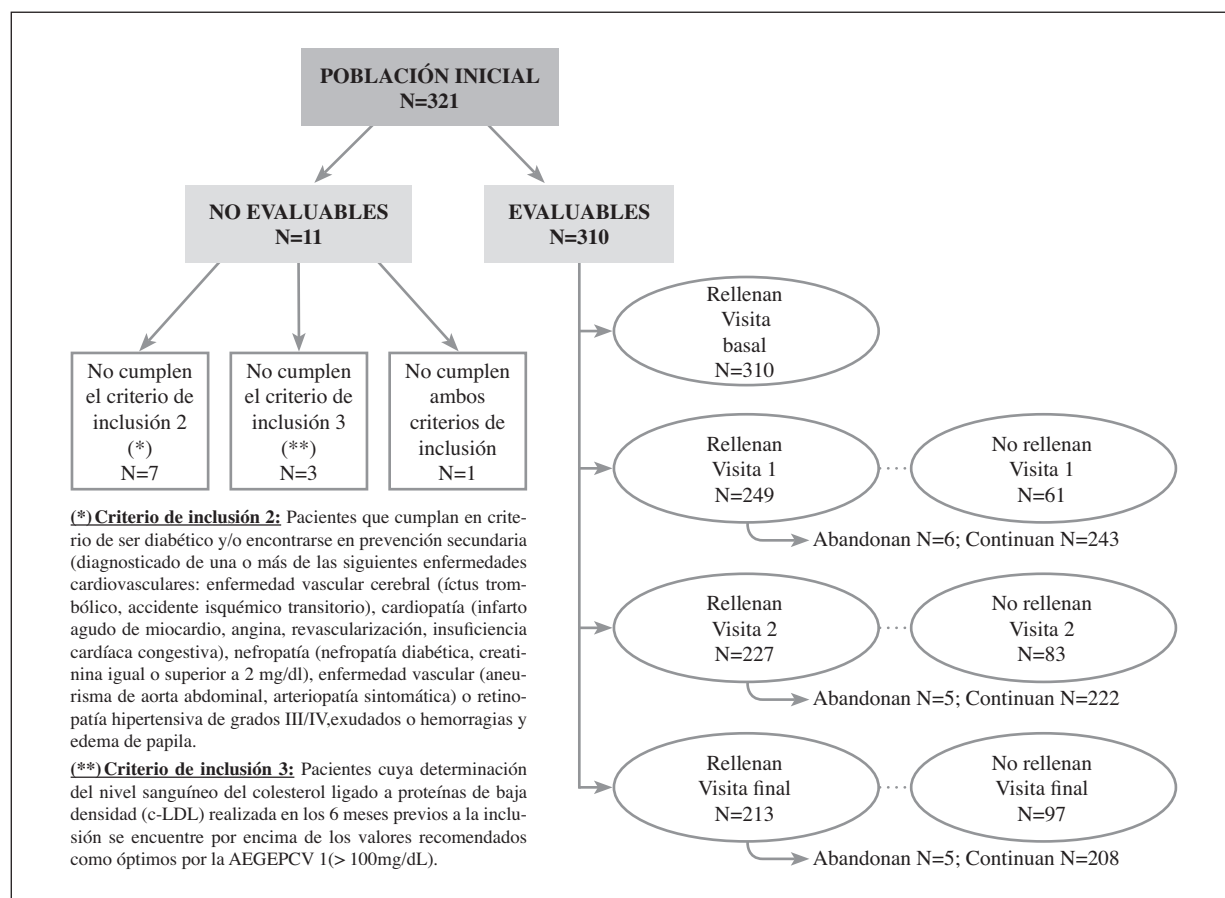


Fig. 1.—

Tabla I			
FRCVs	N	n	%
Hipertensión arterial	307	218	71,01
Diabetes	309	219	70,87
Obesidad abdominal	293	204	69,62
ECV previa	305	127	41,64
Tabaquismo	307	65	21,17
Hª fam. 1º grado ECV	295	62	21,02
Consumo alcohol	302	46	15,23
Sedentarismo	307	161	52,44

Tabla II			
Enfermedades asociadas	N	n	%
Infarto agudo de miocardio	305	62	20,33
Angina	305	49	16,07
Revascularización coronaria	306	26	8,50
Fibrilación auricular	304	19	6,25
Insuficiencia cardiaca congestiva	304	13	4,28
Ictus trombótico / infarto lacunar	306	26	8,50
Accidente isquémico transitorio	291	2	0,69
Arteriopatía sintomática	305	16	5,25
Aneurisma aorta abdominal	304	5	1,64
Nefropatía diabética	306	12	3,92
Proteinuria	305	11	3,61
Insuficiencia renal	305	9	2,95
Retinopatía hipertensiva (III/IV)	296	16	5,41
Exudados o hemorragias	295	7	2,37
Retinopatía avanzada	290	5	1,72

camente significativas ($p < 0,0001$): 43,57 % (IC95 %: 37,31; 49,83) en V2 vs VB; 18,93 % (IC95 %: 9,94; 27,92) en V3 vs V2; 15,06 % (IC95 %: 6,44; 23,68) en VF vs V3.

El perfil lipídico mejoró significativamente en cada visita realizada (figura 2 y tabla III). Todas las disminuciones de los niveles medios de colesterol total, triglicéridos y c-LDL en las V2, V3 y VF con respecto a las determinaciones de las anteriores visitas fueron estadísticamente significativas ($p < 0,0001$). El incremento de c-HDL también fue significativo ($p = 0,013$).

A lo largo del estudio, no hubo variaciones significativas en la evolución del resto de los parámetros analizados excepto en la disminución de la glucemia (-15,8 mg/dL) ($p < 0,0001$) y en la del perímetro abdominal (-2,5 cm) ($p = 0,011$) (Figura 3).

Las medias (mg/dL) de los niveles de c-LDL en aquellos que consiguieron el OT fueron $83,0 \pm 13,4$ en la V2; $83,2 \pm 13,0$ en la V3; y $82,7 \pm 14,1$ en la VF. Los porcentajes de reducciones necesarios para conseguir el OT en las distintas visitas se especifican en el figura 4.

Discusión

Las enfermedades cardiovasculares constituyen la primera causa de morbilidad en los países socioeconómicamente avanzados.

Los pacientes con riesgo cardiovascular (RCV) alto son aquellos que presentan entre un 20 y un 40 % de probabilidades de sufrir una complicación cardiovascular en los próximos 10 años. Suelen ser pacientes que acumulan varios factores de riesgo cardiovascular (FRCV), o tienen diabetes o alguna lesión en sus órganos diana. La intervención sobre este tipo de pacientes debe ser más exhaustiva que sobre otros con menor riesgo. Así si nuestras exigencias de normocolerolemia para la población general son de entre 120-130 mg de cLDL, en este caso debemos rebajarla

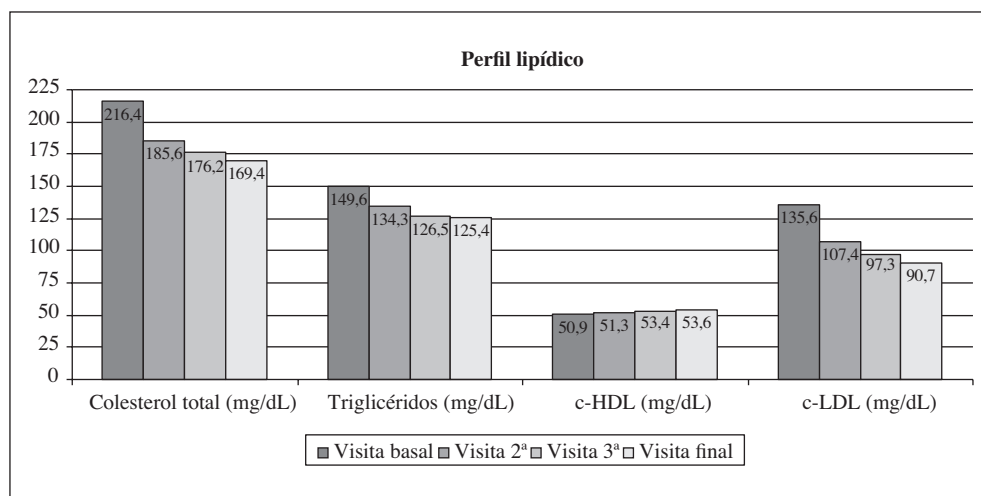


Fig. 2. — Perfil Lipídico

Tabla III
Evolución Perfil lipídico

<i>Evolución del perfil lipídico</i>	<i>VB</i>	<i>V2 - V1</i>	<i>V2</i>	<i>V3 - V2</i>	<i>V3</i>	<i>VF - V3</i>	<i>VF</i>	<i>VF - VB</i>
Colesterol total (mg/dL)	216,4	-30,8	185,6	-9,4	176,2	-6,8	169,4	-47,0
p-valor		<0,0001		<0,001		0,008		<0,0001
Triglicéridos (mg/dL)	149,6	-15,3	134,3	-7,8	126,5	-1,1	125,4	-24,2
p-valor		0,003		0,103		0,832		<0,0001
c-HDL (mg/dL)	50,9	0,4	51,3	2,1	53,4	0,2	53,6	2,7
p-valor		0,708		0,081		0,869		0,013
c-LDL (mg/dL)	135,6	-28,2	107,4	-10,1	97,3	-6,6	90,7	-44,9
p-valor		<0,0001		<0,0001		0,003		<0,0001

a menos de 100 mg. La diabetes de por sí configura un RCV alto. De hecho, la presencia de diabetes en términos de RCV se equipara a la del postinfartado.

Cobra una importancia capital tratar de mantener un peso adecuado en estos pacientes con un programa específico de dieta y ejercicio y suprimir el consumo de tabaco. Debemos vigilar muy estrechamente la circulación en árbol coronario y arterias cerebrales de los diabéticos, ya que la lesión incipiente de arteriosclerosis se caracteriza por la disminución del calibre de estas y se asemeja a un daño vascular. Es muy importante el control metabólico de estos pacientes.

A pesar de la insistencia de los distintos consensos de la conveniencia de alcanzar los objetivos de control de la tensión arterial, diabetes y dislipemia, objetivos por otro lado cada vez más exigentes, en la práctica clínica diaria se observa que éstos están lejos de un nivel óptimo. Esta situación nos la encontramos tanto en la prevención primaria¹⁶ como, y eso es más grave, en la prevención secundaria. La media de edad de nuestros pacientes (65.2 años) como era presumible es alta²⁻³. En cuanto a las distintas variables evaluadas, encontramos que el tabaquismo si bien ha

ido descendiendo evolutivamente hasta el 8.5 % de los pacientes, consideramos que esta prevalencia es alta, máxime tratándose de pacientes en prevención secundaria.

Los resultados del presente estudio indican una mejora apreciable en el grado de consecución de los objetivos terapéuticos del colesterol LDL respecto a los estudios previos realizados en otros ámbitos asistenciales, así como un cambio significativo en la prescripción del tratamiento hipolipemiente, especialmente estatinas, en una población dislipidémica atendida en Atención Primaria.

El 43,57 % de los pacientes que realizaron la Visita 2 (241) consiguieron el objetivo terapéutico. El 62,50 % de los pacientes que realizaron la Visita 3 (216) consiguieron el OT. Finalmente, el 77,56 % de los pacientes que realizaron la Visita Final (205) consiguieron el OT.

Si bien son numerosos los estudios observacionales y transversales que han analizado el grado de consecución de los objetivos terapéuticos, los estudios longitudinales de ámbito nacional como el actual son mucho más escasos²⁰⁻²¹.

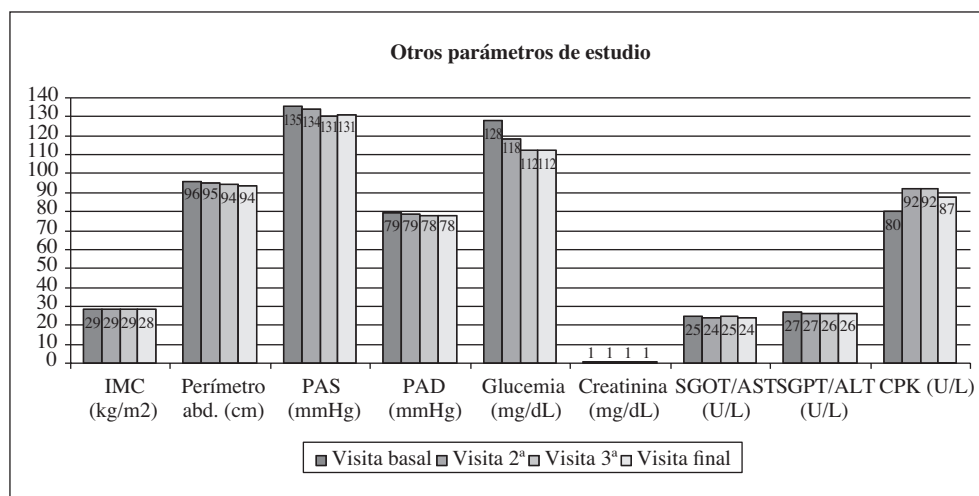


Fig. 3.—Otros parámetros de estudio.

Queda patente que casi el 50 % de los pacientes analizados a pesar de tener RCV alto o diabetes no estaban en el objetivo de colesterol LDL, a pesar de que aproximadamente el 65 % recibían fármacos hipolipemiantes, fundamentalmente estatinas, la mayoría a dosis bajas/moderadas. En la última visita hubo un incremento significativo de todos los tratamientos farmacológicos hipolipemiantes.

Por lo que respecta a la estrategia farmacológica hipolipemiante, en la última visita hubo un claro predominio de la estrategia de moderada-alta potencia. En concreto, casi se dobló la prescripción de estatinas potentes a dosis elevadas (atorvastatina 80 mg), así como el tratamiento de coadministración de estatina más ezetimiba^{18,22}.

Este cambio de actitud terapéutica, comportó una reducción media en colesterol LDL del 33 % con respecto al basal sin tratamiento, y del 16 % comparado al basal en tratamiento.

Con respecto a ese último dato, hay que tener en cuenta que si bien las estatinas a las máximas dosis toleradas son el primer escalón en el tratamiento hipolipemiante, la duplicación de la dosis aporta una reducción media adicional del 6 %²³⁻²⁶, y el cambio a una estatina más potente, dependiendo de la dosis, comporta un descenso suplementario del 9 %²⁰. Por otra parte, estos resultados ponen de relieve de forma directa que el seguimiento activo de los pacientes con cLDL no controlada mejora significativamente.

Globalmente, el 65 % de los pacientes alcanzaron los objetivos terapéuticos en colesterol LDL. Estos resultados muestran una discreta mejoría con respecto a los referidos en el Informe SEA 2007²⁷, y superponibles a los referidos para los pacientes españoles incluidos en el estudio L-TAP 2, pero netamente inferior a otros como los Países Bajos, Estados Unidos, Canadá y Corea²⁸. Esta situación de déficit terapéutico tiene gran relevancia clínica, ya que la falta de consecución de los objetivos de colesterol LDL se asocia a una elevada morbilidad cardiovascular, la cual se reduce tanto más cuanto menor es la concentración de colesterol LDL alcanzada²⁹⁻³¹.

A pesar de que estos resultados son, sin duda alguna, mejorables, indican un avance positivo en comparación con otros estudios longitudinales nacionales.

En este sentido, el estudio REALITY15, que analizó el patrón de uso y prescripción de fármacos hipolipemiantes a lo largo del tiempo y su relación con el grado de consecución de los objetivos terapéuticos en 619 pacientes con enfermedad cardíaca coronaria o riesgo equivalente, concluye que solo el 20,2 % alcanzaron el objetivo en términos de colesterol LDL después de 3 años de seguimiento.

El estudio Improve It incluye a pacientes muy sensibilizados tras síndrome coronario agudo con un seguimiento de 57 meses con tasas de seguimiento altas 91 % y que pese a tener un cLDL de partida bajo 95 mg/dl se consiguió una reducción significativa a 54 mg/dl. Por tanto, IMPROVE IT ha acabado de corroborar la teoría lipídica: cuanto más se bajen los niveles de colesterol LDL, mayor mejoría pronostica se obtiene, independientemente de con qué se baje el colesterol LDL.³¹⁻³⁴

En la regresión logística multivariante los factores que mostraron una asociación significativa e independiente con el éxito terapéutico fueron los parámetros lipídicos, el perímetro de cintura abdominal y la diabetes. Es obvio decir que, por su carácter predictor, estos factores están presentes en la visita inicial. En estudios previos los determinantes de la consecución del objetivo terapéutico en colesterol LDL fueron mayor edad, diabetes, cardiopatía isquémica y estatinas³⁵⁻³⁷.

En conclusión, los resultados del presente estudio demuestran que el grado de consecución de los objetivos terapéuticos del colesterol LDL ha mejorado, particularmente en los pacientes en prevención secundaria o con diabetes, a expensas de una mayor utilización de estrategias farmacológicas de moderada/alta potencia. Por tanto, este estudio avala la utilidad y la eficacia del seguimiento activo en Atención Primaria en el control de los pacientes de alto riesgo vascular como herramienta del proceso asistencial en

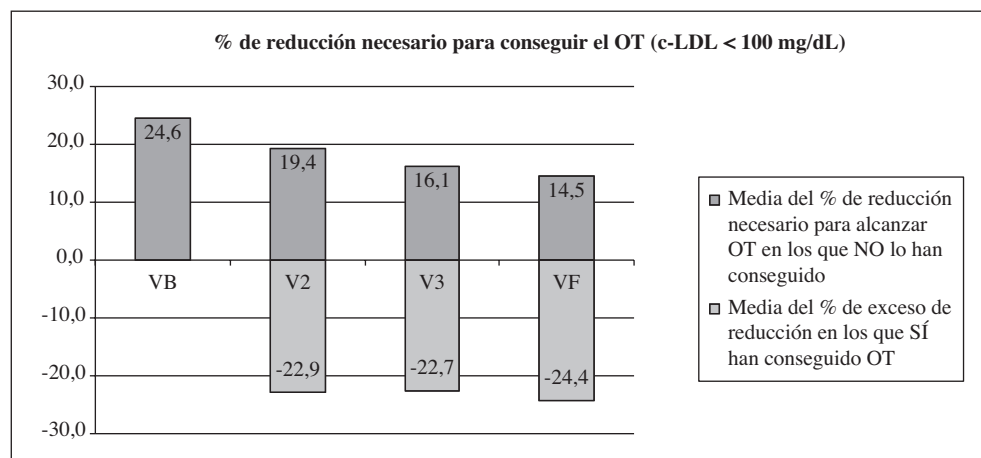


Fig. 4.—Reducción necesaria para conseguir objetivo terapéutico.

nuestro entorno. Sin embargo, también pone de manifiesto la necesidad de un control más eficaz de los pacientes dislipidémicos³⁷.

Referencias

- Cruz I, Serna C, Real J, Galindo G, Gascó E, Galván L. Ischemic heart disease and primary care: identifying gender-related differences. An observational study. *BMC Fam Pract* 2008;9:60.
- Perez Rodrigo, Carmen. Mapping de la obesidad actual. *Nutr Hosp* [online]. 2013, vol.28, suppl.5, pp. 21-31. ISSN 0212-1611
- García-Palmieri MR. Evidence based secondary prevention of coronary artery disease in the elderly—2006. *P R Health Sci J* 2006; 25:229-39.
- Michael KM, Shaughnessy M. Stroke prevention and management in older adults. *J Cardiovasc Nurs* 2006;21:S21-6.
- Saposnik G, Cote R, Phillips S, Gubitz G, Bayer N, Minuk J, et al. Stroke outcome Research Canada (SORCan) Working Group. Stroke outcome in those over 80: a multicenter cohort study across Canada. *Stroke* 2008; 39:2310-7.
- Álvarez J, Quintana M, Hernández MA, Álvarez C, Chaves J, Ribo M. Therapeutic interventions and success in risk factor control for secondary prevention of stroke. *J Stroke Cerebrovasc Dis* 2009;18:460-5.
- Saposnik G, Goodman SG, Leiter LA, Yan RT, Fitchett DH, Bayer NH. Applying the evidence: do patients with stroke, coronary artery disease, or both achieve similar treatment goals?. *Stroke* 2009;40:1417-24.
- Romero Moraleda, Blanca y ProbaF Study Group et al. ¿El modo de ejercicio puede ser determinante en la mejora del perfil lipídico en pacientes con obesidad?. *Nutr Hosp* [online]. 2013, vol.28, n.3, pp. 607-617. ISSN 0212-1611.
- Flu HC, Tamsma JT, Lindeman JH, Hamming JF, Lardenoye JH. A systematic review of implementation of established recommended secondary prevention measures in patients with PAOD. *Eur J Vasc Endovasc Surg* 2010;39:70-86.
- Gitt AK, Jünger C, Smolka W, Bestehorn K. Prevalence and overlap of different lipid abnormalities in statin-treated patients at high cardiovascular risk in clinical practice in Germany. *Clin Res Cardiol* 2010;99:723-33.
- Sacco RL, Adams R, Albers G. Guidelines for prevention of stroke in patients with ischemic stroke or transient ischemic attack: A statement for healthcare professionals from the American Heart Association/American Stroke Association Council on Stroke; cosponsored by the Council on Cardiovascular Radiology and Intervention; the American Academy of Neurology affirms the value of this guideline. *Circulation* 2006;113:e409-e449.
- ACCORD Study Group, Cushman WC, Evans GW, Byington RP, Goff DC, Grimm RH, Cutler JA et al. Effects of intensive bloodpressure control in type 2 diabetes mellitus. *N Engl J Med* 2010;362:1575-85.
- Mancia G, Laurent S, Agabiti-Rosei E, Ambrosioni E, Burnier M, Caulfield MJ et al. Reevaluación de las directrices europeas sobre el tratamiento de la hipertensión: un documento del Grupo de Trabajo de la European Society of Hypertension. *J Hypertens* 2009;27:2121-58.
- Anderson RJ, Bahn GD, Moritz TE, Kaufman D, Abaira C, Duckworth W. Blood pressure and cardiovascular disease risk in the Veterans Affairs Diabetes Trial. *Diabetes care* 2011;34:34-8.
- Cooper-Dehoff RM, Gong Y, Handberg EM, Bavry AA, Denardo SJ, Bakris GL et al. Tight blood pressure control and cardiovascular outcomes among hypertensive patients with diabetes and coronary artery disease. *JAMA* 2010;304:61-8.
- Bouhanick B, Cambou JP, Ferrieres J, Amelineau E, Guize L. Characteristics and six-month outcomes in a cohort of 8288 diabetic and non-diabetic patients with previous history of acute coronary syndrome or stroke: the French PREVENIR 3 survey. *Diabetes Metab* 2006;32:460-6.
- Executive Summary of the Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of high blood cholesterol in adults (Adult treatment panel III). *JAMA* 2001;285:2486-97.
- Banegas JR, López E, Dallongeville J, Guallar E, Halcox JP, Borghi C, et al. Achievement of treatment goals for primary prevention of cardiovascular disease in clinical practice across Europe: the EURIKA study. *Eur Heart J* 2011;32:2143-52.
- Cervantes Cuesta, Miguel Ángel y Reina Sofia University Hospital. Collaborative Group of the Diabetes Unit et al. La terapia psicoeducativa grupal en atención primaria ayuda en el control de la diabetes tipo 2. *Nutr Hosp* [online]. 2013, vol.28, n.2, pp. 497-505. ISSN 0212-1611.
- M. Ruano Gil I, V. Silvestre Teruel E, E. Aguirregoicoa García I, L. Criado Gómez I, Y. Duque López I y G. García-Blanch. Nutrición, síndrome metabólico y obesidad mórbida. *Nutr Hosp* 2011; 26(4):759-764.
- H. Okuyama, Y. Ichikawa, Y. Sun, T. Hamazaki and WEM Lands. Prevention of coronary heart disease. From the cholesterol hypothesis to w6/w3 balance. *Nutr Hosp* v.22 n.4 Madrid jul.-ago. 2007.
- De la Peña A, Roca B, Cuende I, Calabuig JR, Montes J, Muñoz M et al. Efecto de una intervención global sobre el control integral de múltiples factores de riesgo en pacientes con alto o muy alto riesgo cardiovascular. Estudio CIFARC2. *Rev Clin Esp* 2007; 207:112-20.
- García Ruiz FJ, Marín Ibáñez A, Pérez-Jiménez F, Pintó X, Nocea G, humada C, et al., REALITY Study Group. Current lipid management and low cholesterol goal attainment in common daily practice in Spain. The REALITY Study. *Pharmacoeconomics* 2004;22 Suppl. 3: 12.
- De la Peña Fernández A, Roca Villanueva B, Cuende Melero I, Calabuig Alborch JR, Montes Santiago J, Muñoz Rodríguez M, et al. Efecto de una intervención global sobre el control integral de múltiples factores de riesgo en pacientes con alto o muy alto riesgo cardiovascular. Estudio CIFARC 2. *Rev Clin Esp* 2007; 207:112---20.
- Lázaro P, Murga N, Aguilar D, Hernández-Presa MA, en nombre de los investigadores del estudio INERCIA. Inercia terapéutica en el manejo extrahospitalario de la dislipemia en pacientes con cardiopatía isquémica. Estudio INERCIA. *Rev Esp Cardiol* 2010;63:1428-37.
- Carlos Guijarro-Herraiza, Luis Masana-Marinb, Enrique Galvez y Alberto Cordero-Fort. Control del colesterol LDL en pacientes de muy alto riesgo vascular. Algoritmo simplificado para alcanzar objetivos de colesterol LDL «en dos pasos». *Clin Invest Arterioscl* 2014;26(5):242-252
- Kotseva K, Wood D, de Backer G, de Bacquer D, Pyörälä K, Keil U. Cardiovascular prevention guidelines in daily practice: A comparison of EUROASPIRE I, II, and III surveys in eight European countries. *Lancet* 2009;373:929-40.
- Guallar E, Banegas JR, Blasco-Colmenares E, Jiménez FJ, Dallongeville J, Halcox JP, et al. Excess risk attributable to traditional cardiovascular risk factors in clinical practice settings across Europe - The EURIKA Study. *BMC Public Health* 2011;11:704.
- García Ruiz FJ, Marín Ibáñez A, Pérez-Jiménez F, Pintó X, Nocea G, Ahumada C, et al. Current lipid management and low cholesterol goal attainment in common daily practice in Spain. The REALITY Study. *Pharmacoeconomics* 2004;22 Suppl 3:1-12.
- Millán J, Alegría E, Guijarro C, Lozano JV, Vitale GC, González-Timón B, et al. Dislipemia en población diabética tratada con estatinas. Resultados del estudio DYSIS en España. *Med Clin (Barc)* 2013;141:430-6.
- Emilia Arrebola Vivas, Bricia López Plaza, Thabata Koester Weber, Laura Bermejo López, Samara Palma Milla, Arturo Lisbona Catalán y Carmen Gómez-Candela. Variables predictoras de baja adherencia a un programa de modificación de estilos de vida para el tratamiento del exceso de peso en atención primaria. *Nutr Hosp* 2013;28(5):1530-1535.
- Baena-Díez JM, Félix FJ, Grau M, Cabrera de León A, Sanz H, Leal M, et al. Tratamiento y control de los factores de riesgo según el riesgo coronario en la población española del estudio DARIOS. *Rev Esp Cardiol* 2011;64:766-73.

33. Guallar-Castillón P, Gil-Montero M, León-Muñoz LM, Graciani A, Bayán-Bravo A, Taboada JM, et al. Magnitude and management of hypercholesterolemia in the adult population of Spain, 2008-2010: The ENRICA study. *Rev Esp Cardiol* 2012; 65:551-8.
34. Pérez de Isla L, Saltijeral Cerezo A, Vitale G, González Timón B, Torres do Rego A, Alvarez-Sala Walther LA. Prevalencia de colesterol LDL inadecuado en pacientes con enfermedad coronaria y/o diabetes mellitus tipo 2. *Rev Clin Esp* 2012;212:475-81.
35. Pedro-Botet J, Mostaza JM, Pintó X, Banegas JR, en nombre del Grupo de Investigadores EDICONDIS-ULISEA. Achievement of low-density lipoprotein cholesterol therapeutic goal in lipid and vascular risk units of the Spanish Arteriosclerosis Society. *Clin Investig Arterioscler* 2013;25:155-63.
36. Cannon CP, et al. IMPROVE IT. Sesiones Científicas de la AHA. Lunes 17.11.14, Chicago, USA.
37. Sattar NA, Ginsberg H, Ray K, et al. The use of statins in people at risk of developing diabetes mellitus: Evidence and guidance for clinical practice. *Atherosclerosis Supplements* 2014;15(1):1-15.



Original/Otros

Food intake reported *versus* nursing records: is there agreement in surgical patients?

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Abstract

Objectives: to evaluate the agreement between oral feeding by patients and chart records of this acceptance.

Method: Besides the food intake surveys of surgical patients, the nursing records of nutrition were evaluated. It was considered *good oral feeding*: intake $\geq 75\%$ of total calories prescribed at the day; *medium acceptance*: 50 to 74.9%; *low acceptance*: $< 50\%$ and NPO (nothing per oral). The Kappa coefficient was adopted to assess agreement.

Results: there were similar answers between patient and nursing records in 91.3% of NPO situations, 87.1% for *good oral feeding*, 17.8% for medium acceptance and 16.5% for low acceptance (Kappa = 0.45).

Conclusion: agreement between patient's reports and nursing records was moderate to low. A higher proportion of similar answers were observed when the patients related *good oral feeding* or NPO.

(Nutr Hosp. 2015;31:2735-2739)

DOI:10.3305/nh.2015.31.6.8691

Key words: Food Intake. Nursing Records. Hospitalization.

¿ACEPTACIÓN DE LA DIETA ORAL REPORTADA POR PACIENTES Y LOS REGISTROS DE ENFERMERAS: EXISTE ACUERDO EN PACIENTES QUIRÚRGICOS?

Resumen

Objetivo: evaluar la concordancia entre la aceptación de la dieta oral reportada por los pacientes y los registros en prontuario de esta aceptación.

Método: fueron evaluados el consumo de alimentos y los registros de la ingestión en prontuario por las enfermeras. Se consideró "buena aceptación": la ingesta de $\geq 75\%$ de las calorías totales prescritas por día, "regular aceptación": de 50 a 74,9%; "baja aceptación": $< 50\%$ y NPO (nada por la boca). Para la evaluación de la concordancia fue utilizado el coeficiente Kappa.

Resultados: la proporción de respuestas coincidentes entre el relato del paciente y el registro de las enfermeras fue 91,3% en casos de NPO, 87,1% para "buena aceptación", 17,8% para "regular aceptación" y 16,5% para "baja aceptación" (Kappa = 0,45).

Conclusión: la concordancia entre los relatos de los pacientes y los registros de las enfermeras fue de moderada a débil. Hubo una mayor proporción de respuestas coincidentes cuando los pacientes informaron "buena aceptación" o cuando había NPO prescrito.

(Nutr Hosp. 2015;31:2735-2739)

DOI:10.3305/nh.2015.31.6.8691

Palabras clave: Ingestión de Alimentos. Registros de Enfermería. Hospitalización.

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Recibido: 20-I-2015.
1.ª Revisión: 2-III-2015.
Aceptado: 23-III-2015.

Introduction

About the high prevalence of malnutrition¹ and its negative impact on non-systematic hospital outcomes^{2,3}, there is an impression that food acceptance records through oral feeding made on records by nurses, when existing, are restricted to summarize the acceptance by oral feeding with an adjective (example: “good oral feeding”). It appears to be more related to the ability to chew or swallow than the quantity of ingested food. Besides that, in those records where there is any reference to low acceptance of food by oral health, not always seems to have a nursing prescription of any specific care to minimize this condition. Although malnutrition is configured as the highest prevalent comorbidity inside hospitals, it is not observed that diagnoses and related nursing care follow the same proportion. The nurse, as a health team member, should acquire knowledge to act in the prevention as well as in the recovery of compromised nutrition states and also in the recognition of signals requiring nursing interventions⁴.

The increment in the assessment of the records' quality is observed with interest as theme of investigations. A study at a university hospital in São Paulo State identified diagnose registers, prescriptions and nursing evolution happened in 41%, 75.2% and 45.8% respectively, and only 11.3% were complete records⁵. Specifically in surgical patients, recent studies about nursing records has been providing important subsidies to the care planning⁶. A study with surgical patients at a school hospital in Paraná State found 20.8% of nursing prescriptions were incomplete⁷.

Although the magnitude and relevance of this problem, nursing actions involved in the surgical patient care, not always seem to be sufficiently directed to change this situation. For this reason, the need to identify how much nurses from a university hospital who have resources to adopt an assistance system and where the prevalence of malnutrition in adults is higher than 50%^{1,8} identify nutritional changes in its assistance routine, register this fact and take notes, is justified. Thus, the present study aimed to evaluate the agreement between food acceptance by food intake referred by patients and the registrations in nursing records.

Method

The study project was approved regarding its ethical and methodological aspects by the Ethics in Research Committee of the institution under the protocol nº 11-0307.

Between August 2011 and October 2012, patients under elective surgeries, with exception of cardiovascular specialties and neurosurgery and those with no conditions to answer the food intake surveys, that had enteral or parenteral nutrition in the admission or those consuming food not provided by the hospital, were considered eligible.

One nurse did the total food intake surveys (records from 24 hours), following a previously applied protocol⁹. Participants were asked about the quantity of consumed food in each meal (breakfast, lunch, afternoon snack, dinner, night snack), in the last 24 hours and the information was registered in a specific instrument. She also revised the records to identify if the nursing records contained information about food intake. Any suggestive information present in the evolution records referred to acceptance of food by oral feeding was considered. Information was considered similar when those provided by patients and those from nursing evolution records attended the described criteria in figure 1.

Analyses were run with the *PASW Statistics* program, version 20.0. Descriptive analysis respected the characteristics and distribution of variables.

The total estimate considered the results from a pilot study conducted by the authors, proceeding 174 intake controls in 27 patients in total. From those 8.5% were identified as inadequate intake from nursing registries in the records and 44.7% with adequate intake. Thus, it was estimated to evaluate 56 eating surveys, accepting a 95% confidence interval of precision for the differences within proportions, for a 5% significance level, power of 80%, ratio of 1 patient exposed to adequate intake for each patient exposed to an inadequate intake. Considering the high number of available observations, from a patient's cohort follow-up, it was opted to extend the sample for the study period. For the studied sample (3259 food intake inquiries), for a

Eating survey (patient report)	Nursing registries (in the record)
Good acceptance by oral via: $\geq 75\%$ of total calories prescribed per day.	Accepting well through oral via; good acceptance of OV [*] ; eating well; GOF [†]
Medium acceptance by oral via: 50 to 74,9% of total prescribed calories.	Partially accepting; MAOV [‡] , moderate acceptance; regular diet acceptance.
Low acceptance by oral via: $< 50\%$ of total prescribed calories.	LAOV [§] ; diminished ingestion; did not accept well the diet; bad acceptance.
Patient informed have not ingested food in the past 24 hours due to medical determination.	NPO : considered adequate if this information is in the nursing evolution.

*oral via; [†]good oral feeding; [‡]medium acceptance oral via; [§]low acceptance oral via; ^{||}nothing per oral.

Fig. 1.—Coincidence criteria between patient report and nursing record.

5% significance level, power of 80% and accepting a 95% confidence interval, it was found that a sample of 1123 observation is capable to determine if a Kappa coefficient of 0.4 is statistically different from a Kappa coefficient of 0.5%.

Results

From total hospitalized patients for elective surgeries during the study period (n=1047), 595 attended to eligibility criteria. Each patient presented a 5 (3-8) days eating survey median (24 hours of eating records), generating 3259 patients/day of follow-up (addition of the days when each patient was evaluated regarding the eating survey and the nursing registries in their records later assessed for agreement). In only 1719 patients/day there was some type of register about oral feeding acceptance in the nursing evolution, where the patient's acceptance was categorized by nurses as: "good oral feeding" (39.8%), "medium acceptance" (16.0%), "low acceptance" (21.5%) and "NPO" (22.7%).

The highest proportion of coincident information between patients and nurses was observed when the oral feeding acceptance was "good" or there was "NPO"; and lower proportions of coincidences when it was "medium" and "low". When assessing the agreement between the information related by the patients (eating surveys) and the nurses records (evolution) it was identified moderate to low agreement (Kappa=0.448).

They were first line in figure 2 shows 32.2% of nursing registries tended to overestimate what the patients were actually ingesting, once they reported medium or low acceptance, or they were in NPO. Also, when nurses classified intake as medium (2nd line), in about 40% of the cases there was worse intake reported by patients. On the other hand, when nurses classified oral feeding acceptance as "low" (3rd line), 34.2% of surveys pointed to better acceptance by the patients. Still, when there was NPO registered by nurses (4th line), about 40% of registries demonstrated the patients accepting the diet, even when in little quantities.

When the agreement was stratified by the day of observation, low to moderate agreement was identified with a Kappa coefficient varying between 0.276 (on the 5th day) and 0.537 (on the 2nd day). There was also lower proportion of coincidence between the patient's and nurses' information in the intermediate categories of food acceptance by oral feeding (medium and low acceptance).

Discussion

The present study identified moderate to low agreement between the patient's report of food quantity consumed during hospitalized days and the registries done by nurses in the patient's charts.

Big dimension studies as the nutritionDay have been producing available information about nutritional care, including food intake⁹. In one of its editions, 16,290 hospitalized adults were assessed and it was found more than half of patients not eating their whole meal offered by the hospital¹⁰. Only 40.4% from those patients reported "good oral feeding" ($\geq 75\%$ of prescribed calories), while other studies showed 34 to 58% patients eating their whole meal¹⁰⁻¹².

Regarding the food acceptance registry done by nurses, those professionals tend to register a higher acceptance than the patient actually ingested. A direct observational study compared the acceptance registries done by nurses with photography methods, demonstrating over estimation in nursing registries for food intake in 22% and the team did not identified 53% of patients who ingested less than 75% of most part of meals¹³.

Regarding the agreement, in general it is observed no modification between agreement percentage proportions in 10 days. In the extremes (*good oral feeding* and *NPO*) high levels of agreement are perceived between food intake reported by patients and registered by nurses, while in the intermediate levels (*low* and *medium acceptance*) there were low levels of agreement. Exactly in inadequate food intake situations, that is, in those requiring actions directed to the problem,

Nursing (evolution)	Patient's information (eating survey)					TOTAL
		GOF*	MAOV†	LAOV‡	NPO§	
	GOF*	596	159	108	16	879
	MAOV†	34	49	51	4	138
	LAOV‡	22	17	61	14	114
	NPO§	32	50	149	357	588
	TOTAL	684	275	369	391	1719

*good oral feeding; †medium acceptance oral via; ‡low acceptance oral via; §nothing per oral.

Fig. 2.—Coincident answers between eating surveys and evolution recorded by nurses.

the nurse does not register the exact information of ingested food. Regarding the high number of patients with insufficient food intake, there is a need to change attitude of clinical practice professionals. A study published in 2009 showed more than half of patients who ingested less than 25% of their meals did not receive additional nutrition support and only 25% of patients who did not eat at lunch were receiving it¹⁰.

In a scenario with high prevalence of patients presenting nutritional deficits who does not ingest all offered food, the nutritional care should be understood as a fundamental part of treatment and, being prioritized in caring plan of nurses, as it can positively contribute for the health status of hospitalized patients. A study tested the impact of a nutritional protocol applied by a nurse combined with a nutrition support team, in which improved the nutrition provided in a pediatric ICU¹⁴.

Only the participation of nurses in the multi professional nutritional therapy team as the RDC n°63/2000¹⁵ does not guarantee the implementation of nutritional care. For this, this professional should change practices and start to give value and register in a systematic way information related to nutrition, especially food acceptance. It seems to be mandatory a better formation of future nurses and nursing technicians to monitor nutritional demands and to introduce early care.

As well as in other scenarios, the food intake control of patients is not an easy task to be done¹⁶. In clinical practice, the registry is, many times, done from a unique meal observation and therefore, it does not represent total food intake. In this study, the aim was to evaluate the quantity of ingested food in all meals. For this objective, a diet record was used as assessment method in 24 hours. It has many positive aspects: quick application, it does not change the food intake; it can be used in different age groups and in alphabets, low cost. But within the main disadvantages, it is the dependence of memories from the interviewed and the capacity of the interviewer to establish a good communication and avoid answers induction. The study conducted a food inquiry in days when the patient remembered their food of 24 hours, not necessarily in consecutive days of hospitalization due to the dynamics of a surgical hospitalization: conduction of exams, frequent situations of NPO, and surgery cancellations, within others, which could have minimized the memory bias.

Also, to establish a comparison between the impression of two different individuals about the quantity of food ingested per day, when summarized by adjectives ("good", "medium", "low") can generate interpreting errors related to personal values and comparison parameters of each involved part. The adoption of a category criteria for the food acceptance in a quantitative way, as the nutritionDay, and the standardization of quartiles to establish the comparison of those portions to the adjectives ("good", "medium", "low") emitted by nurses were trials to reduce potential biases related to subjectivity.

As previously demonstrated by Tavares, Matos and Amaral¹⁷, the present study showed low intake of patients. Despite that, the early identification of the reduced intake allows the adoption of strategies to minimize the damages of hospital malnutrition¹⁸. The study conducted by us found the small endeavor of nurses on recording the food intake of patients, which should not be an isolated practice in our reality. Indeed, it serves as a warning to all health team in order to develop better observation, control and record of food intake.

Conclusion

The agreement between what the patient refers to in relation to his intake and the registries done by nurses is moderate to low. Higher discrepancies are seen when patients refers to "medium" or "low". The results did not document the elevated prevalence of malnutrition and the adequate acceptance of food by oral feeding in adults hospitalized due to surgeries.

Acknowledgment support

This study was supported by the Hospital de Clínicas de Porto Alegre Research Incentive Fund.

References

1. Beghetto MC, Koglin G, Mello ED. Influence of the assessment method on the prevalence of hospital malnutrition: a comparison between two periods. *Nutr Hosp*. 2008; 25(5):774-80.
2. Almeida AI, Correia M, Camilo M, Ravasco P. Nutritional risk screening in surgery: valid, feasible, easy! *Clinical Nutrition*. 2012; 31:206-11.
3. Assis MCS, Silveira CRM, Beghetto MG, Mello ED. Is duration of postoperative fasting associated with infection and prolonged length of stay in surgical patients? *Nutr Hosp*. 2014; 30(4):919-916.
4. Ferezin C, Sonzogno MC. Reflections on the insertion of the nutrition discipline in nursing education. *Rev Latino-am Enfermagem*. 2007; 15(6):1092-8.
5. Seltz VG, Inocenso MD. Avaliação da qualidade dos registros de enfermagem no prontuário por meio da auditoria. *Acta Paul Enferm*. 2009; 22(3):313-7.
6. Dalri CC, Rossi LA, Dalri MCB. Diagnósticos de enfermagem de pacientes em período pós-operatório imediato de colecistectomia laparoscópica. *Rev Latino-am Enfermagem*. 2006; 14(3):389-6.
7. Venturini DA, Marcon SS. Anotações de enfermagem em uma unidade cirúrgica de um hospital escola. *Rev Bras Enferm*. 2008; 61(5):570-5.
8. Mello ED, Beghetto MG, Teixeira LB, Luft VC. Desnutrição hospitalar cinco anos após o IBRANUTRI. *Rev. Bras. de Nutrição*. 2003; 18(2):65-9.
9. NutritionDay Worldwide. Research Project - NutritionDay worldwide 2010. [acesso em 10 jun 2012]. Available at: http://www.nutritionday.org/uploads/media/nutritionday_long_international_2010.pdf
10. Hiesmayr MH, Schindler K, Pernicka E, Schuh C, Schoeniger-Hekele A, Bauer P, et al. Decreased food intake is a risk

- factor for mortality in hospitalized patients: The NutritionDay survey 2006. *Clinical Nutrition*. 2009; 28:484-91.
11. Schindler K, Pernicka E, Laviano A, Howard P, Schütz T, Bauer P, et al. How nutritional risk is assessed and managed in European hospitals: A survey of 21007 patients findings from the 2007-2008 cross-sectional nutritionDay survey. *Clinical Nutrition*. 2010; 29:552-559.
 12. Contreras MJL, Torralba C, Zamora S, Llamas FP. Nutrition and prevalence of undernutrition assessed by different diagnostic criteria in nursing homes for elderly people. *J Hum Nutr Diet*. 2012; 25:239-46.
 13. Simmons SF, Reuben D. Nutritional intake monitoring for nursing home residents: a comparison of staff documentation, direct observation, and photography methods. *J Am Geriatr Soc*. 2000; 48(2):209-13.
 14. Geukers VG, Neef M, Dijsselhof ME, Sauerwein HP, Bos AP. Effect of a nurse-driven feeding algorithm and the institution of a nutritional support team on energy and macronutrient intake in critically ill children. *E-SPEN Journal*. 2012; 7: 35-40.
 15. RDC nº63, de 6 de julho de 2000 (BR). Este Regulamento técnico fixa os requisitos mínimos exigidos para a Terapia de Nutrição Enteral. 2000. [acesso em 26 set 2013]. Available at: <http://portal.anvisa.gov.br/wps/wcm/connect/61e1d-380474597399f7bdf3fbc4c6735/RCD+N%C2%B0+63-2000.pdf?MOD=AJPERES>
 16. Ojeda GM, et al. Validation of a semi-quantitative food frequency questionnaire to assess food groups and nutrient intake. *Nutr Hosp*. 2013;28(6):2212-2220.
 17. Tavares MM, Matos L, Amaral TF. Insufficient voluntary intake of nutrients and energy in hospitalized patients. *Nutr Hosp*. 2007;22(5):584-89.
 18. Montoya SM, García NEM. Efecto de la intervención nutricional temprana en el resultado clínico de pacientes en riesgo nutricional. *Nutr Hosp*. 2014;29(2):427-436.



Original/Otros

Empleo de bacteriófagos frente a *Salmonella enteritidis* como herramienta de prevención

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Resumen

Introducción: la salmonelosis es una enfermedad de alta prevalencia, siendo la búsqueda de herramientas preventivas para evitar la contaminación una prioridad a nivel de salud pública.

Objetivo: en el presente trabajo se evaluó el efecto *in vitro* de bacteriófagos frente a *Salmonella enteritidis* como una herramienta de prevención.

Método: se realizaron dos pruebas con tres concentraciones de bacteriófagos frente a dos cepas de *Salmonella enteritidis* inoculadas en muestras de heces frescas de gallinas ponedoras, y el correspondiente control positivo. Así, se testaron cuatro grupos en cada una de las dos pruebas. Cada grupo experimental contó con dos réplicas, y en cada réplica se incubaron tres placas. Las concentraciones ensayadas fueron tres: solución comercial (5×10^7 pfu/mL), y dos diluciones de la misma (1/10 y 1/30). Una de las cepas testada fue la cepa CECT 4300, cepa certificada de la Colección Española de Cultivo Tipo, y la otra una cepa de campo aislada en una explotación de ponedoras sacrificadas. Ambas cepas se inocularon en muestras de heces a la dosis de $1,3 \times 10^5$ ufc/g de heces en cada uno de los cuatro grupos. Se procedió con el aislamiento e identificación de la bacteria por ISO 6579 a varios tiempos desde la inoculación: 1 minuto, 24 h y 7 días.

Resultados: en la primera prueba, con la cepa certificada, se aisló *Salmonella* en todos los grupos a tiempo 1 minuto. A las 24 h se aisló *Salmonella* en todos los grupos excepto en una de las réplicas tratada con la dilución 1/10 de bacteriófagos, en una de las placas de la otra réplica tratada con la dilución 1/10, y en dos placas de cada una de las dos réplicas tratadas con la solución comercial. A partir de los 7 días ya no se aisló la bacteria de ninguno de los grupos experimentales. En la segunda prueba, con la cepa de campo, se aisló *Salmonella* en todos los grupos a tiempo 1 minuto. A las 24 h se aisló *Salmonella* en todos los grupos excepto en una de las réplicas tratada con la

USE OF BACTERIOPHAGES AGAINST *SALMONELLA ENTERITIDIS*: A PREVENTION TOOL

Abstract

Introduction: salmonellosis is a highly prevalent disease still searching for preventive tools to avoid contamination level priority public health.

Objective: the *in vitro* effect of bacteriophages against *Salmonella enteritidis* was evaluated as a prevention tool.

Method: two tests with three concentrations of bacteriophages were conducted against two strains of *Salmonella enteritidis* inoculated in fresh faeces of laying hens. Each test had a positive control. Thus, four groups in each test were evaluated. Each experimental group included two replicates, and three plates were incubated per replicate.

The concentrations tested were three: commercial solution (5×10^7 pfu/mL), and two dilutions (1/10 and 1/30). One of the strains tested was CECT 4300, a certified strain of Colección Española de Cultivo Tipo and the other a field isolated strain in a sacrificed hen farm. Both strains were inoculated at 1.3×10^5 cfu/g of faeces in each of the four groups. Isolation and identification of bacteria by ISO6579 was done at various times after inoculation: 1 minute, 24 hours and 7 days.

Results: in the first test, with certified strain, *Salmonella* was isolated in all groups at time 1 minute. After 24 hours, *Salmonella* was isolated in all groups except in one of the replicas treated with 1/10 dilution of bacteriophages, one of the other replica plate treated with 1/10 dilution, and two plates of the two replicas treated with the commercial solution. After 7 days, the bacteria were not isolated from any of the experimental groups. In the second test, with the field strain, *Salmonella* was isolated in all groups at time 1 minute. After 24 hours, *Salmonella*

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Recibido: 15-III-2015.

Aceptado: 22-IV-2015.

dilución 1/10 de bacteriófagos y en las dos réplicas tratadas con la solución comercial. Al igual que en la prueba primera, a los 7 días tampoco se aisló *Salmonella* en ninguno de los grupos experimentales.

Conclusiones: el empleo de bacteriófagos contribuyó a reducir los aislamientos de *Salmonella enteritidis* en las muestras de heces a las 24 h de su aplicación, por lo que podría ser considerado una herramienta de prevención. A los 7 días tras la inoculación de la bacteria no se aisló la misma en ninguno de los grupos experimentales.

(Nutr Hosp. 2015;31:2740-2742)

DOI:10.3305/nh.2015.31.6.8975

Palabras clave: *Bacteriófago*. *In-vitro*. *Salmonella enteritidis*. ISO 6579.

Introducción

La salmonelosis humana presenta una destacada prevalencia¹ y forma parte del grupo de enfermedades de transmisión alimentaria con graves consecuencias económicas, sociales y sanitarias. Los principales factores de riesgo de intoxicación alimentaria causada por *Salmonella* están relacionadas con las aves de corral tales como carne de pollo o huevos poco cocinados. Entre las salmonelas más importantes asociadas con el pollo y huevos se encuentra la *Salmonella* entérica serovar Enteritidis (*S. Enteritidis*). Éste es un serotipo que ha entrado en la industria avícola intensiva y puede causar la infección y la contaminación de los productos avícolas, con ausencia de la enfermedad clínica. El control de salmonelas en la etapa de producción primaria es de importancia primordial. Se puede prevenir la introducción de esta bacteria en la cadena alimentaria y por tanto, reducir la intoxicación entre los consumidores². Una de las prácticas utilizadas en las explotaciones para controlar la salmonela es el uso de antibióticos. Sin embargo, el elevado grado de resistencia de la bacteria plantea limitaciones graves en las posibilidades del tratamiento eficaz.

Los bacteriófagos (fagos) son virus que matan bacterias³. Los fagos han sido propuestos como alternativa al uso de antibióticos basado en su capacidad para invadir y perturbar el metabolismo bacteriano, que causa la lisis de las bacterias⁴.

Los bacteriófagos son específicos para cada bacteria previniendo la destrucción de la flora circundante; se adhieren a la pared bacteriana contribuyendo a atenuar factores de virulencia; no inducen fenómenos alérgicos; no se han detectado efectos secundarios (son inofensivos para los animales, las plantas y para el medio ambiente); pueden ser usados como tratamiento preventivo y para higienización; continúan multiplicándose hasta que la infección con el huésped se mantenga (terminan su acción cuando ya no hay bacteria huésped); se utilizan en una única aplicación y no tienen intervalo de seguridad⁵.

En este trabajo se evaluó el efecto *in-vitro* de bacteriófagos frente a *Salmonella enteritidis*. Para ello, se

was isolated in all groups except in one of the replicas treated with 1/10 dilution of bacteriophages and the two replicas treated with the commercial solution. *Salmonella* was not isolated in any of the experimental groups at 7 days.

Conclusions: the use of bacteriophages reduced *Salmonella enteritidis* isolates in faeces at 24 hours after the application, so it could be considered as a prevention tool. At 7 days after inoculation of bacteria, no one was isolated in any of the experimental groups.

(Nutr Hosp. 2015;31:2740-2742)

DOI:10.3305/nh.2015.31.6.8975

Key words: *Bacteriophage*. *In-vitro*. *Salmonella enteritidis*. ISO6579.

realizaron dos pruebas con tres concentraciones de bacteriófagos frente a dos cepas de *Salmonella enteritidis* (una cepa de referencia y una cepa aislada en campo) inoculadas en muestras de heces frescas de gallinas ponedoras, y el correspondiente control positivo. Así, se testaron cuatro grupos en cada una de las dos pruebas.

Material y métodos

En este trabajo se evaluó el efecto *in-vitro* de bacteriófagos frente a *Salmonella enteritidis*, inoculada en muestras de heces frescas de gallinas ponedoras. Para ello, se realizaron dos pruebas con dos cepas de *Salmonella enteritidis*. Las cepas inoculadas fueron: cepa CECT 4300, cepa certificada de la Colección Española de Cultivo Tipo y cepa de campo aislada en una explotación de ponedoras sacrificada. Se emplearon dos cepas con orígenes diferentes para evaluar posibles diferencias en cuanto a la resistencia a la acción del tratamiento o la viabilidad de la cepa inoculada en heces y mantenida a 25°C. La inoculación se realizó sobre heces de gallinas ponedoras libres de *Salmonella* spp. Para garantizar la ausencia de este microorganismo se analizaron las heces 10 veces por el método ISO 6579:2002/Amd. 1:2007^{6,7}, con resultado de ausencia de *Salmonella* spp. Posteriormente, se adicionó 100 mL de una solución de 10⁶ u.f.c/mL de cada una de las cepas sobre 2 kg de estas heces (equivalente a 0.4 m² de la cinta). Por tanto, ambas cepas se inocularon en muestras de heces a la dosis de 1.3×10⁵ ufc/g de heces.

Para cada prueba, la mezcla de heces inoculada se repartió en 4 porciones de 500 g. Cada porción constituye la muestra de análisis de un grupo experimental. Una de las porciones se pulverizó con 2 mL de una solución comercial de bacteriófagos Bio-S107 de Controvet Genetics (5×10⁷ pfu/mL), otra con 2 mL de una dilución 1/10 (5×10⁶ pfu/mL) y otra con 2 mL de una dilución 1/30 (1.6×10⁶ pfu/mL), de la misma. La última porción es el control positivo y no fue tratada con bacteriófagos.

Las cuatro porciones de heces se repartieron en dos subporciones.

Por tanto, en cada prueba se testaron tres concentraciones de bacteriófagos y el correspondiente control. Se realizaron dos réplicas (una réplica de cada subporción) de cada grupo experimental

Se tomaron 25 gramos de cada subporción y se analizaron según la ISO 6579:2002/Amd. 1:2007^{6,7}, teniendo en cuenta que se sembraron tres placas de Rappaport-Vassiliadis semisólido modificado (MSRV) de cada submuestra. El ensayo se realizó a distintos tiempos desde la incubación: 1 minuto, 24h y 7 días.

Las submuestras se mantuvieron a $25\pm 2^{\circ}\text{C}$ entre cada análisis, controlando la temperatura con sondas calibradas.

Resultados y discusión

En la primera prueba, con la cepa certificada, se aisló *Salmonella* en todos los grupos a tiempo 1 minuto. A las 24h se aisló *Salmonella* en todos los grupos excepto en una de las réplicas tratada con la dilución 1/10 de bacteriófagos, en una de las placas de la otra réplica tratada con la dilución 1/10, y en dos placas de cada una de las dos réplicas tratadas con la solución comercial de bacteriófagos.

En la segunda prueba, con la cepa de campo, se aisló *Salmonella* en todos los grupos a tiempo 1 minuto. A las 24h se aisló *Salmonella* en todos los grupos excepto en una de las réplicas tratada con la dilución 1/10 de bacteriófagos y en las dos réplicas tratadas con la solución comercial de bacteriófagos. A los 7 días, no se aisló *Salmonella* en ninguno de los grupos experimentales de las dos pruebas. Comparando los resultados obtenidos con ambas cepas, no se han detectado diferencias a excepción de los resultados a las 24 horas en las muestras tratadas con la dilución 1/10 y dilución pura de bacteriófagos, donde parece que el efecto es ligeramente mayor frente a la cepa de campo.

Algunos estudios han demostrado que matrices con a_w menor o igual a 0.93 no sustentan el crecimiento de *Salmonella*⁸. La deshidratación de las heces a 25°C podría ser el motivo por el cual no se ha aislado *Salmonella* a los 7 días en los controles positivos en ambas pruebas.

Como conclusión, el empleo de bacteriófagos contribuyó a reducir los aislamientos de *Salmonella enteritidis* en las muestras de heces a las 24h de su aplicación, por lo que podría ser considerado una herramienta de prevención. Por otro lado, la solución de bacteriófagos resulta ligeramente más eficaz frente a la cepa de campo que frente a la cepa certificada. Teniendo en cuenta los resultados obtenidos, este estudio podría complementarse reduciendo los tiempos entre los análisis, es decir, realizando el ensayo de *Salmonella* al minuto¹, a las 24 horas, a las 48 horas, a las 72 horas, etc. desde la inoculación. De esta forma, se evaluaría la reducción de los aislamientos de *Salmonella enteritidis* por acción de los bacteriófagos en función del tiempo durante el periodo en el que el control positivo es viable en las condiciones experimentales.

Referencias

1. Mølbak K, Neimann J. Risk factors for sporadic infection with *Salmonella enteritidis*, Denmark, 1997-1999. *Am J Epidemiol* 2002; 156: 654-61.
2. Fiorentin L, Vieira ND, Barioni WJr. Oral treatment with bacteriophages reduces the concentration of *Salmonella enteritidis* PT4 in caecal contents of broilers. *Avian Pathol* 2005; 34: 258-63.
3. Huff WE, Huff GR, Rath NC, Donoghue AM. The potential and limitations of the development of bacteriophage therapeutics for the poultry industry. *Poultry Sci* 2013; 92: 930-4.
4. Oliveira A, Sereno R, Azeredo J. In vivo efficiency evaluation of a phage cocktail in controlling severe colibacillosis in confined conditions and experimental poultry houses. *Vet Microbiol* 2010; 146: 303-8.
5. Sereno R. Fagoterapia en Avicultura Industrial en Portugal. *Controlvet Genetics. IV Jornada de Sanidad Avícola CECAV*. 2013.
6. ISO 6579:2002. Microbiology of food and animal feeding stuffs. Horizontal method for the detection of *Salmonella* spp.
7. ISO 6579:2002/Amd. 1:2007. Microbiology of food and animal feeding stuffs. Horizontal method for the detection of *Salmonella* spp. Amendment 1: Annex D: Detection of *Salmonella* spp. in animal faeces and in environmental samples from the primary production stage.
8. D'Aoust JY. *Salmonella*. In: M. P. Doyle (Ed.) *Foodborne Bacterial Pathogens*. Marcel Dekker, Inc., New York. 1989. p. 327-445.



Original/Otros

Presence of microorganisms from isolated *Megaselia* spp. in foodservice establishments

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Abstract

Introduction: the transmission of harmful pathogens by arthropods is an increasing health concern. More concretely, flies are known to be able to transmit the infectious agent mechanically.

Objective: the present work shows a case report occurred from foodservice establishments where were isolated and identified, at the first time, *Megaselia* spp. in the food preparation place. Furthermore, microorganisms were analyzed from these flies.

Method: it is based in entomological and microbiological analysis.

Results: mesophilic aerobic flora and Enterobacteriaceae were found in all the samples, exceeding the limits established from food commodities on 41.7% (5/12) for mesophilic aerobic bacteria and 66.7% (8/12) for Enterobacteriaceae. Furthermore, 25% (3/12) of analyzed flies were found positive to *Escherichia coli*, data that can be linked with the microbiological food results. The most surprising results were the presence of *S. aureus* in 66.7% (8/12) of the analyzed flies.

Conclusions: a binomial relationship among *Megaselia* spp. and bacteria is demonstrated being an important study to demonstrate that must be checked more hygienically measurement in foodservice.

(Nutr Hosp. 2015;31:2743-2746)

DOI:10.3305/nh.2015.31.6.8971

Key words: Bacterial pathogens. Foodservice establishment. Food contamination. *Megaselia* spp.

PRESENCIA DE MICROORGANISMOS AISLADOS DE *MEGASELIA* SPP. EN LOS ESTABLECIMIENTOS DE SERVICIOS DE RESTAURACIÓN

Resumen

Introducción: la transmisión de patógenos por insectos es una creciente preocupación para la salud pública. Más concretamente, las moscas son conocidas por ser capaces de transmitir el agente infeccioso mecánicamente.

Objetivo: el presente trabajo muestra un estudio en los servicios de restauración en los que se aisló por primera vez en la literatura *Megaselia* spp, detectándose la presencia de microorganismos en estas moscas.

Método: se basa en análisis microbiológicos y entomológicos.

Resultados: la presencia de aerobios mesófilos y Enterobacteriaceae se han encontrado en todas las muestras, superando los límites establecidos en el 41,7% (5/12) para las bacterias aerobias mesófilas y el 66,7% (8/12) para Enterobacteriaceae. Por otra parte, en el 25 y 66,7% de las moscas analizadas se detectó la presencia de *Escherichia coli* y *Staphylococcus aureus*, respectivamente.

Conclusiones: hay un binomio entre la presencia de microorganismos y *Megaselia* spp., lo que demuestra la importancia de mantener una vigilancia más estricta en las medidas higiénico-sanitarias en los servicios de restauración.

(Nutr Hosp. 2015;31:2743-2746)

DOI:10.3305/nh.2015.31.6.8971

Palabras clave: Bacterias patógenas. Servicios de restauración. Contaminación de los alimentos. *Megaselia* spp.

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Recibido: 15-III-2015.

Aceptado: 22-IV-2015.

Introducción

Flies are also known to carry bacteria such as *Staphylococcus aureus*, *Escherichia coli* and *Campylobacter jejuni*, among others, that are potential human food borne pathogens¹⁻⁴. In this situation, flies amplify the risk of foodborne disease by transporting pathogens from places where the pathogens pose no hazard to place where they do and all segments of a population are at risk of gastroenteritis from food contaminated with the pathogens⁵. The seriousness of gastroenteritis is limited (transitory minor disability; annoying complaints) unless a patient's health is otherwise compromised⁶. Furthermore, many of the infectious agent can survive into the fly, as are houseflies^{7,8} and fruit flies⁹, during two weeks after the exposure and, although it is difficult to find the needed number of microorganism under natural conditions in the fly, the bacteria placed into the food, even though in low concentration, can multiply to reach the needed concentration to infect the humans^{10,11}.

The aim of this study is reflecting a case report occurred from foodservice establishments where were isolated and identified, at the first time, *Megaselia spp.* in the food preparation place. Furthermore, microorganisms were analyzed from these flies.

Materials and methods

Sampling were carried out in four out of twenty-two foodservice establishments from Spain, which were observed a notable number of flies in the food preparation place. Since from a food-safety standpoint, there is a distinct set of natural attributes that enable a flies species to be an effective carrier of foodborne patho-

gens, the flies were catch following the next procedure; the flies were caught with traps designed for that end, conformed by flasks of glass of 500 cc, washed and autoclaved to 121 °C, during 15 min. In the mouth of the flasks, funnels of plastic were adapted in form of invested cones, to facilitate the entrance of the flies, but not their left. The trapped flies (n=12) were those that settled or explored the surface of the foods, for space of one to two minutes approximately. Observed this, we preceded to place on them the flask to force them to enter in. They were trapped individually and analyzed entomologically and microbiologically the same day. The microbial analysis were carried out from the legs of the trapped flies being studied aerobic plate counts, Enterobacteriaceae, *Escherichia coli*, *Staphylococcus aureus* and *Salmonella spp.* according to the ISO 4833 reference method¹², ISO 21528-1¹³, Soriano *et al.*¹⁴, ISO 6888-1¹⁵ and ISO 6579¹⁶, respectively.

Results and discussion

Table I shows the number of trapped flies and the results obtained from the analysis of their legs. Mesophilic aerobic flora and Enterobacteriaceae were found in all the samples, exceeding the limits established from food commodities on 41.7% (5/12) for mesophilic aerobic bacteria and 66.7% (8/12) for Enterobacteriaceae. Furthermore, 25% (3/12) of analyzed flies were found positive to *Escherichia coli*, data that can be linked with the microbiological food results. The most surprising results were the presence of *S. aureus* in 66.7% (8/12) of the analyzed flies. It is evident that there is not an established microflora concentration for flies. However, the presence of certain bacteria as *Sal-*

Table I
Presence of microorganisms in trapped flies

Fly Number	Aerobic plate count (log CFU/g) range	Enterobacteriaceae (MPN/g) range	<i>Escherichia coli</i>	<i>Salmonella</i>	<i>Staphylococcus aureus</i> (CFU/g)range
1	3.2	<3	-	-	-
2	5.1	150	+	-	122
3	3.5	<3	-	-	15
4	4.6	<3	-	-	-
5	2.1	7	-	-	-
6	6.2	>1100	-	-	320
7	5.0	>1100	-	-	90
8	2.8	<3	-	-	-
9	5.4	>1100	+	-	150
10	3.2	240	-	-	30
11	4.3	>1100	-	-	245
12	5.9	>1100	+	-	300

monella, *S. aureus* or *E. coli*, in the legs of the insect prove the contact of the flies with a contaminate surface, becoming a possible carrier of these pathogenic microorganisms.

The trapped fly adults was identifying, checking that they belong to the same family and genus; *Megaselia*. The larvae are myiasis-producing agents in humans and animals^{17,18}, and pestiferous in fruit¹⁹. However, it is important keep in mind that this specie has not been studied in depth, and far from it in the context of food safety, which last stage are the consumers. Within the genera of *Megaselia*, in particular the puparia, other study²⁰ have indicated the difficulty of identifying between species due to their similarity of morphological appearance. The distribution of these diphtheroids is very large, colonizing any type of habitat except cold and dry media. Most of the larvae belonging to the group of the phorid show a predatory behaviour, although some of them behave as parasites. There are species of *Megaselia* that feed on larvae and pupae of other diphtheroid, aphid and myriapods. Some specie of these genera develops at the expense of food substances²⁰. More concretely, it has been identify infecting some foods that contains as bacon, spaghetti, cheese, fruit and flour²¹. The number of flies in a given foodservice establishment is influenced by factors such as: the sanitation practices; the food handling, the activity of the responsible controlling the flies; the location of the establishment; and general facility keeping. The role of the flies as vectors of disease is, in general, far to clear. It has been proven that such pest carry a wide range of disease causing organisms but can they transmit them? There is a lack of studies properly designed to test this role and hence relatively little evidence to suggest that they actually do so. Simply finding an organism in a fly is not sufficient evidence that the fly is acting as a vector for that organism. Equally it is not sufficient to show that a fly could theoretically act as a vector, it must be shown actually to do²² with the following parameters; larvae, temperature, personnel hands hygienic status and incidence of microbial flora in food.

Bearing in mind this fact, can we considerer the *Megaselia* spp. as a potencial vector of pathogenic bacteria? This would be a premature conclusion, given the punctual presence of this specie in food commodities. However, without doubt, ecological conclusions about its presence in the food services is that with the climatic change and the warm temperatures the appearance of new and unknown risk can be possible and additional sampling of the flies is necessary to examine more deeply their role as a foodborne vectors^{23,24}. Understanding the mechanisms of contamination is critical to interrupting them, and thus preventing the infection from reaching the consumers.

In conclusion, the ignorance on the family and especially on the *Megaselia* spp. it is quite important in connection with the European fauna. This study put forward the hypothesis that *Megaselia* spp. plays an important role in the transmission of the bacteria, than

has previously been recognized. Factors supporting this hypothesis are: (i) the ability of flies in general to function as vectors; (ii) a ubiquitous presence of bacteria in the environment; (iii) a seasonality of the bacterial growth with warm temperature peaks; and (iv) the increment of the contamination of the foods after the confirmation of the presence of the flies in these products. This conclusion suggests that in addition to stringent control measures during manufacturing and use of foodstuffs, reducing arthropod presence in kitchens and manufacturing environments could result in a substantial reduction in the transmission of bacterial pathogens.

References

1. Hald B, Skovgård H, Bang DD, Pedersen K, Dybdahl J, Jespersen JB, Madsen M. Flies and *Campylobacter* infection of broiler flocks. *Emerg Infect Dis* 2004; 10: 1490-2.
2. Kobayashi M, Sasaki T, Saito N, Tamura K, Suzuki K, Watanabe H, Agui N. Houseflies: not simple mechanical vectors of enterohemorrhagic *Escherichia coli* O157:H7. *Am J Trop Med Hyg* 1999; 61: 625-9.
3. Rahuma N, Ghenghesh KS, Ben Aissa R, Elamaari A. Carriage by the housefly (*Musca domestica*) of multiple-antibiotic-resistant bacteria that are potentially pathogenic to humans, in hospital and other urban environments in Misurata, Libya. *Ann Trop Med Parasitol* 2005; 99: 795-802.
4. Soler C, Mañes J, Savino A, Soriano JM. Propuesta de valores de referencia ambientales microbiológicos en los servicios de restauración. *Nutr Hosp* (en prensa).
5. Graczyk TK, Knight R, Gilman RH, Cranfield MR. The role of non-biting flies in the epidemiology of human infectious diseases. *Microbes Infect* 2001; 3: 231-5.
6. Nmorsi OPG, Agbozele G, Ukwandu NCD. Some aspects of epidemiology of filth flies: *Musca domestica*, *Musca domestica vicina*, *Drosophila melanogaster* and Associated Bacteria Pathogens in Ekpoma, Nigeria. *Vector Borne Zoonotic Dis* 2007; 6: 107-17.
7. De Jesus AJ, Olsen AR, Bryce JR, Whiting RC. Quantitative contamination and transfer of *Escherichia coli* from foods by houseflies, *Musca domestica* L. (Diptera: Muscidae). *Int J Food Microbiol* 2004; 93: 259-62.
8. Ugbohu OC, Nwachukwu NC, Ogbuagu UN. Isolation of *Salmonella* and *Shigella* species from house flies (*Musca domestica*) in Uturu, Nigeria. *Afr J Biotechnol* 2006; 5: 1090-1.
9. Sela S, Nestel D, Pinto R, Nemny-Lavy E, Bar-Joseph M. Mediterranean fruit fly as a potential vector of bacterial pathogens. *Appl Environ Microbiol* 2005; 71: 4052-6.
10. Manrique-Saïde PC, Delfin-González H. Role of flies as vectors of diarrhoeal diseases in people. *Biomedica* 1997; 8: 163-70.
11. Millikan LE. Myiasis. *Clin Dermatol* 1999; 17: 191-5.
12. Anonymous. ISO 4833:2003. Microbiology of food and animal feeding stuffs- Horizontal method for the enumeration of microorganisms- Colony-count technique at 30° C.
13. Anonymous. ISO 21528-1:2004. Microbiology of food and animal feeding stuffs-Horizontal methods for the detection and enumeration of Enterobacteriaceae- Part 1: Detection and enumeration by MPN technique with pre-enrichment.
14. Soriano JM, Rico H, Moltó JC, Mañes J. Effect of introduction of HACCP on the microbiological quality of some restaurant meals. *Food Control* 2002; 13: 253-61.
15. Anonymous. ISO 6888-1 Microbiology of food and animal feeding stuffs-horizontal method for the enumeration of coagulase-positive staphylococci (*Staphylococcus aureus* and other species): Part 1. Technique using Baird- Parker agar medium.
16. Anonymous. ISO 6579:2002/ Cor. 1:2004 Microbiology of food and animal feeding stuffs – horizontal method for the detection of *Salmonella* spp.

17. Disney RHL. *Scuttle flies: the Phoridae*. 1994. London: Chapman & Hall.
18. Hira PR, Assad RM, Okasha G, Al-Ali FM, Iqbal J, Mutawali KLEH, Disney RHL, Hall MJR. Myiasis in Kuwait: nosocomial infections caused by *Lucilia sericata* and *Megaselia scalaris*. *Am J Trop Med Hyg* 2004; 70:386-9.
19. Karunaweera ND, Ihalamulla RL, Kumarasinghe SP. *Megaselia scalaris* (Diptera: Phoridae) can live on ripe bananas-a potential health hazard?. *Ceylon Med J* 2002; 47:9-10.
20. Zumpt F. Myiasis in man and animals in the old world. A Textbook for Physicians, Veterinarians and Zoologists. *Q Rev Biol* 1966; 41: 343-4.
21. Papp L, Darvas B. Contributions to a manual of palaearctic diptera. 1998. Vol. 3: Higher Brachycera. Science Herald. Budapest.
22. Ekdahl K, Normann B, Andersson Y. Could flies explain the elusive epidemiology of campylobacteriosis?. *BMC Infect Dis* 2005; 5: 11-4.
23. Stevens JR, Wallman JF. The evolution of myiasis in humans and other animals in the Old and New Worlds (part I): phylogenetic analyses. *Trends Parasitol* 2006; 22: 129-36.
24. Stevens JR, Wallman JF, Otranto D, Wall R, Pape T. The evolution of myiasis in humans and other animals in the Old and New Worlds (part II): biological and life-history studies. *Trends Parasitol* 2006; 22: 181-8.



Original/Otros

Anti-adipogenic activity of an olive seed extract in mouse fibroblasts

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Abstract

The administration of different polyphenols protects against increased body weight and fat accumulation. The aim of the study was to determine the anti-adipogenic activity of an olive-seed polyphenolic extract, by means of mouse fibroblast cell line 3T3-L1 adipocyte differentiation.

Material and methods: cells were incubated and differentiated (6000 cells/cup) in the presence of olive-seed extract at 10 and 50 mg/l biosecure concentrations of polyphenols, and with no extract in the control sample. After 5 to 7 days mature adipocytes are formed. The fat clusters are quantified by means of red-oil staining, 490 nm absorbance, and the expression of the leptin and PPAR γ genes, and then compared to the values obtained in the cultures before and after adipocyte differentiation.

Results: the control samples, with no extract, presented an accumulation of fat of 100%. By contrast, the addition of 50 mg/l of olive-seed extract polyphenols resulted in a 50% accumulation of fat, similar to that of the non-differentiated cells. A 10 mg/l extract concentration had no effect. Anti-adipogenic activity is thus confirmed, as the expression of the PPAR γ and leptin genes is reduced in adipocyte differentiation in the presence of extract at 50 mg/l.

In conclusion, both the formation of fatty substances characteristic of adipogenesis, and the expression of the adipogenic PPAR γ and leptin genes are found to be inhibited by the prior addition of olive-seed extract polyphenols at a 50 mg/l concentration.

(Nutr Hosp. 2015;31:2747-2751)

DOI:10.3305/nh.2015.31.6.8997

Key words: Adipogenesis. Fat accumulation. Inhibition. Olive-seed extract. Polyphenols.

ACTIVIDAD ANTI-ADIPOGÉNICA DE UN EXTRACTO DE HUESOS DE ACEITUNA EN FIBROBLASTOS DE RATÓN

Resumen

La administración de diferentes polifenoles protege contra el incremento de peso y la acumulación de grasa.

Objetivo: comprobar la actividad anti-adipogénica de un extracto polifenólico de huesos de aceituna, utilizando la diferenciación a adipocitos de la línea celular 3T3-L1 de fibroblastos de ratón.

Material y métodos: se cultivan y diferencian las células (6.000 células/pocillo) en presencia del extracto de huesos de aceituna a 10 y 50 mg/l de polifenoles, concentraciones bioseguras, y sin extracto como control. A los 5-7 días se forman los adipocitos maduros. Se cuantifican los cúmulos de grasa formados mediante tinción con Oil-Red y medida de la absorbancia a 490 nm y la expresión de los genes de leptina y PPAR γ , relacionándolos con los valores en los cultivos antes y después de diferenciarse a adipocitos.

Resultados: las muestras control, sin extracto, se consideran el 100% de acumulación de grasas. En contraste, la adición de 50 mg/l de extracto de polifenoles de huesos de aceituna muestra un cúmulo de grasa de alrededor del 50%, semejante a las células no diferenciadas. Con 10 mg/l de extracto no se muestra efecto. Se confirma la actividad antiadipogénica, observándose disminución en la expresión de los genes PPAR γ y de leptina en la diferenciación a adipocitos en presencia del extracto a 50 mg/l.

En conclusión, la formación de los cuerpos grasos característicos de la adipogénesis queda inhibida previa adición de 50 mg/l de polifenoles de extracto de huesos de aceituna, así como la expresión de los genes adipogénicos PPAR γ y de leptina.

(Nutr Hosp. 2015;31:2747-2751)

DOI:10.3305/nh.2015.31.6.8997

Palabras clave: Adipogénesis. Inhibición. Polifenoles. Extractos de huesos de aceituna. Cúmulos de grasa.

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Recibido: 23-III-2015.
Aceptado: 23-IV-2015.

Introduction

The balance between energy consumption and energy expenditure is very complex, and is influenced by lifestyle, calorie and nutrient intake, energy metabolism, response to stress, immunological metabolism and genes. If this balance is altered, it could result in obesity. Fat metabolism is a significant indicator of this balance, with peroxisome proliferator-activated receptors (PPAR), leptin and adiponectin gene expression¹.

It has been demonstrated that polyphenols have a beneficial effect on the adipogenesis in obese patients. Obesity has a strong inflammatory component which can potentially be affected by diet, and polyphenols can form part of this anti-inflammatory nutritional response²⁻⁴. Furthermore, there are also studies which demonstrate the effect of polyphenols in reducing fat deposits in rats⁵.

Dietary supplements containing polyphenol compounds are associated with a reduction of diet-induced obesity^{6,7}. Recent studies indicate that these anti-obesity effects come about through the genes involved in adipogenesis, lipolysis and the oxidation of fatty acids⁸.

Due to the powerful antioxidant activity and anti-inflammatory properties of polyphenols derived from the olive, they are the object of numerous studies⁹⁻¹¹. Likewise, very recently olives, and the fractions deriving from olive production, have been linked to their effects on obesity-related mechanisms¹²⁻¹³.

In our literature research we found no papers related to the anti-adipogenic effect of extracts with olive-seed polyphenols, although our research group showed the anti-inflammatory effect of this extract¹⁴. Therefore, we carried out a study assessing this issue. To this end, the cell line 3T3-L1 model was used, which, together with the right inducers (insulin, dexamethasone, and IBMX) can result in adipocyte differentiation, and as an assay biomarker a characteristic feature of adipogenesis was used: namely, the formation of body fat and the expression of the genes PPAR γ , and leptin, which favour adipogenesis.

Material and methods

Assessment of the regulatory activity of the fatty tissue was carried out by means of the cellular line of mouse fibroblasts which are capable of 3T3-L1 (CL-173 [ATCC]) adipocyte differentiation, and are therefore a good model for obesity-related studies¹⁵.

For the assay, cells 3T3-L1 (CL-173 [ATCC]) were differentiated in the presence of a 10 and 50 mg/l olive seed extract, concentrations which had previously been shown to be biosecure¹⁶, with the same cultures being used as a control sample, but without the addition of the extract.

The assay was performed on 96 cup thermal cycler plates, with an initial seeding of 6,000 cells/cup. With two days incubation at 37 °C and 5% CO₂ in

the fibroblast growth medium DMEM: 4% glucose, 10% CS, 2mM de L-glutamine and Penicillin (100 U/ml)-Streptomycin (10 g/ml). Differentiation is initiated by substituting the growth medium for the differentiation 1 medium (DMEM/10% fetal calf serum/0.5 mM IBMX/1 μ M dexamethasone). After two days the medium was replaced with the differentiation 2 medium (DMEM/10% fetal calf serum/+10 μ g/ml insulin). After three days, the medium was replaced with the maintenance medium (DMEM/10% fetal calf serum). The adipocyte is considered mature after 5-7 days of differentiation^{17,18}. The differentiation process involves molecular and metabolic changes, as well as morphological changes.

Screening of the bioactive extract responsible for modulating obesity was performed by means of "high-throughput screening", using as an obesity biomarker the analysis of the capacity to inhibit the formation of accumulation of fat during adipogenesis^{19,20}. Thus, once the differentiation process was completed, the formation of fat accumulation was analysed by means of a colourimetric technique with Oil-Red staining (International Chemical). This compound stains the accumulated fats, which are quantified by measuring A_{490nm}. The resulting accumulation of fat is directly proportional to A_{490nm}, so that the changes in absorption are related to the changes in lipid concentration. The expression of the results is carried out with reference to the control cells, cells which have been differentiated in a similar fashion, but with no extract being added, on the basis of the following formula:

$$\% \text{ Lipids} = (A_{490nm} \text{ sample} / A_{490nm} \text{ control cells differentiated}) \times 100.$$

For the analysis of the gene expression, RNA was extracted from the cultured and differentiated cells, without and with extract (50 mg/l of polyphenols). The extraction is carried out with the kit Rneasy Mini Kit (74104 Quiagen). From the RNA, c-DNA was obtained by means of the transcriptase enzyme (High Capacity cDNA reverse transcription kit, 4368814, Applied Biosystems), and with the cDNA obtained, a real-time PCR was performed for the PPAR γ and leptin genes, with the Mm00440181_m1 primers (Applied Biosystems) for the leptin, and Mm01184322_m1 (Applied Biosystems) for the PPAR γ , the control gene being GAPDH Mm99999915_g1 (Applied Biosystems). Reaction conditions were 10 μ l (1x) TaqMan Gene Expression Mastermix 4369016 Applied Biosystems; 2 μ l (0.3 μ M) for each primer, 2 μ l (0.1 μ M) for the marker gene sonda, 0.4 μ l for the PCR internal reaction control, (AND exo 50x), 2 μ l Mix EXO y 2 μ l (50ng) de c-ADN. The amplification conditions in the thermocycler (7300 Applied Biosystem) were universal. 50 °C during 2 min, 95 °C during 10 min and 40 cycles of: 95 °C - 15 sec and 60 °C - 1 min. Gene expression was quantified relatively, the physiological changes in the biomarker genes being measured by comparison with the reference gene.

All the assays were carried out during two different periods, and in each case they were duplicated (n = 4). The data was analysed statistically by means (t-test) of the Epidat 3.1 programme.

Results

The adipocyte cells were round and present an accumulation of fatty substances (Fig. 1). This figure shows the formation of adipocytes which have been produced in the culture and differentiation cups. Before proceeding to analyse the accumulation of fatty tissue and the gene expression, the cellular viability of line 3T3-L1 was examined following the adipogenesis process in the presence of the extract at maximum concentration of 50 mg/l polyphenols, and a viability of 100.4% (SD 2.3; 95% CI: 96.8-104.0%) was observed.

The adipocytes present a rounded shape and the internal accumulation of fatty substances.

In the culture cups, the fatty substances were quantified in differentiated cells 3T3-L1 in the presence of the extract, at concentrations of 10 mg/l and 50 mg/l, and only with the culture media as a control. The results are expressed in table I, in the form of comparative data obtained with reference to the differentiated control cells (without the extract), with the result that

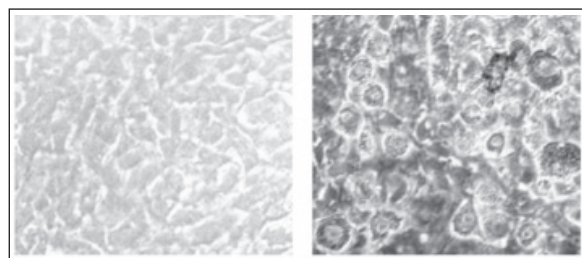


Fig. 1.—Effect of adipogenesis on cell line 3T3-L1 after 5 days incubation with differentiation media (2 days with differentiation medium 1 (DMEM/10% fetal calf serum/0.5 mM IBMX/1 μ M dexamethasone, followed by 3 days with differentiation medium 2 (DMEM+10% fetal calf serum+10 μ g/ml insulin).

Left part: Cell line 3T3-L1preadipocytic state (undifferentiated), presents fibroblast morphology in culture (striated and elongated cell).

Right part: Cell line 3T3-L1 after adipogenesis.

100% of these differentiated cells are shown to present accumulation of fatty tissue, and in comparison with this value, the cells treated with the samples show the presence of lipids. It must be pointed out that the cells before adipocyte differentiation present 57.9% (SD 5.3; 95% CI: 49.5-66.3%) of accumulated fat with respect to the differentiated ones, and that only a 50 mg/l concentration shows significant anti-adipogenic activity ($p=0.021$), with relative fatty tissue values of 49.5% (SD 4.4; 95% CI: 49.5-56.5%).

Anti-adipogenic activity, based on the capacity of olive seed extract at 50 mg/l to inhibit the formation of fatty substances during adipocyte differentiation, deals with practically all the accumulation of fat, leaving the cells differentiated in the presence of the extract with similar amounts of fatty tissue to those present in the cells prior to differentiation.

On the basis of the results obtained and represented, the addition of olive seed extract at 50 mg/l of polyphenols was observed to be extremely effective in inhibiting the formation of fatty substances during adipogenesis.

Table II shows the results of the gene expression of the leptin and PPAR γ genes in cells 3T3-L1 before and after the process of adipogenesis, in the absence (control group) and in the presence of the extract. Normalised values in the undifferentiated cells are presented by means of the formula $2^{-\Delta\Delta Ct}$ (GAPDH was used as an internal control gene). In this table it can be observed that the expression of the leptin gene increases significantly ($p=0.014$) during the differentiation from 0.05 (95% CI: 0.03-0.07) to 1.1 (95% CI: 0.5-1.7), with the said expression being inhibited some 5 times, until it reached 0.2 (95% CI: 0.1-0.3) significantly ($p=0.022$) when the differentiation was performed in the presence of the extract at 50 mg/l. Similar results were observed for gene PPAR γ , which during differentiation changes from 0.5 (95% CI: 0.4-0.7) to 1.5 (95% CI: 0.8-2.3) with significant differences ($p=0.030$), and in the presence of the extract to 1.0 (95% CI: 0.5-1.5).

Discussion

Adipocyte dysfunction is closely linked to the development of obesity and resistance to insulin. The

Table I
Evaluation of fat accumulation in 3T3-L1 cells prior to and following the adipogenesis process (adipocyte differentiation) in the presence of olive extract. The values relate to the differentiated cells with 100% fatty substance deposits

Study groups	% Fat mean $\pm$ SD (95% CI)	p-value for the means difference with differentiated cells
Differentiated cells	100.0 $\pm$ 22.2 (64.7-135.3)	N/A
Undifferentiated cells	57.9 $\pm$ 5.3 (49.5-66.3)	0.034
Differentiated cells + 10 mg/l extract	109.3 $\pm$ 11.8 (90.5-128.1)	0.487
Differentiated cells + 50 mg/l extract	49.5 $\pm$ 4.4 (42.5-56.5)	0.021

Abbreviations: CI, confidence interval; N/A, not applicable; SD, standard deviation.

Table II
Gene expression of the leptin and PPAR γ genes in 3T3-L1 cells prior to and following the process of adipogenesis, in the absence (control) and presence of 50 mg/l olive seed polyphenol extract

Study groups	Leptin gene Mean $\pm$ SD (95% CI) ^a	PPAR γ gene Mean $\pm$ SD (95% CI) ^b
Undifferentiated cells	0.05 $\pm$ 0.01 (0.03-0.07)	0.5 $\pm$ 0.1 (0.4-0.7)
Differentiated cells	1.1 $\pm$ 0.4 (0.5-1.7)	1.5 $\pm$ 0.5 (0.8-2.3)
Differentiated cells with 50 mg/l extract	0.2 $\pm$ 0.1 (0.1-0.3)	1.0 $\pm$ 0.3 (0.5-1.5)

^aMeans difference between undifferentiated cells and differentiated cells: p=0.014; means difference between undifferentiated cells and differentiated cells with 50 mg/l extract: p=0.059; means difference between differentiated cells and differentiated cells with 50 mg/l extract: p=0.059.

^bMeans difference between undifferentiated cells and differentiated cells: p=0.030; means difference between undifferentiated cells and differentiated cells with 50 mg/l extract: p=0.020; means difference between differentiated cells and differentiated cells with 50 mg/l extract: p=0.137.

adipocytes synthesise and secrete active molecules known as adipokines (such as leptin for example), which reduces the absorption of food and increases energy expenditure.

In this study we used the 3T3L1 cell line of mouse fibroblasts (pre-adipocytes) from the American Type Culture Collection (ATCC), obtained from a continuous 3T3 extract, and characterised by the fact that it is made up of unipotent cells which have the ability to express insulin receptors, and which have been used extensively as models for the study of adipogenesis²⁰. The lipogenesis process in the adipocytes was evaluated in terms of the number of triglycerides present in the fatty cells, by means of a qualitative-quantitative method consisting of staining the cells with red oil, which results in the triglycerides being colored²¹.

The regulatory activity of the fatty tissue was evaluated via a fibroblast cell-line model capable of adipocyte 3T3-L1 (CL-173 [ATCC]) differentiation. The process of the formation and development of the adipocyte was also evaluated via an analysis of the genes that participate in the process: the PPAR γ gene (a transcriptional factor which in turn modulates the expression of other genes) and the leptin gene. Both genes were expressed during adipogenesis. The fatty tissue is considered to have a regulatory effect if it modifies the expression of the genes, and anti-obesity activity is demonstrated if the expression of the marker genes diminishes^{1,20,22,23}.

Studies dealing with the effects of polyphenols and flavonoids on adipocytes are much less frequent than in relation to any other type of cell, but some very interesting results are coming to light. Quercetin and

fisetin have been shown to enhance epinephrine-induced lipolysis in isolated adipocytes in rats, and seem to increase the methylation of the phospholipids in the membrane associated with cyclic AMP cell accumulation²⁴. It has been discovered that quercetin blocks insulin-dependent lipogenesis, thus inhibiting the activity of insulin tyrosine kinase from substrate-level phosphorylation.

These lipocyte and anti-polygenic effects in rat adipocytes go hand in hand with the antiproliferative activity in one cell-type, which suggests that flavonoids can reduce the mass of fatty tissue, thus inhibiting the signals which promote adipogenesis²⁵. By using 3T3-L1 cells it can be shown that genistein and naringenin inhibit the proliferation of pre-confluent pre-adipocyte cells, but only genistein was able to inhibit post-confluent proliferation in differentiation induction and subsequent mature adipocyte differentiation. In mature adipocytes, it was shown to be highly effective in inducing lipolysis, both on its own and in combination with epinephrine²⁶. These discoveries in adipose cells suggest that the presence of flavonoids in the diet, in particular genistein, can have inhibitory effects on the growth of fatty tissue. Genistein offers promising prospects for the nutrient-mediated regulation of body fat due to its effects on preadipocyte replication, differentiation and lipolysis. Genetic expression studies, in particular those which use adipocyte RNA microarrays, have brought to light some interesting additional polyphenol effects.

Other authors^{27,28} have shown that grape-seed and skin extracts are rich in polyphenol compounds, and that these compounds inhibit the enzymes which metabolise fat, pancreatic lipase and hormone-sensitive lipase. Consequently, the authors described this effect as a possible approach to weight-control which would be safe, natural and cost-effective.

Resveratrol has shown Anti-adipogenic activity in mesenchymal cells differentiation to adipocytes, a hypolipidemic effect, and PPAR and lipoprotein lipase genes expression reduction. This effect can be synergic with other phytochemical products^{28,29}.

Flavonoid-type polyphenols have also been shown to inhibit glucose transport. The regulation of glucose absorption, under the control of insulin, is crucial for maintaining adequate glucose levels in the blood during food-intake and fasting.

In addition, the polyphenols of *Rosmarinus officinalis* (rosemary) have been effective in preadipocyte 3T3-L1 differentiation to inhibit the accumulation of triglycerides³⁰. The extract inhibited adipocyte differentiation and the molecular events taking place during the process of adipogenesis involve early (C/EBP β) and late (PPAR γ) response transcription factors, the results of which show that the polyphenols and components of rosemary extract have an anti-adipogenesis effect in that they play a part in the expression of transcription factors that are crucial to the acquisition of the adipocytic phenotype, which has a beneficial effect in

the treatment of obesity and related illnesses. Furthermore, the green tea increases the fatty oxidation and the thermogenic effect³¹.

Conclusion

The present study has focused on the inhibition of the formation of the fatty substances characteristic of adipogenesis, through the use of an olive seed extract rich in oleuropein and hydroxytyrosol, the conclusion being drawn through a quantitative analysis that extract concentrations of 50 mg/l are capable of preventing the complete formation of fatty substances. This inhibition of adipogenesis is confirmed by the reduction in the expression of the leptin and PPAR γ genes.

Acknowledgments

We thank Catherin Nichols Baeza for her help in preparing the English version of this work.

References

- Oben JE, Ngondi JL and Blum K. Inhibition of Irvingia gabonensis seed extract (OB131) on adipogenesis as mediated via down regulation of the PPARgamma and leptin genes and up-regulation of the adiponectin gene. *Lipids Health Dis* 2008; 7: 44.
- Hsu CL and Yen GC. Phenolic compounds: evidence for inhibitory effects against obesity and their underlying molecular signaling mechanisms. *Mol Nutr Food Res* 2008; 52: 53-61. Review. Erratum in: *Mol Nutr Food Res* 2008; 52: 624-5.
- Sears B and Ricordi C. Role of fatty acids and polyphenols in inflammatory gene transcription and their impact on obesity, metabolic syndrome and diabetes. *Eur Rev Med Pharmacol Sci* 2012; 16: 1137-54.
- Siriwardhana N, Kalupahana NS, Cekanova M, LeMieux M, Greer B and Moustaid-Moussa N. Modulation of adipose tissue inflammation by bioactive food compounds. *J Nutr Biochem* 2013; 24: 613-3.
- Tian C, Ye X, Zhang R, Long J, Ren W, Ding S, Liao D, Jin X, Wu H, Xu S and Ying C. Green tea polyphenols reduced fat deposits in high fat-fed rats via erk1/2-PPAR γ -adiponectin pathway. *PLoS One* 2013; 8: e53796.
- Boqué N, Campión J, de la Iglesia R, de la Garza AL, Milagro FI, San Román B, Bañuelos Ó and Martínez JA. Screening of polyphenolic plant extracts for anti-obesity properties in Wistar rats. *J Sci Food Agric* 2013; 93: 1226-32.
- Panickar KS. Effects of dietary polyphenols on neuroregulatory factors and pathways that mediate food intake and energy regulation in obesity. *Mol Nutr Food Res* 2013; 57: 34-47.
- Boqué N, de la Iglesia R, de la Garza AL, Milagro FI, Olivares M, Bañuelos O, Soria AC, Rodríguez-Sánchez S, Martínez JA and Campión J. Prevention of diet-induced obesity by apple polyphenols in Wistar rats through regulation of adipocyte gene expression and DNA methylation patterns. *Mol Nutr Food Res* 2013; 57: 1473-8.
- Manna C, D'Angelo S, Migliardi V, Loffredi E, Mazzoni O, Morrica P, Galletti P and Zappia V. Protective effect of the phenolic fraction from virgin olive oils against oxidative stress in human cells. *J Agric Food Chem* 2002; 50: 6521-6.
- Manna C, Della Ragione F, Cucciolla V, Borriello A, D'Angelo S, Galletti P and Zappia V. Biological effects of hydroxytyrosol, a polyphenol from olive oil endowed with antioxidant activity. *Advan Exp Med Biol* 1999; 472: 115.
- Manna C, Galletti P, Maisto G, Cucciolla V, D'Angelo S and Zappia V. Transport mechanism and metabolism of olive oil hydroxytyrosol in Caco-2 cells. *FEBS Letters* 2000; 470: 341-4.
- Hao J, Shen W, Yu G, Jia H, Li X, Feng Z et al. Hydroxytyrosol promotes mitochondrial biogenesis and mitochondrial function in 3T3-L1 adipocytes. *J Nutr Biochem* 2010; 21: 634-44.
- Jacomelli M, Pitozzi V, Zaid M, Larrosa M, Tonini G, Martini A et al. Dietary extra-virgin olive oil rich in phenolic antioxidants and the aging process: long-term effects in the rat. *J Nutr Biochem* 2010; 21: 290-6.
- Cortés Castell E, Veciana Galindo C, Torro Montell L, Sirvent Segura E, Rizo Baeza MM and Gil Guillén V. Actividad anti-inflamatoria de un extracto polifenólico de hueso de olivas en la línea celular de monocitos humanos THP1-XBLUE-CD14. *Nutr Hosp* 2014; 30: 113-7.
- Poulos SP, Dodson MV and Hausman GJ. Cell line models for differentiation: preadipocytes and adipocytes. *Exp Biol Med (Maywood)* 2010; 235: 1185-93.
- Veciana Galindo C, Cortés Castell E, Torro Montell L, Sirvent Segura E, Rizo Baeza MM and Gil Guillén V. Evaluación de la citotoxicidad y bioseguridad de un extracto de polifenoles de huesos de aceitunas. *Nutr Hosp* 2014; 29: 1388-93.
- Lee H, Kang R and Yoon Y. Shikonin Inhibits Fat Accumulation in 3T3-L1 Adipocytes. *Phytother Res* 2010; 24: 344-51.
- Yao Y, Li XB, Zhao W, Zeng YY, Shen H, Xiang H and Xiao H. Anti-obesity effect of an isoflavone fatty acid ester on obese mice induced by high fat diet and its potential mechanism. *Lipids Health Dis* 2010; 9: 49.
- Roh C, Jung U and Jo SK. Screening of anti-obesity agent from herbal mixtures. *Molecules* 2012; 17: 3630-8.
- Suzuki R, Tanaka M, Takanashi M, Hussain A, Yuan B, Toyoda H and Kuroda M. Anthocyanidins-enriched bilberry extracts inhibit 3T3-L1 adipocyte differentiation via the insulin pathway. *Nutr Metab (Lond)* 2011; 8: 14.
- Student AK, Hsu RY and Lane MD. Induction of fatty acid synthetase synthesis in differentiating 3T3-L1 preadipocytes. *J Biol Chem* 1980; 255: 4745-50.
- Blancas-Flores G, Almanza-Pérez JC, López-Roa RI, Alarcón-Aguilar FJ, García-Macedo R and Cruz M. Obesity as an inflammatory process. *Bol Med Hosp Infant Mex* 2010; 67: 88-97.
- Fu M, Sun T, Bookout AL, Downes M, Yu RT, Evans RM and Mangelsdorf DJ. A nuclear Receptor Atlas: 3T3-L1. *Adipogenesis Mol Endocrinol* 2005; 19: 2437-50.
- Xiang-Hui L, Zhang J, Sui S and Yang M. Effect of daidzin, genistin, and glycitin on osteogenic and adipogenic differentiation of bone marrow stromal cells and adipocytic transdifferentiation of osteoblasts. *Acta Pharmacol Sinica* 2005; 26: 1081-6.
- Shisheva A and Shechter Y. Role of cytosolic tyrosine kinase in mediating insulin-like actions of vanadate in rat adipocytes. *J Biol Chem* 1993; 268: 6463-9.
- Harmon AW, Patel YM and Harp JB. Genistein inhibits CCAAT/enhancer-binding protein beta (C/EBPbeta) activity and 3T3-L1 adipogenesis by increasing C/EBP homologous protein expression. *Biochem J* 2002; 367(Pt 1): 203-8.
- Park HJ, Jung UJ, Lee MK, Cho SJ, Jung HK, Hong JH et al. Modulation of lipid metabolism by polyphenol-rich grape skin extract improves liver steatosis and adiposity in high fat fed mice. *Mol Nutr Food Res* 2013; 57: 360-4.
- Rayalam S, Della-Fera MA and Baile CA. Synergism between resveratrol and other phytochemicals: Implications for obesity and osteoporosis. *Mol Nutr Food Res* 2011; 55: 1177-85.
- Lasa A, Churrua I, Eseberri I, Andrés-Lacueva C and Portillo AP. Delipidating effect of resveratrol metabolites in 3T3-L1 adipocytes. *Mol Nutr Food Res* 2012; 56: 1559-68.
- Gaya M, Repetto V, Piwien Pilipuk G and Moreno S. Estudio del efecto antiadipogénico de compuestos bioactivos de Rosmarinus officinalis L. en la línea celular 3T3-L1. *Medicina Buenos Aires* 2010; 70: 185.
- Wolfram S, Wang Y and Thielecke F. Anti-obesity effects of green tea: From bedside to bench. *Mol Nutr Food Res* 2006; 50: 176-87.



Original/Otros

Relationship between the domains of the Multidimensional Students' Life Satisfaction Scale, satisfaction with food-related life and happiness in university students

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Abstract

Aim: to characterize types of university students based on satisfaction with life domains that affect eating habits, satisfaction with food-related life and subjective happiness.

Materials and methods: a questionnaire was applied to a nonrandom sample of 305 students of both genders in five universities in Chile. The questionnaire included the abbreviated Multidimensional Student's Life Satisfaction Scale (MSLSS), Satisfaction with Food-related Life Scale (SWFL) and the Subjective Happiness Scale (SHS). Eating habits, frequency of food consumption in and outside the place of residence, approximate height and weight and sociodemographic variables were measured.

Results: using factor analysis, the five-domain structure of the MSLSS was confirmed with 26 of the 30 items of the abbreviated version: Family, Friends, Self, Environment and University. Using cluster analysis four types of students were distinguished that differ significantly in the MSLSS global and domain scores, SWFL and SHS scores, gender, ownership of a food allowance card funded by the Chilean government, importance attributed to food for well-being and socioeconomic status.

RELACIÓN ENTRE LOS DOMINIOS DE LA ESCALA MULTIDIMENSIONAL DE SATISFACCIÓN CON LA VIDA, SATISFACCIÓN CON LA ALIMENTACIÓN Y FELICIDAD EN ESTUDIANTES UNIVERSITARIOS

Abstract

Resumen

Objetivo: caracterizar tipologías de estudiantes universitarios según la satisfacción en dominios de la vida que afectan a los hábitos alimentarios, satisfacción con la alimentación y nivel de felicidad subjetiva.

Material y método: se aplicó un cuestionario a una muestra no probabilística de 305 estudiantes de ambos géneros de cinco universidades de Chile. El cuestionario incluyó: Escala Multidimensional de Satisfacción con la Vida para Estudiantes (MSLSS) abreviada, Satisfacción con la Alimentación (SWFL) y la Escala de Felicidad Subjetiva (SHS). Se consultaron hábitos de consumo de alimentos, frecuencia de comidas dentro y fuera del lugar de residencia, peso y estatura aproximada y variables sociodemográficas.

Resultados: mediante análisis factorial se confirmó la estructura de cinco dominios de la MSLSS, con 26 de los 30 ítems de la versión abreviada: Familia, Amigos, Sí mismo, Entorno de vida y Universidad. Mediante análisis clúster se distinguieron cuatro tipologías que difirieron significativamente en los puntajes de los dominios de la MSLSS y en su puntaje global, en los puntajes de la SWFL, SHS, género, contar con una tarjeta de alimentación financiada por el Estado chileno, importancia asignada a la alimentación para el bienestar personal y nivel socioeconómico.

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Recibido: 30-XII-2014.
1.ª Revisión: 6-III-2015.
Aceptado: 28-III-2015.

Conclusions: higher levels of life satisfaction and happiness are associated with greater satisfaction with food-related life. Other major life domains that affect students' subjective well-being are Family, Friends, University and Self. Greater satisfaction in some domains may counterbalance the lower satisfaction in others.

(*Nutr Hosp.* 2015;31:2752-2763)

DOI:10.3305/nh.2015.31.6.8593

Key words: *Life satisfaction. Satisfaction with food-related life. Happiness. Life domains. University students.*

Introduction

Subjective well-being (SWB) is an assessment people make of their own lives, including happiness, pleasurable emotions, life satisfaction, and the relative absence of unpleasant emotional states¹. Positive evaluations of life satisfaction are linked to happiness and the achievement of the 'good life'². Numerous studies have addressed overall satisfaction with life and in certain domains, including food. Recent studies with adult samples suggest that those who are satisfied with their food and eating habits are satisfied with their lives³⁻⁵. Others have concluded that healthful eating increases satisfaction with life⁶ and happiness⁷. However, the relation between these variables has not been analysed in younger populations, although recent studies show that eating is a domain that relates positively with life satisfaction⁸⁻¹⁰ and happiness in university students^{10,11}.

The study of food as a life domain in university students is relevant because the period of university studies is usually the first time youth take responsibility for their meals. Therefore, this critical stage in development of eating habits will affect their future health¹²⁻¹⁴. Satisfaction with food-related life is defined as a person's overall assessment regarding their food and eating habits³. Evidence from adult population indicates that satisfaction with food-related life not only positively affects life satisfaction, it also relates with other life domains, like family and health⁵. Likewise, eating habits of university students are influenced by family^{10,13,15-18}, living conditions^{13,14,16,19,20}, university^{11,13,16,17,19}, body image and self-concept^{9,13,17,20,21}, friends and classmates^{10,11,13,16,17,19}, among others. Therefore, if university students' eating habits are influenced by these variables and satisfaction with food-related life reflects the overall assessment regarding food and eating habits, it is expected that satisfaction with food-related life relates to students' satisfaction in these life domains.

Much of the research on life satisfaction has relied upon global measures. Although this unidimensional perspective provides useful information, it may mask distinctions between life domains. A multidimensional approach may provide richer, more differentiated profiles based on students' educational, emotional and interpersonal needs²². Therefore, in this research

Conclusiones: mayores niveles de satisfacción con la vida y de felicidad se asocian con una mayor satisfacción con la alimentación. Otros dominios importantes que afectan al bienestar subjetivo de los estudiantes corresponden a la familia, los amigos, la universidad y el sí mismo. La mayor satisfacción en unos dominios compensa la menor satisfacción en otros.

(*Nutr Hosp.* 2015;31:2752-2763)

DOI:10.3305/nh.2015.31.6.8593

Palabras clave: *Satisfacción con la vida. Satisfacción con la alimentación. Felicidad. Dominios de la vida. Estudiantes universitarios.*

a typology of university students from various regions of Chile was developed based on satisfaction with life domains that affect students' eating habits. The types were characterized by their level of satisfaction with food-related life, happiness, eating habits in and out of the place of residence, health-related aspects and socio-demographic characteristics. The abbreviated 30-item version of the Multidimensional Students' Life Satisfaction Scale (MSLSS) proposed by Huebner et al.²³ was used. Commonly used to provide a multidimensional profile of children and youth, the MSLSS assesses both overall life satisfaction and satisfaction across five domains: family, friends, school, living environment and self²⁴.

Materials and method

Participants

The convenience sample comprised 305 students from five state universities in different geographical areas of Chile (Universidad de Tarapacá-Arica, Universidad de Chile-Santiago, Universidad de Talca-Talca, Universidad de La Frontera-Temuco, Universidad de Magallanes-Punta Arenas). All participants were volunteers, with a mean age of 21.5 (SD=2.76); 39.8% were male and 60.2% female; 91.1% resided in an urban area.

Instrument

The questionnaire included the following scales:

- *Multidimensional Students' Life Satisfaction Scale (MSLSS)*: a 40-item self-report scale designed for children of ages 8-18. It uses a 6-point Likert-type response scale, ranging from completely disagree to completely agree²³. Domain and global scores are computed by summing the values of the items and then dividing them by the total number of items comprising each domain or by the total number of items of the scale, respectively. Negatively worded items are reversed-keyed

so that a higher mean score is indicative of higher levels of satisfaction with a particular domain. In this study, the abbreviated 30-item version of the MSLSS²³ was used, which excludes the reverse-keyed items. The internal consistency scores for the domain scores ranged from 0.71 to 0.91²³. Although there is a Spanish-language version of the MSLSS available²⁵, the scale was translated from the original English version to adapt the language to Chilean culture. Two bilingual translators translated the MSLSS from English to Spanish, and a third translator back-translated the Spanish version into English. The differences were resolved by discussion, and all translators agreed on the final version. In addition, the items of the School domain were reworded using “university” instead of school.

- *Satisfaction with Food-related Life Scale (SWFL)*: proposed and tested by Grunert et al.³, it consists of five items grouped into a single dimension (“Food and meals are positive elements”; “I am generally pleased with my food”; “My life in relation to food and meals is close to ideal”; “With regard to food, the conditions of my life are excellent”; “Food and meals give me satisfaction in daily life”). Respondents must indicate their degree of agreement with the statements using a 6-point Likert scale (1: disagree completely, 6: agree completely). This study used the Spanish versions of the SWFL, which has shown good levels of internal consistency in previous studies with Chilean university student samples⁸⁻¹⁰. In this study, the SWFL scale presented adequate levels of internal consistency (Cronbach’s $\alpha=0.836$). The average score of the SWFL was 19.18 (SD=4.92) out of a theoretical maximum of 30.
- *Subjective Happiness Scale (SHS)*: Developed by Lyubomirsky and Lepper²⁶, this instrument consists of four items on a 7-point Likert scale. The first item “is generally considered” goes from 1: a not very happy person, up to 7: a very happy person. The second item “compared with the majority of their peers, is considered” goes from 1: less happy up to 7: happiest. Items 3 “Some people are very happy. They enjoy life despite what happens, taking benefits from almost everything. To what extent does this characterization describe you?” and 4 “Some people are not very happy. Although they are not depressed, they never seem as happy as they could be. To what extent does this characterization describe you?” go from 1: Not at all up to 7: totally. This study used the Spanish version of the SHS, which has previously shown good levels of internal consistency in a study with Chilean university students¹⁰. In this study, the SHS presented good internal consistency (Cronbach’s $\alpha=0.875$). The average score of the SHS in the sample was 5.23 (SD=1.06) out of a theoretical maximum of 7.

Students were asked about the frequency of consumption of nine food groups categorized by the National Statistics Institute in the Surveys of Family Budgets²⁷. They were asked where they lived during the semester and the frequency of meals at their place of residence. Those who ate daily at their place of residence were asked with whom they shared their meals. In case of eating outside the residence, they were asked where they usually had their meals. It was enquired whether they had a food allowance card provided by the Chilean government. They were also asked about the perceived importance of food for their well-being using a 6-point Likert scale (1: not important at all, 6: totally and completely important). The students were asked to indicate the education level and occupation of the head of the household to determine the socioeconomic status (SES) according to Adimark²⁸. The combination of these two variables in a matrix made it possible to determine the SES of the household, corresponding to high and upper middle (ABC1), middle-middle (C2), lower middle (C3), low (D) and very low (E). Finally, their estimated weight and height were assessed in order to calculate their body mass index (BMI) (kg/m²).

Procedure

The execution of the study was approved by the Ethics Committee of the Universidad de La Frontera. Prior to the survey, the questionnaire was pretested with 30 students from said university with similar characteristics. As no problems were detected in the pretest, no changes were required in the questionnaire. The survey was administered through the online survey program QuestionPro, during March and May 2014. QuestionPro is an online service for conducting online research. It allows the creation and administration of survey and polls with different types of questions and formats and the distribution may be private (through email or direct links) or public distribution through social networks or embedded links²⁹. The participants signed informed consent statements before responding.

The MSLSS scale factors were extracted using principal component analysis, considering *eigenvalues* greater than 1 and a varimax factor rotation³⁰. To determine the adequacy of the factor analysis, the Kaiser-Meyer-Olkin (KMO) test and Bartlett’s test of sphericity were used. A cluster analysis (hierarchical conglomerates) was used to determine student types based on the MSLSS factors, with linkage by Ward’s method and the squared Euclidian distance as the measure of similarity between objects³⁰. This analysis was applied to the Z-scores resulting from the MSLSS factor analysis. The number of groups was determined based on the percentage change of the recomposed conglomeration coefficients. To describe the segments, Pearson’s Chi² test was applied to the discrete variables, and analyses of variance to the Z-scores re-

sulting from the factor analysis of the benefits. Because the Levene's statistic indicated non-homogeneous variances in all the continuous variables analysed, the variables for which the analysis of variance resulted in significant differences ($P<0.001$) were subjected to Dunnett's T3 multiple comparisons test. The programme used was SPSS v. 16.0 (SPSS, 2007) for Windows.

Results

Most students in the sample live with their parents year-round (46.6%) and belong to the SES C2 (25.9%) and C3 (31.1%). 36.7% of the sample asserts that food issues are important for their well-being, while 38.7% considered them to be "very important". 49.5% of the sample has a food allowance card provided by the government (Table I).

The average diet of most participants consists of bread (68.2%), soft drinks (46.6%), sugar, coffee and tea (68.9%), milk and dairy products (42.0%) and vegetables (47.2%) on a daily basis; fruits are reported to be consumed daily or two to three times per week (40.7% and 25.9%, respectively). Also two to three times per week, students consume cereals and pasta (56.4%) and meat (51.8%). Fish and seafood (50.5%) are consumed occasionally (Table II). Regarding the frequency of meals at the residence, the largest proportion of students eat breakfast and lunch there daily (45.9 y 36.4%, respectively) or two to three times per week (23.6 y 34.8%, respectively). Most participants skip dinner (42.0%). Considering students that eat breakfast daily at where they live, 70.0% eat alone due to the incompatibility of schedules with other mem-

bers of their residence. Among those who have lunch daily at where they live, 44.5% have lunch with their family and 31.8% do it alone due to incompatibility of schedules. Among students who have dinner on a daily basis where they live, 55.6% do so in the company of their family (Table III). Among those who eat breakfast daily outside of their residence, 26.5% have breakfast in a university cafeteria and 32.9% skip this meal. Out of students who do not eat lunch daily at their place of residence, 52.3% have lunch at the university main cafeteria, 14.0% bring lunch from home and 10.9% eat at smaller cafeterias in campus. Among those who do not eat dinner daily in their place of residence, 75.0% skip this meal (Table IV).

The average BMI of the sample was 23.98 kg/m² (SD=3.64). The nutritional status of the participants, according to the norms of the World Health Organization, were 1.3% low weight, 70.2% in the normal range, 22.3% with overweight (BMI $\geq$ 25) and 6.2% with obesity (BMI $\geq$ 30).

Using factor analysis, the MSLSS five-factor structure was confirmed and grouped 26 of the 30 original items, with an explained variance of 64.5% (Table V). The item "I like my family's house" from the Living environment domain was eliminated because it did not load on a single factor. Likewise, items "University is interesting", from the University domain and "I have fun being around other people" from the Self domain were deleted. The item "I have learned a lot in the university" from the University domain was eliminated because it presented communality values below 0.4. Hence, the MSLSS with the remaining 26 items presented adequate levels of internal consistency, in general (Cronbach's $\alpha=0.91$) and in each of its

Table I
Socio-demographic characteristics, importance of eating habits for well-being and posesión de una food allowance card (%) of university students sample from Chile, May 2014

Place of residence during study period	With parents the entire year	46.6
	With parents the entire year although he/she travels for the day to attend class	10.2
	With their parents only on weekends or for holidays	30.2
	Independent of parents	13.1
Socio-economic status	ABC1 (high and upper middle)	14.8
	C2 (middle-middle)	25.9
	C3 (lower middle)	31.1
	D (low)	20.2
	E (very low)	7.9
Importance of eating habits for well-being	Not important at all	1.0
	Very little important	1.3
	Slightly important	8.2
	Important	36.7
	Very important	38.7
	Totally and completely important	14.1
Has a food allowance card provided by the Chilean government	Yes	49.5
	No	50.5

Table II
Eating habits (%) of university students sample from Chile, May 2014

Frequency of consumption of bread	Daily	68.2
	2-3 times a week	20.3
	Once a week	3.6
	Occasionally	4.9
	Does not consume	3.0
Frequency of consumption of cereals and pasta	Daily	22.0
	2-3 times a week	56.4
	Once a week	16.7
	Occasionally	3.6
	Does not consume	1.3
Frequency of consumption of meat	Daily	23.3
	2-3 times a week	52.8
	Once a week	11.1
	Occasionally	8.2
	Does not consume	5.6
Frequency of consumption of fish and seafood	Daily	0.7
	2-3 times a week	11.1
	Once a week	25.9
	Occasionally	50.5
	Does not consume	11.8
Frequency of consumption of milk and dairy products	Daily	35.1
	2-3 times a week	42.0
	Once a week	13.1
	Occasionally	7.9
	Does not consume	2.0
Frequency of consumption of fruits	Daily	25.9
	2-3 times a week	40.7
	Once a week	15.4
	Occasionally	15.7
	Does not consume	2.3
Frequency of consumption of vegetables	Daily	47.5
	2-3 times a week	36.7
	Once a week	8.9
	Occasionally	5.6
	Does not consume	1.3
Frequency of consumption of soft drinks	Daily	46.6
	2-3 times a week	26.6
	Once a week	10.2
	Occasionally	12.5
	Does not consume	4.3
Frequency of consumption of sugar, coffee and tea	Daily	68.9
	2-3 times a week	15.4
	Once a week	4.9
	Occasionally	5.9
	Does not consume	4.9

domains. The value of the KMO sample adequacy test is considered excellent, and Bartlett's test of sphericity was significant ($p \leq 0.001$)³⁰. This finding is consistent with that obtained by Jovanovic and Zuljevic²⁴ in Serbia, who found a better fit with a 25-item model, excluding all negatively worded and some positively

worded items. The average score the MSLSS was 4.45 (SD=0.59) out of a theoretical maximum of 6. The Pearson correlation between MSLSS and SWFL was 0.389 ($p < 0.01$).

Using a cluster analysis, four student types were detected with significant differences in the Z-scores

Table III
Frequency of meals at the residence and companions with whom the students eat daily at the place of residence (%) of university students sample from Chile, May 2014

Frequency of breakfast at the residence	Daily	45.9
	Two or three times a week	23.6
	Only on weekends	4.6
	Occasionally	17.4
	Never	5.2
	Does not have breakfast	3.3
Frequency of lunch at the residence	Daily	36.4
	Two or three times a week	34.8
	Only on weekends	13.4
	Occasionally	11.1
	Never	3.6
	Does not have lunch	0.7
Frequency of diner at the residence	Daily	26.9
	Two or three times a week	9.2
	Only on weekends	1.3
	Occasionally	10.8
	Never	9.8
	Does not have diner	42.0
Companions for breakfast at the place of residence (daily)	With their family	19.3
	With roommates	3.6
	Alone, due to incompatible schedules	70.0
	Alone, because they live alone	7.1
Companions for lunch at the place of residence (daily)	With their family	44.5
	With roommates	17.3
	Alone, due to incompatible schedules	31.8
	Alone, because they live alone	6.4
Companions for dinner at the place of residence (daily)	With their family	55.6
	With roommates	17.2
	Alone, due to incompatible schedules	22.2
	Alone, because they live alone	4.9

Table IV
Place where the student eats in case he/she doesn't eat at the place of residence (%) of university students sample from Chile, May 2014

Place where the student eats breakfast, in case it is not at the place of residence	University main cafeteria	17.4
	Smaller cafeteria in campus	26.5
	Food stand in campus or nearby	7.1
	Buys snacks in a store near campus	4.5
	Brings food from home and eats it anywhere	11.6
	Skips breakfast	32.9
Place where the student eats lunch, in case it is not at the place of residence	University main cafeteria	52.3
	Smaller cafeteria in campus	10.9
	Food stand in campus or nearby	3.1
	Fast food restaurant near campus	9.3
	Buys snacks in a store near campus	4.6
	Brings food from home and eats it anywhere	14.0
Place where the student eats dinner, in case it is not at the place of residence	Skips lunch	5.7
	University main cafeteria	3.1
	Smaller cafeteria in campus	5.2
	Food stand in campus or nearby	5.1
	Fast food restaurant near campus	6.2
	Brings food from home and eats it anywhere	5.3
	Skips dinner	75.0

Table V
Results of factor analysis of principal components for the MSLSS in university students from various regions of Chile, May 2014.

	Components				
	Family	Friends	Self	Living environment	University
My family gets along well	0.814	-0.014	0.065	0.149	0.081
I like being at home with my family	0.797	0.114	0.119	0.109	0.007
My family is better than most	0.794	0.103	0.129	0.152	-0.061
The members of my family speak well...	0.774	0.094	0.073	0.128	0.057
My parents and I do fun things together	0.746	0.142	0.142	0.139	0.060
My parents treat me fairly	0.739	0.185	0.087	0.000	0.024
I like spending time with my parents	0.731	0.170	0.128	0.048	0.083
My friends are excellent	0.172	0.857	0.099	0.073	0.128
My friends help me if I need it	0.089	0.824	0.125	0.125	0.127
I have a lot of fun with my friends	0.140	0.754	0.056	0.112	0.030
My friends treat me well	0.095	0.750	0.272	0.046	0.067
My friends are nice	0.217	0.694	0.234	0.019	-0.027
I have enough friends	0.062	0.664	0.160	0.153	0.112
Most people like me	0.059	0.084	0.813	0.087	0.097
I think I'm good looking	0.112	0.174	0.811	0.116	0.042
I consider myself a nice person	0.165	0.103	0.763	0.075	0.078
I like how I am	0.223	0.236	0.756	0.169	0.031
There are many things I do well	0.028	0.258	0.691	0.086	0.202
I like to try new things	0.109	0.084	0.554	-0.021	0.089
I like where I live	0.186	0.093	0.064	0.871	-0.059
I like my neighborhood	0.102	0.159	0.076	0.859	-0.047
I like my neighbors	0.214	0.083	0.032	0.676	0.211
There are many fun things to do where I live	0.090	0.114	0.219	0.655	0.116
I like being in the university	0.052	0.151	0.153	0.041	0.828
I look forward to going to the university	0.081	0.039	0.034	0.129	0.814
I like university activities	0.028	0.142	0.264	-0.002	0.743
Variance explained by component (%)	29.65	11.98	8.43	7.72	6.64
Cumulative variance (%)	29.65	41.64	50.08	57.80	64.45
Cronbach's α per component	0.90	0.86	0.86	0.85	0.79

Extraction method: principal components analysis. Rotation method: Varimax with Kaiser Normalization. Rotation converged in five iterations. Measure of sampling adequacy: Keiser-Meyer-Olkin (KMO) = 0.868. Bartlett's Test of Sphericity, approximate Chi-square = 4297.013; $df = 325$; $p = 0.000$. Note: the remaining item should qualified the following standards: the eigenvalues of each extracted factor should be more than 1.000; the factor loadings of each reserved item should be more than 0.40; each item should be only loaded on a single factor; each factor should include at least 3 items.

(Table VI) of the five components obtained from the MSLSS ($p \leq 0.001$). The types differed significantly in the scores of the SWFL, MSLSS and SHS ($p \leq 0.001$) (Table VII). They also differed in owning a food allowance card, gender, importance of food for the well-being and SES ($p \leq 0.05$) (Table VIII).

Group 1, Satisfied with their food-related life, with their self and university (33.4%): This group scored significantly higher than the other groups on the Self and University domains. Participants in this group had a low score on Friends (Table VI). These students scored significantly higher on SWLF and SHS scales

than Groups 3 and 4. The MSLSS total score was significantly lower than Group 2 (Table VII). Group 1 had a higher proportion of students with a food allowance card (58.8%) and that belonged to the SES C3 (39.2%) (Table VIII).

Group 2, Satisfied with their food-related life, with their family, friends and living environment (20.7%): This group scored significantly higher than the rest of groups on Family, Friends and Living environment domains (Table VI). This group had the highest scores on the SWFL and SHS scales, although there were no statistical differences with Group 1 (Table VII). Group 2 had the highest score on the MSLSS, significantly higher than the rest of the groups. Group 2 had more students who considered that food is “totally and completely important” for their well-being (26.4%) and that belonged to the SES E (15.1%) (Table VIII).

Group 3, Moderately satisfied with their food-related life, dissatisfied with their family and self (21.3%): This group scored the lowest on Family and Self, although the latter did not differ statistically from Group 4 (Table VI). Group 3 scored significantly lower than Groups 1 and 2 on SWFL, MSLSS and SHS scales (Table VII). Group 3 consisted of a higher proportion of students that belonged to the SES C2 (45.5%).

Group 4, Moderately satisfied with their food-related life, dissatisfied with their friends and university (24.6%): This group scored significantly lower

than the rest of the groups on Friends and University. It also had a low score on Self, although it did not differ significantly from Groups 2 and 3 (Table VI). Students in this group had significantly lower scores on the SWFL, MSLSS and SHS scales than Groups 1 and 2. Group 4 consisted of a higher proportion of students who did not own a food allowance card (62.1%), male (57.6%), and who considered that food is not at all important for their well-being (4.5%) (Table VIII).

Discussion

The results confirm a five-factor structure for the MSLSS in a sample of university students from different regions of Chile, showing adequate global and domain internal consistency, with 26 out of the 30 original items of the abbreviated version²³. Therefore, the MSLSS may be useful to measure domain-specific life satisfaction in university students.

From the Z-scores of the Family, Friends, Self, Living environment and University domains, four student types were distinguished, which differed in MSLSS domain and global scores, SWFL and SHS scores. They also differed in ownership of a food allowance card, gender, assigned importance to food for well-being and SES. The types did not differ in the frequency of consumption of food groups, place of residence during the semester, frequency of meals in and out of the place of residence, nor BMI. These results contradict

Table VI
Z-score averages of groups obtained from cluster analysis, students of state universities in Chile, May 2014

<i>Component</i>	<i>Group 1 (n = 102)</i>	<i>Group 2 (n = 63)</i>	<i>Group 3 (n = 65)</i>	<i>Group 4 (n = 75)</i>	<i>F</i>	<i>P-value</i>
Family	0.194 b	0.698 a	-1.391 c	0.302 b	65.978	0.000 *
Friends	-0.162 c	0.829 a	0.310 b	-0.855 d	35.500	0.000 *
Self	0.493 a	-0.114 bc	-0.537 c	-0.405 c	17.369	0.000 *
Living environment	0.143 b	0.712 a	0.248 b	-0.051 b	92.050	0.000 *
University	0.600 a	-0.181 b	-0.193 b	-0.753 c	27.044	0.000 *

*Significant at 1%. Letters in horizontal orientation indicate statically significant differences according to Dunnett's T3 Comparison test ($p \leq 0.001$) for non-homogeneous variables.

Table VII
Average scores for the SWFL, 26-item version MSLSS and SHS scales in groups obtained by cluster analysis in university students from various regions in Chile. May 2014

	<i>Group 1 (n = 102)</i>	<i>Group 2 (n = 63)</i>	<i>Group 3 (n = 65)</i>	<i>Group 4 (n = 75)</i>	<i>F</i>	<i>P-value</i>
SWFL	20.19 a	20.67 a	17.85 b	17.33 b	6.046	0.000
MSLSS	4.73 b	5.04 a	3.95 c	4.17 c	69.285	0.000
SHS	5.50 a	5.53 a	4.75 b	4.97 b	7.056	0.000

*Significant at 1%. Letters in horizontal orientation indicate statically significant differences according to Dunnett's T3 Comparison test ($p \leq 0.001$) for non-homogeneous variables.

Table VIII
Characteristics (%) with statistically significant differences in groups of university students from various regions of Chile obtained by cluster analysis. May 2014

	Group 1 (n = 102)	Group 2 (n = 63)	Group 3 (n = 65)	Group 4 (n = 75)
Food allowance card	P = 0.027			
Yes	58.8	49.1	40.0	37.9
No	41.2	50.9	60.0	62.1
Gender	P = 0.014			
Male	38.2	30.8	30.9	57.6
Female	61.8	69.2	69.1	42.4
Importance food on well-being	P = 0.017			
Not at all important	0.0	0.0	0.0	4.5
Very little important	2.0	1.9	0.0	1.5
A little important	5.9	5.7	12.7	12.1
Important	44.1	41.5	38.2	28.8
Very important	44.1	41.5	38.2	28.8
Totally and completely important	14.7	26.4	7.3	6.1
Socio-economic status	P = 0.003			
ABC1 (high and upper middle)	14.7	22.6	9.1	16.7
C2 (middle-middle)	17.6	18.9	45.5	31.8
C3 (lower middle)	39.2	24.5	25.5	31.8
D (low)	23.5	18.9	14.5	13.6
E (very low)	4.9	15.1	5.5	6.1

reports indicating that university students living with their family have more healthful eating habits^{8,10,13,15-18}, which relate to higher satisfaction with their life and food related-life^{8,10} and lower overweight and obesity prevalence^{8,10,18}. Some studies also assert that living with friends and classmates during the semester may negatively influence students' eating habits^{8,10,19}. This in turn is linked to living conditions^{13,14,16,18-20}, by associating the type of nutrition (healthful or unhealthful) to whether they are living with their family, peers or in dormitories during the semester. Evidence indicates that the quality of the living environment affects the SWB in adolescents^{2,24}. According to Oberle et al.³¹, supportive and positive relationships with peers and non-related adults in the community are significantly and positively related to life satisfaction. This may help explain higher scores in Group 2 for the Living environment domain, as well as for the SWFL, SHS and MSLSS.

Inconsistencies between the literature cited and the results of this study on the Family and Friends domains may relate to the MSLSS items that make up these domains, which mainly focus on the social interaction of students with their families and friends. The pleasure of eating is associated with social interaction, es-

pecially in university students¹³. In this respect, it has been reported that students who receive more social support from their family are more satisfied with their life^{10,31-33}, with their food-related life¹⁰ and experience more happiness^{10,33}. This is consistent with the highest scores in Group 2, and the lowest scores in Group 3 in SWFL, MSLSS and SHS and the Family domain, respectively. However, the characteristics of Group 4, statistically similar to Group 3 on SWFL, MSLSS, SHS scores and an intermediate score on Family, suggest that satisfaction with family alone is not enough.

Peers, particularly roommates and partners, seem to have the largest influence on students, positively and negatively, by acting as role models and providing both social support¹⁶ and social pressure^{16,17}. In a qualitative study with UK university students, Brown et al.¹¹ concluded that eating involved socialising and building relationships, and that being in company with friends enhanced the experience of eating, which in turn made them experience more happiness. The opposite can become a strong source of social pressure and it may be associated with feelings of loneliness and even stigmatization¹¹. Also, there is evidence that social support from friends and peers has a major influence on life satisfaction^{24,31}. This is consistent with

the higher scores for Group 2 and lower scores for Group 4 on the SWFL, MSLSS, SHS and the Friends domain. However, the characteristics of Group 3, with statistically similar scores to Group 4 in SWFL, MSLSS, SHS, and an intermediate score on Friends, allows suggesting that satisfaction with friends alone is not enough either. This may be associated with low scores on Self by groups 3 and 4, which had the lowest scores on the SWFL, MSLSS and SHS. Goodwin and Hernández³² found that perceived support from friends was significantly correlated with self-esteem. In university students, SWB is linked to positive relations to people who are the closest (especially friends) and positive evaluations of oneself³⁴. In this regard, students in Groups 3 and 4 scored particularly low on the Self items “Most people like me”, “I like how I am” and “I think I’m good looking”, which would partly explain the lower scores on the SHS, representing the affective component of SWB.

Similarly, although no significant differences in BMI were obtained among the student groups, these results may be linked to low satisfaction with food-related life. There is evidence that people unsatisfied with their body image turn to eating as an immediate distraction to avoid and forget negative feelings on their corporeality, thus reducing anxiety and threats to the self²¹, which may affect negatively their satisfaction with food-related life. Students with important weight fluctuations are reportedly less satisfied with their food-related life than those who maintain their weight⁹ and thus may be more satisfied with their body image. This aspect is a highly relevant variable for university students, who generally aspire to be attractive to others¹⁷ and adjust to the sociocultural Thin Ideal image¹³. Additionally, students who reported greater body dissatisfaction had poorer social and academic adjustment²⁰. This is in line with the low scores for Group 4 on Friends, Self and University. Therefore, it is reasonable to expect that adjustment problems may contribute to a declining SWB²⁰, while the opposite happens in Group 1, with high scores on Self and University. Educational institutions may operate as a protective force for young individuals, and it is positively relates to well-being, self-esteem, and academic engagement, achievement and adjustment³¹. This is noteworthy and must be considered by university authorities, given that more positive perceptions of the university environment tend to be associated with greater student engagement in educational experiences and in the learning process and, in turn, academic success³⁵.

Differences in the SES composition between Groups 1, 2 and 3 confirm that this variable is related to students’ life satisfaction^{2,10}, satisfaction with food-related life and happiness¹⁰. The budgetary restrictions that affect university students negatively impacts their SWB^{10,36}, the quality of their eating habits^{11,14-16} and their food-related life¹⁰. However, contrary to the findings of these studies, the present research reports that

the lowest scores for SWFL, MSLSS and SHS belonged to Group 3, with a higher proportion of students from the SES C2. On the other hand, Group 2 had the highest scores in these scales and had a higher proportion of students from families of the SES E. In this regard, Lyubomirsky et al.³⁷ have asserted that family social support satisfies fundamental needs for acceptance, belonging and love, which cannot be satisfied by economic security alone, as occurs in Group 2 (the highest score in the Family domain) and Group 3 (the lowest score). Regarding Group 1, with high scores on the SWFL and SHS scales, intermediate scores on the MSLSS and the Family domain, and higher presence of students from the SES C3, it can be suggested that budgetary constraints that may affect their SWB are counterbalanced by greater satisfaction in other domains such as Self and University.

In the case of the food domain, the highest level of satisfaction with food-related life may be linked to ownership of a food allowance card provided by the Chilean government. This may allow students to meet their food needs and experience positive levels of satisfaction with food-related life and in the University domain. This is in line with the findings of Gaines et al.¹⁵ in a sample of university students in the USA, in which they found that food assistance improves students’ nutrition. Also, this result is in contrast to studies indicating easy access to unhealthy food in campus which affects students negatively^{13,17,19}. On the contrary, holders of the food allowance card provided by the Chilean government have access to healthful food.

Finally, Group 2 had the highest proportion of students who believe that food is “totally and completely important” to their well-being, and the higher presence of students from Group 4 who believe that food is “not at all important” to their well-being. In part, these differences may be due to a higher presence of men in Group 4, because women tend to be more concerned with food and eating behaviour than men¹⁹. Additionally, this confirms that students’ assigned importance to food for their well-being relates to satisfaction with life and with food-related life^{8,9}. Therefore, there is a need to foster educational campaigns about the importance of food for a higher well-being, physical but also psychological.

Thus, it is possible to indicate that life satisfaction, measured through the MSLSS, relates to satisfaction with food-related life and subjective happiness in university students. These components of SWB are related to satisfaction in other domains, such as family, friends, self, and university. However, the results obtained indicate that similar levels of satisfaction with life, with food-related life and happiness may be associated with satisfaction in different life domains, i.e. higher levels of SWB may be associated with greater satisfaction with the Self and University, but these levels can also be achieved through greater satisfaction with family and friends. This suggests that satisfaction

in some domains counterbalance the lower satisfaction in others.

Limitations of this study include the non-probabilistic nature of the sample and its relatively small size, which does not allow generalization of the results. Also, all data were self-reported, thus responses may be affected by social desirability and recall or response bias. Another limitation of the study lies in asking only the frequency of food consumption and not the amount ingested; therefore, it is not possible to analyse the real nutritional contribution of their intake. These aspects must be dealt with in future studies.

Based on the results obtained, the following can be concluded:

- Four types of university students were distinguished that differ significantly in the MSLSS global and domain scores, SWFL and SHS scores, gender, ownership of a food allowance card funded by the Chilean government, importance attributed to food for well-being and socioeconomic status.
- Higher levels of life satisfaction and happiness are associated with greater satisfaction with food-related life. Other major life domains that affect students' subjective well-being are Family, Friends, University and Self.
- Greater satisfaction in some domains may counterbalance the lower satisfaction in others. However, students reporting satisfaction in more domains of the MSLSS tend to have higher levels of life satisfaction, satisfaction with food-related life and happiness.
- Higher levels of satisfaction with food-life are related to the importance of food assigned by the students to their well-being.

Acknowledgements

These results belong to the Fondecyt Project 1130165.

References

1. Diener E, Biswas-Diener R. New directions in subjective well-being research: The cutting edge. In E. Diener (Ed.), *Positive psychology*. 2000. Available online at http://stat.psych.uiuc.edu/~ediener/hotopic/NEW_DIRECTIONS.html.
2. Proctor CL, Linley PA, Maltby J. Youth life satisfaction: A review of the literature. *J Happiness Stud*. 2009; 10: 583-630.
3. Grunert K, Dean D, Raats M, Nielsen N, Lumbers M. A measure of satisfaction with food-related life. *Appetite* 2007; 49(2): 486-93.
4. Schnettler B, Peña JP, Mora M, Miranda H, Sepúlveda J, Denegri M, Lobos G. Estilos de vida en relación a la alimentación y hábitos alimentarios dentro y fuera del hogar en la Región Metropolitana de Santiago, Chile. *Nutr Hosp*. 2013; 28(4): 1266-1273.
5. Schnettler B, Miranda H, Sepúlveda J, Orellana L, Denegri M, Mora M, Lobos G. Variables que influyen en la satisfacción con la vida en personas de distinto nivel socioeconómico en el sur de Chile. *Suma Psicológica* 2014; 21(1): 54-62.
6. Blanchflower D, Oswald A, Stewart-Brown S. Is psychological well-being linked to the consumption of fruit and vegetables? *Soc Indic Res*. 2013; 114: 785-801.
7. White B, Horwath C, Conner T. Many apples a day keep the blues away – Daily experiences of negative affect and food consumption in young adults. *Br J Health Psychol*. 2013; 18: 782-798.
8. Schnettler B, Denegri M, Miranda H, Sepúlveda J, Orellana L, Paiva G, Grunert KG. Hábitos alimentarios y bienestar subjetivo en estudiantes universitarios del sur de Chile. *Nutr Hosp* 2013; 28(6): 2221-2228.
9. Schnettler B, Miranda H, Sepúlveda J, Orellana L, Etchebarne S, Lobos G, Mora M, Denegri M, Grunert KG. Dietary restraint and subjective well-being in university students in Chile. *Nutr Hosp* 2014; 30(2): 453-461.
10. Schnettler B, Denegri M, Miranda H, Sepúlveda J, Orellana L, Paiva G, Grunert KG. Family support and subjective well-being: an exploratory study of university students in southern Chile. *Soc Indic Res*, (in press), doi 10.1007/s11205-014-0718-3.
11. Brown L, Edwards J, Hartwell H. Eating and emotion: focusing on the lunchtime meal. *Br Food J* 2013; 115(2-3): 196-208.
12. Cervera F, Serrano R, Daouas T, Delicado A, García M. Hábitos alimentarios y evaluación nutricional en una población universitaria Tunecina. *Nutr Hosp*, 2014; 30(6): 1350-1358.
13. Deliens T, Clarys P, De Bourdeaudhuij I, Deforche B. Determinants of eating behaviour in university students: a qualitative study using focus group discussions. *BMC Public Health* 2014; 14: 53.
14. Verger P, Combes JB, Kovess-Masfety V, Choquet M, Guagliardo V, Rouillon F, Peretti-Wattel P. Psychological distress in first year university students: socioeconomic and academic stressors, mastery and social support in young men and women. *Soci Psych Psych Epid*. 2009; 44: 643-650.
15. Gaines A, Robb CA, Knol LL, Sickler S. Examining the role of financial factors, resources and skills in predicting food security status among college students. *Int J Consumer Studies*, 2014; 38: 374-384.
16. Hartman H, Wadsworth D, Penny S, van Assema P, Page R. Psychosocial determinants of fruit and vegetable consumption among students in a New Zealand university. Results of focus group interviews. *Appetite* 2013; 61: 35-42.
17. Smith-Jackson R, Reel J. Freshman women and the "freshman 15". Perspectives on prevalence and causes of college weight gain. *J Am Coll Health*, 2012; 60(1): 14-20.
18. Durá T, Castroviejo A. Adherencia la dieta mediterránea en la población universitaria. *Nutr Hosp* 2011; 26(3): 602-608.
19. Deliens T, Clarys P, Van Hecke L, De Bourdeaudhuij I, Deforche B. Changes in weight and body composition during the first semester at university. A prospective explanatory study. *Appetite*, 2013; 65: 111-116.
20. Barker ET, Galambos NL. Body dissatisfaction, living away from parents, and poor social adjustment predict binge-eating symptoms in young women making the transition to university. *J Youth Adolescence*, 2007; 36:904-911.
21. Polivy J, Herman PC. Causes of eating disorders. *Ann Rev Psychol*, 2002; 53: 187-213.
22. Abolghasemi S, Varaniyab S. Resilience and perceived stress: predictors of life satisfaction in the students of success and failure. *Procedia Soc Behav Sci*, 2010; 5: 748-752.
23. Huebner ES, Zullig J, Saha R. Factor structure and reliability of an abbreviated version of the Multidimensional Students' Life Satisfaction Scale. *Child Indic Res*, 2012; 5: 561-657.
24. Jovanovic V, Zuljevic D. Psychometric evaluation of the Serbian version of the Multidimensional Student' Satisfaction Scale. *Soc Indic Res*, 2013; 110: 55-69.
25. Galindez E, Casas F. Adaptación y validación de la MSLSS de satisfacción vital multidimensional con una muestra de adolescentes. *Revista de Psicología Social*, 2011; 26: 309-323.
26. Lyubomirsky S, Lepper H. A measure of subjective happiness: Preliminary reliability and construct validation. *Soc Indic Res*, 1999; 46: 137-155.
27. Instituto Nacional de Estadística. Metodología VI Encuesta de presupuestos familiares 2006-2007. Resultados Encuestas de

- Presupuestos familiares. Nov. 2006-oct. 2007. Conectado en diciembre de 2008. Available online at http://www.ine.cl/canales/chile_estadistico/encuestas_presupuestos_familiares/2008/metodologia_vi_epf.pdf
28. Adimark. El nivel socioeconómico ESOMAR. Manual de aplicación. Santiago. Available online at <http://www.microweb.cl/idm/documentos/ESOMAR.pdf>.
 29. QuestionPro Survey Software. QuestionPro. Available online at <http://www.questionpro.com/>
 30. Hair J, Anderson R, Tatham R, Black W. Análisis multivariante. Otero. 5ª ed. Madrid: Prentice Hall Internacional. Inc.; 1999.
 31. Oberle E, Schonert-Reichl K, Zumbo B. Life satisfaction in early adolescence: Personal, neighborhood, school, family, and peer influences. *J Youth Adolesc*, 2011; 40: 889-901.
 32. Goodwin R, Hernández S. Perceived and received social support in two cultures: Collectivism and support among British and Spanish students. *J Soc Pers Relat*, 2000; 17(2): 282-291.
 33. Brannan D, Biswas-Diener R, Mohr C, Mortazavi S, Stein N. Friends and family: A cross-cultural investigation of social support and subjective well-being among college students. *J Posit Psychol*, 2013; 8(1): 65-75.
 34. Babinčak P, Bacova V. Life satisfaction, beliefs and relations to oneself and others in university students. *Stud Psychol*, 2008; 50(1), 79-94.
 35. Mohammadi M, Schwitzer A, Nunnery J. Examining the Effects of Residence and Gender on College Student Adjustment in Iran: Implications for Psychotherapists. *J College Stud Psychother*, 2009; 24(1): 59-72
 36. Tumkaya S. Humor styles and socio-demographic variables as predictors of subjective well-being of Turkish university students. *Edu Sci*, 2011; 36(160): 158-170.
 37. Lyubomirsky S, King L, Diener E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychol Bull*, 2005; 131: 803-855.



Original/Otros

Protein intake, nitrogen balance and nutritional status in patients with Parkinson's disease; time for a change?

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Abstract

Objective: to evaluate protein intake, nitrogen balance and nutritional status of clinically stable patients with Parkinson's disease (PD).

Methods: a cross-sectional study of PD patients Hoehn-Yahr scale stage 1-3 and subjects with no neurologic disease (controls) matched for age and gender. All participants underwent a diet history interview, anthropometric measurements, bioelectrical impedance and food record over three non-consecutive days, including a weekend. A 24-hour urine collection and fasting venous blood sampling were collected from the participants for evaluation of creatinine clearance, creatinine height index and the nitrogen balance.

Results: the mean age of PD patients was 58.9 ± 12.8 year compared to 54.7 ± 12.6 year of the controls, $P = 0.34$. One third of PD group had symptoms of dysphagia and ingested less water and fibers when compared to controls. Calf circumference was small in PD group (35.5 ± 2.8 vs. 38.4 ± 3.5 cm, $P = 0.012$). Intake of nitrogen was significantly lower and nitrogen balance was negative in PD patients (-1.8 ± 3.9 vs. 1.1 ± 4.2 controls, $P = 0.06$). The antioxidants folate and vitamin E were consumed in small amounts in both groups, although significantly less in PD patients ($P = 0.04$ and 0.03 , respectively).

Discussion: daily intakes of protein of approximately 1.1 g/kg by clinically stable PD patients may not be enough to ensure a neutral calorie-nitrogen balance and muscle tissue conservation. Larger studies are necessary to provide a more comprehensive picture of PD patients' metabolic status.

(Nutr Hosp. 2015;31:2764-2770)

DOI:10.3305/nh.2015.31.6.8938

Key words: Parkinson Disease. Nutritional status. Nitrogen balance.

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Recibido: 10-III-2015.
Aceptado: 3-IV-2015.

INGESTIÓN PROTEICA, BALANCE NITROGENADO Y ESTADO NUTRICIONAL EN PACIENTES CON ENFERMEDAD DE PARKINSON; ¿TIEMPO PARA CAMBIOS?

Resumen

Objetivo: evaluar ingestión proteica, balance nitrogenado y estado nutricional de pacientes con enfermedad de Parkinson (EP) clínicamente estables.

Métodos: estudio transversal de pacientes con EP en los niveles 1-3 según la escala de Hoehn-Yahr e individuos sin enfermedad neurológica (controles), pareados por edad y género. Todos los participantes fueron sometidos a una entrevista de la historia nutricional, antropometría, impedancia eléctrica y registro alimentario de 3 días consecutivos, incluyendo un fin de semana. Fueron colectados sangre venosa en ayuno y orina de 24 horas para evaluación de la depuración de la creatinina, índice creatinina-altura y balance nitrogenado.

Resultados: el promedio de edad en pacientes con EP fue $58,9 \pm 12,8$ años en comparación con $54,7 \pm 12,6$ años de los controles, $p = 0,345$. Un tercio del grupo EP tuvo síntomas de disfagia, con menor ingestión de agua y fibras, comparados a los controles. La circunferencia de la pantorrilla fue menor en grupo EP ($35,5 \pm 2,8$ vs. $38,4 \pm 3,5$ cm, $p = 0,012$). La ingestión de nitrógeno fue significativamente menor y el balance de nitrógeno fue negativo en grupo EP ($-1,8 \pm 3,9$ vs. $1,1 \pm 4,2$ controles, $p = 0,064$). Los antioxidantes folato y vitamina E fueron consumidos en pequeñas cantidades en ambos grupos, aunque significativamente menor en los pacientes con EP ($p = 0,042$ y $0,031$, respectivamente).

Discusión: la ingestión proteica diaria de aproximadamente 1,1 g/kg en pacientes clínicamente estables con EP puede no ser suficiente para garantizar un balance neutro de calorías-nitrógeno, así como para mantener la masa muscular. Serán necesarios mayores estudios que produzcan una imagen más completa del estado metabólico de los pacientes con Parkinson.

(Nutr Hosp. 2015;31:2764-2770)

DOI:10.3305/nh.2015.31.6.8938

Palabras clave: Enfermedad de Parkinson. Estado nutricional. Balance nitrogenado.

Abbreviations

PD: Parkinson Disease.
HY: Hoehn and Yahr scale.
EAT-10: Eating Assessment Tool.
FOIS: Functional Oral Intake Scale.
BMI: Body Mass Index.
CC: Calf Circumference.
WHO: World Health Organization.
SMI: Skeletal Muscle Index.
BF: Body Fat.
BIA: Bioelectrical Impedance.
DRI: Dietary Reference Intakes.
EAR: Estimated Average Requirement.
AI: Adequate Intake.
NB: Nitrogen Balance.
CHI: Creatinine Height Index.
NAA: Neutral Aromatic Amino Acids.
RDA: Recommended Dietary Allowances.

Introduction

Parkinson's disease (PD) is recognized as the second most common neurodegenerative disorder after Alzheimer's disease and affects 1% of the population worldwide after the age of 65 years, with an incidence of 10 to 14 cases per 100,000 per year. PD results mainly from progressive degeneration of dopaminergic neurons in the substantia nigra and other monoaminergic cell groups in the brainstem¹.

It causes motor dysfunctions, such as bradykinesia, resting tremor, rigidity and postural instability, but also affects autonomic functions and cognition². The treatment aims to increase dopamine levels and alleviate the symptoms. For this purpose, drugs as levodopa, for example, are commonly used³.

Nutritional status can be compromised in patients with PD¹, often leading to weight loss. Low dietary intake due to dysphagia and anorexia, reduced absorption by slow gastric emptying and increased energy expenditure by high muscle activity has been suggested as possible weight loss mechanisms⁴.

Adequate nutrition plays an important role in preventing complications and malnutrition in PD. In addition, it is important as a determinant of treatment response, since the intake of large quantities of proteins, especially animal proteins can compete with intestinal absorption of levodopa and reduce its absorption and effectiveness⁵. On the other hand, low consumption can lead to changes in nutritional status.

Thus, the aim of this study was to evaluate the protein intake, nitrogen balance and nutritional status of patients with Parkinson's disease.

Methods

This was a cross-sectional, observational study involving selected patients with primary PD attending an

outpatient clinic for Movement Disorders from a tertiary, university-affiliated hospital. All patients were under chronic levodopa therapy and were classified as grade 1 to 3 from Hoehn and Yahr scale (HY).

Exclusion criteria were associated neurological disease, use of diuretics, physical limitations to the anthropometric measurements, and illiterate patients without caregivers to assist in food consumption notes. A control group, matched for age and gender, with no neurologic disease was recruited among patients in Internal Medicine Outpatient Clinic at the same institution.

A detailed nutritional history was performed and patients were asked about comorbidities; bowel habits, being considered constipated individuals with less than three bowel movements per week; usual fluid intake; cough during meals; dysphagia symptoms as evaluated by the Eating Assessment Tool (EAT-10)⁶, and safety and adequate oral intake by Functional Oral Intake Scale - FOIS⁷.

In all patients, weight, height, body mass index (BMI), calf circumference (CC) were measured using an electronic scale, a stadiometer and an inelastic tape measure, respectively, according to the methods recommended by the World Health Organization (WHO)⁸. Analysis of body composition as skeletal muscle index (SMI)⁹ and body fat (BF)¹⁰ was performed by bioelectrical impedance (BIA) using an RJL Systems Quantum-101Q[®] device (Michigan, MI).

The habitual energy and nutrient intakes were determined by a food record over three non-consecutive days, including a weekend. The subjects collected a 24-hour urine sample during the last day of the recording period. To minimize the loss of urine, they were given detailed oral and written instructions concerning the collection. The analysis and calculation of food records were made through a Microsoft Excel spreadsheet (2010), using serving sizes and food composition tables¹¹.

Adequacy of intake for all nutrients analyzed was provided by the Dietary Reference Intakes (DRI) for age and sex. The estimated average requirement (EAR) values were considered, and when unavailable, the adequate intake (AI) values were used¹².

Blood and urine creatinine were measured by alkaline picrate reaction, and we calculated the creatinine clearance. Urea was measured after its hydrolysis by urease, and protein by biuret method. Nitrogen balance (NB) was calculated based on nitrogen intake and on total urinary nitrogen in a 24-hour urine collection¹³ and creatinine height index (CHI) by the ratio of 24-hour urine creatinine x 100 and ideal urinary creatinine according to height, age and sex¹⁴.

Analyses were performed by R version 3.0.2 software. (R Development Core Team, 2013). The Shapiro-Wilk test was used to assess the normality of the data, which were expressed as mean and standard deviation, or as median, minimum and maximum value. To test the statistical differences between the groups

we used the parametric Student's t test and the non-parametric Wilcoxon Mann-Whitney test. To assess relationships between variables, Pearson's correlations or Spearman's for non-normal distributions were used. All statistical tests were two tailed, with a significance level of $p < 0.05$.

The local ethics committee approved the study, and written informed consent was obtained from each subject.

Results

A total of 17 patients with PD were investigated. Their average age was 58.9 ± 12.8 year, and 53% (9/17) were males. Eight PD patients were classified as grade 1, eight as grade 2 and one patient as grade 3 from HY scale. The control group comprised 17 individuals with an average age of 54.7 ± 12.6 year, 53% of whom were also male. Baseline demographic, anthropometric and biochemical data of both groups are shown in table I. The BMI of the control group was higher (median 27.9 vs. 26.3, $p < 0.058$) than the PD group, but both groups are classified as overweight, as defined by WHO. The mean of CC was the only anthropometric measure significantly different between the groups, with control group having higher values when compared to PD disease patients.

PD group had a mean protein intake of 1.1 ± 0.3 g/kg compared to 1.2 ± 0.5 g/kg of the controls, $p = 0.31$. We

also found that PD patients ingested significantly less nitrogen when compared to the control group (Fig. 1) and their nitrogen balance was negative (-1.8 ± 3.9 vs. 1.1 ± 4.2 g/day, $p < 0.06$). No correlation was found between CC or SMI and protein and energy intake, NB and CHI ($p = \text{NS}$).

Creatinine clearance was similar in both groups, 92.5 ± 26.9 mL/min for PD patients and 91.3 ± 29.2 mL/min for controls, $p = 0.91$. Diabetes mellitus (2/17, 11.8% in PD group and 3/17, 17.7 in control group, $p = \text{NS}$) and high blood pressure (7/17, 41.2% in PD group and 6/17, 35.3% in the control group, $p = \text{NS}$) were the most common comorbidities, evenly distributed between the groups.

Nonmotor complications were assessed in both groups. Dysphagia symptoms were present in five (30%) patients with PD classified as level six according to FOIS scale. Similar results were found by the self-assessment questionnaire to identify the risk of dysphagia, EAT-10, 35.3% ($n = 6$) of patients were classified as risk. None of the subjects of the control group referred symptoms of dysphagia or had it detected by EAT-10 ($p < 0.04$ vs. PD). Two patients with PD complained of cough during meals compared to one subject from the control group. Constipation was present in very few subjects in both groups (two in PD group and one in controls, $p = \text{NS}$).

As depicted in table II, energy intake, consumption of carbohydrate, protein, and different types of fat were similar among the groups. Relative to control

Table I
Baseline demographic, anthropometric and biochemical data of both groups

	PD (n=17)	Controls (n=17)	p value
Age (years)	58.9 ± 12.8	54.7 ± 12.6	0.35
Gender			
Male, n (%)	9 (52,9)	9 (52,9)	
Female, n (%)	8 (47,1)	8 (47,1)	
Body weight (kg)	70.3 ± 12.0	75.4 ± 13.1	0.25
Height (m)	1.7 ± 0.1	1.6 ± 0.1	0.08
BMI (kg/m ²)*	26.3 (20.5-30.6)	27.9 (20.0-38.0)	0.058
CC (cm)	35.5 ± 2.8	38.4 ± 3.5	0.012
BIA			
SMI (kg/m ²)	8.9 ± 1.7	9.8 ± 1.6	0.15
BF (%)	28.1 ± 8.2	32.0 ± 10.7	0.24
NB (g/day)**	-1.8 ± 3.9	1.1 ± 4.2	0.06
Nitrogen intake (g)	10.6 ± 4.4	14.4 ± 4.1	0.019
Nitrogen excretion (g)	12.4 ± 3.3	13.3 ± 3.7	0.47
CHI (%)**	114.9 ± 29.7	121.3 ± 28.2	0.545

Values are presented as mean $\pm$ SD

*BMI: Values are presented as median (minimum-maximum)

**NB: n=15; CHI PD: n=16; CHI Controls: n=15

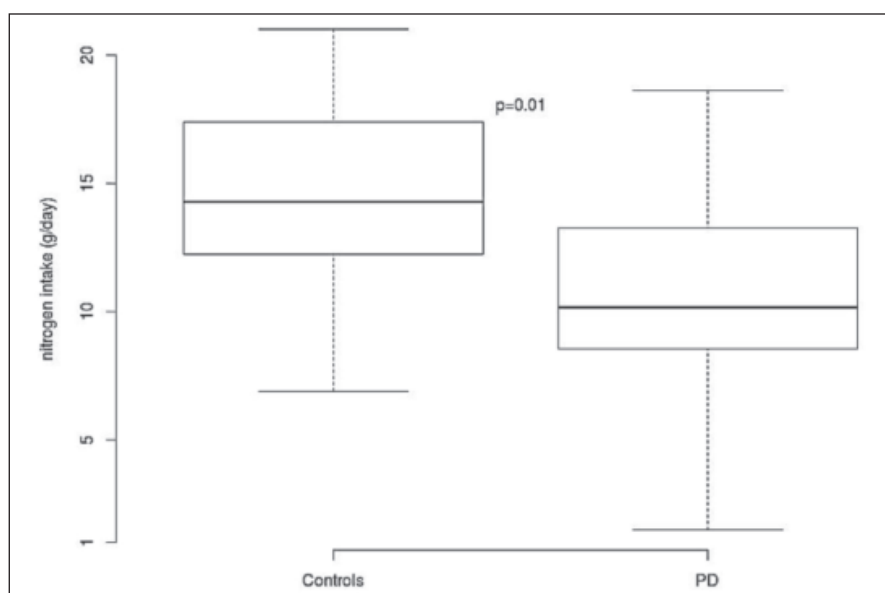


Fig. 1.—Nitrogen intake (g/day) of both groups.

Table II
Macronutrient intake, water and fiber per day of both groups

	PD (n=17)	Controls (n=17)	p value
Energy (kcal)*	2018.6 (1248.9-2683.7)	2152.8 (991.3-4672.2)	0.24
Carbohydrate (g)	275.7 (104.7-401.1)	262.6 (139.1-625.0)	0.97
Protein (g)*	73.8 (42.3-118.4)	92.8 (44.1-133.0)	0.10
Fat (%)	30.9 (21.1-52.0)	28.4 (19.3-43.6)	0.22
Cholesterol (mg)	238.0 (126.1-647.9)	277.9 (102.0-627.1)	0.47
Saturated fatty acids (%)*	11.5 (8.4-18.2)	10.4 (7.6-17.2)	0.20
Mono unsaturated fatty acids (%)	10.2 (6.9-19.7)	10.6 (7.1-17.5)	0.71
Poly unsaturated fatty acids (%)*	5.3 (3.6-9.3)	5.2 (3.3-7.7)	0.84
Trans fat (%)	1.7 (0.8-4.2)	1.3 (0.6-2.8)	0.11
Fiber (g)	16.2 (6.9-35.6)	24.5 (10.4-90.6)	0.013
Water (mL)	800 (200-2000)	1800 (200-4000)	0.019
Energy (kcal/kg)	30.9 (18.3-44.6)	27.4 (14.5-62.5)	0.74
Protein (g/kg)	1.1 (0.7-1.8)	1.2 (0.6-2.3)	0.31

Values are presented as median (minimum-maximum)

*Test t for parametric data.

group, PD patients ingested significantly less water (median 800 ml vs. 1800 ml, $p=0.019$) and total fiber (16.2 vs. 24.5 grams, $p=0.013$) per day.

We extensively evaluated the intake of minerals and vitamins consumption in both groups. There were small differences (albeit statistically significant) in the intake of folate and vitamin E between the groups, with higher consumption in the control group, as demonstrated in table III. Adequacy of intake (in percentage of DRI) for some nutrients analyzed in this work is shown in figure 2.

Discussion

The investigation showed that clinically stable, grade 1 to 3 HY PD patients doesn't had adequate daily calorie and protein intake to meet their metabolic needs and had negative NB. Consequently, they had low muscle mass as assessed by CC and potentially reduced energy availability for daily life. One third of them had symptoms of dysphagia and ingested less water and fibers when compared to controls. In addition, two important antioxidants (folate and vitamin E) were consumed in small amounts.

Table III
Micronutrient intake, water and fiber per day of both groups

	PD (n=17)	Controls (n=17)	p value
Calcium (mg)	623.2 (279.5-1229.4)	816.2 (413.8-1825.2)	0.30
Magnesium (mg)	223.8 (97.9-343.1)	267.9 (64.1-926.8)	0.08
Manganese (mg)	2.1 (1.5-20.0)	3.0 (0.8-8.8)	0.17
Phosphorus (mg)	987.1 (530.3-1660.9)	1276.4 (535.1-2983.4)	0.24
Iron (mg)	9.4 (5.3-18.6)	11.1 (4.0-32.8)	0.08
Sodium (mg)	2980.5 (1385.5-4432.5)	3691.3 (1158.4-8584.8)	0.17
Potassium (mg)	2289.2 (1028.0-3858.1)	2908.3 (1254.4-8273.4)	0.11
Copper (mg)	0.9 (0.6-10.9)	1.1 (0.4-5.5)	0.26
Zinc (mg)	9.6 (5.1-17.4)	11.2 (4.1-27.7)	0.058
Selenium (mcg)	79.1 (40.6-120.2)	94.6 (32.9-206.6)	0.23
Vitamin A (mcg)	487.5 (157.9-6882.5)	676.3 (202.2-6320.1)	0.29
Thiamin (mg)	1.4 (0.6-2.2)	1.4 (0.5-4.1)	0.89
Riboflavin (mg)*	2.0 (1.0-4.4)	2.2 (0.8-3.5)	0.73
Niacin (mg)	16.2 (7.3-31.2)	16.9 (5.0-45.1)	0.51
Vitamin B6 (mg)	1.6 (0.8-3.7)	1.9 (0.7-3.7)	0.41
Vitamin B12 (mcg)	3.3 (2.0-51.7)	5.0 (1.4-26.5)	0.14
Folate (mcg)	224.8 (106.2-541.7)	317.5 (99.4-1255.2)	0.042
Vitamin D (mcg)	4.1 (1.4-7.9)	4.2 (1.6-18.4)	0.76
Vitamin E (mg)	3.6 (3.1-6.4)	5.1 (2.6-21.1)	0.031
Vitamin C (mg)	85.9 (8.5-662.4)	85.8 (18.9-610.6)	0.58

Values are presented as median (minimum-maximum)

*Test t for parametric data.

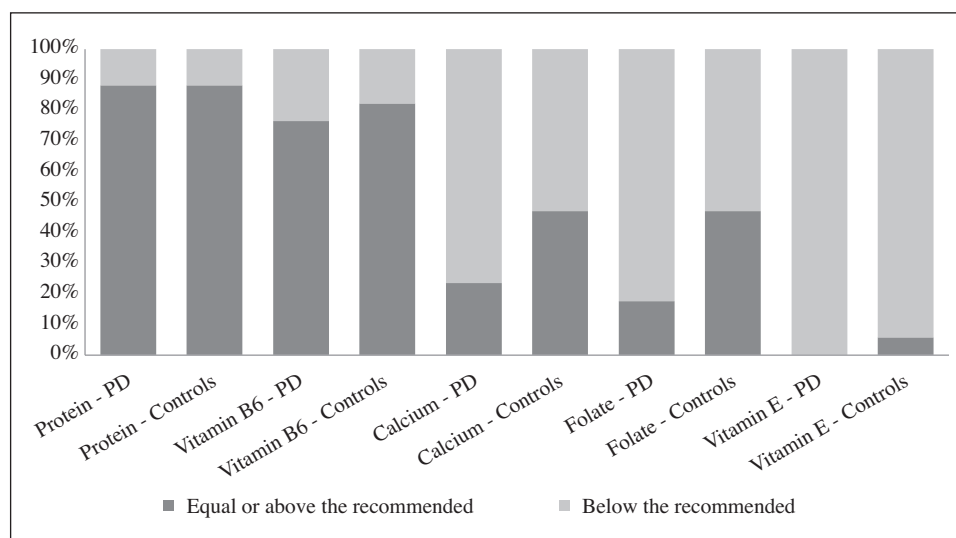


Fig. 2.—Adequacy of intake (%) for some nutrients per day of both groups.

Patients with chronic neurological diseases are in increase risk of malnutrition by multiple factors related to nutrient ingestion, abnormalities in the energy expenditure, changes in eating behavior, and gastrointestinal changes⁴.

Whereas bradykinesia, rigidity, tremor, and postural instability result in disability, nonmotor complications

in PD may be equal or greater significance in some patients and can significantly change the nutritional status¹.

Autonomic dysfunction is one of these complications, which may present as gastrointestinal, urinary, and sexual disturbances. In effect, one third of our patients had presented advanced dysphagia. Some au-

thors have proposed that this condition can affect over 80% of individuals, reflecting the underlying motor impairments and the extent of the disease's progression. These dysphagia-related impairments have a direct influence on the nutritional and health status of the patients, and are associated with increased morbidity and mortality¹⁵.

Levodopa is the most effective drug for the symptomatic treatment of PD³. Unfortunately, the neutral aromatic amino acids (NAA) contained in dietary proteins may compete with this drug for intestinal absorption and transport across the blood-brain barrier, thus limiting its efficacy and being responsible for the occurrence of motor fluctuations¹⁶. A reduction of protein intake to 0.75-0.8 g/kg body weight/day has been recommended in PD with protein redistribution, as shifting protein intake to the evening has showed to ameliorate the response to levodopa. However, some authors have suggested that in elderly patients protein restriction may lead to a lasting negative nitrogen balance, and even in younger patients the supply of certain minerals and vitamins may become too low or marginally adequate¹⁷. Furthermore, the restriction of protein intake seems to be effective only in a small group of patients¹⁸.

In the present study, PD patients had a mean intake of 1.1 ± 0.3 g/kg of protein (vs. 1.2 ± 0.5 g/kg from controls, $p=0.308$) and ingested 10.6 ± 4.4 g/day of nitrogen compared to 14.4 ± 4.1 of the control group, $P=0.019$. Similar results have been found in more recent studies³. Nitrogen balance was negative, although the difference between the groups did not reach statistical significance (Table I). Body proteins are in a constant state of flux, with degradation and synthesis constantly going on. When necessary, muscle protein becomes a source of energy, resulting in a negative nitrogen balance.

Calf circumference correlates positively with muscle mass and values lower than 31 cm has been associated with disability¹⁹. In the current work, CC was significantly lower in the PD patients compared to the control group (Table I). In other study, CC showed no significant difference, and the control subjects had lower values²⁰.

However, age-related changes in fat deposits and loss of skin elasticity can lead to imprecise measurements in older people. BIA could be used for sarcopenia screening. Our data demonstrated similar values of muscle mass index as assessed by BIA in both groups (Table I).

While maintaining nitrogen balance is critical for health, there are some suggestions that Recommended Dietary Allowances (RDA) may not be the right amount of protein needed to promote optimal health in healthy individuals. To achieve that, more protein is needed, and recent studies suggest that athletes, active people, and older individuals require even more²¹.

Our investigation offers some evidence that spontaneous nutrition of clinically stable PD patients, li-

kewise observed in other chronic diseases²² may not balance for the various catabolic factors that can be present and that a recommended "normal" protein intake is not synonymous with an "adequate" protein intake. Although excessive protein intake remains a concern in subjects with pre-existing renal disease, the literature lacks significant research demonstrating a link between protein intake and the initiation or progression of renal disease in healthy individuals²³. As showed in the results section, glomerular filtration rate as estimated by the creatinine clearance was normal for both groups.

Finally, some data suggest that is not necessary to limit protein intake in PD to achieve stable levels of levodopa and NAA. By the opposite, in susceptible patients, consumption of meals containing high carbohydrate, but lacking enough protein, can cause signs of levodopa toxicity (dyskinesias), probably because too much drug suddenly enters the brain²⁴.

A large systematic review and meta-analysis found that dietary intake of vitamin E protects against PD. This protective influence was seen with both moderate intake (relative risk 0.81, 95% CI 0.67-0.98) and high intake (0.78, 0.57-1.06) of vitamin E. The authors concludes that although the results requires confirmation in randomized controlled trials, dietary vitamin E may have a neuroprotective effect attenuating the risk of PD²⁵. In our work, both groups had a very low intake of vitamin E (median 3.6 vs. 5.1 in the control group, $p<0.031$), well below the EAR of 12 mg. These intake estimates might be low, however, because the amounts and types of fat added during cooking are often unknown and not accounted for. Additionally, in people who already have PD, high-dose vitamin E was not able to slow disease's progression²⁶.

There is conflicting evidence regarding the usefulness of folic acid in PD. In patients with low or low-normal folate levels, levodopa administration is associated with increases in homocysteine²⁷. This aminoacid is associated with cardiovascular risks, neuropsychiatric illness, and increased fractures in elderly persons. As depicted in table III our PD patients had an estimated intake of folic acid of $224.8 \mu\text{g/day}$ in median, below the EAR of $320 \mu\text{g/day}$.

In our opinion, the main limitation of this study was the sample size of our population. The small sample size limits generalizability, so larger-scale studies are urgently needed. Nonetheless, this sample is probably an accurate representation of PD patients presenting to Movement Disorders outpatient clinics. Second, a significant amount of the clinical information was based on interviews with patients and their caregivers, which could have resulted in recall bias. We are also aware that because of its cross-sectional design, this study does not allow to establish any cause-effect relationships.

In conclusion, we believe that the present work has implications for clinical practice. Daily intakes of protein of approximately 1.1 g/kg by clinically stable, predomi-

nantly 1-2 HY scale, PD patients may not be sufficient to ensure a neutral calorie nitrogen balance and muscle tissue conservation. As advised in other chronic diseases²², this study emphasizes the importance to estimate nitrogen balance and not only macronutrient intakes. Therefore, larger studies involving more PD patients and matched controls may help in providing a more comprehensive picture of the patients' metabolic status.

References

1. Ułamek-Kozioł M, Bogucka-Kocka A, Kocki J, Pluta R. Good and bad sides of diet in Parkinson's disease. *Nutrition*. 2013;29(2):474-5.
2. Munhoz RP, Werneck LC, Teive HA. The differential diagnoses of parkinsonism: findings from a cohort of 1528 patients and a 10 years comparison in tertiary movement disorders clinics. *Clin Neurol Neurosurg*. 2010;112(5):431-5.
3. Fracasso BM, Morais MB, Gomez R, Hilbig A, Rabito EI. Protein intake and the use of levodopa in patients with Parkinson's disease. *Rev Chil Nutr*. 2013;40(2):102-6.
4. Capecchi M, Petrelli M, Emanuelli B, Millevolte M, Nicolai A, Provinciali L, et al. Rest energy expenditure in Parkinson's disease: role of disease progression and dopaminergic therapy. *Parkinsonism Relat Disord*. 2013;19(2):238-41.
5. Barichella M, Akpalu A, Cham M, Privitera G, Cassani E, Cereda E, et al. Nutritional status and dietary habits in Parkinson's disease patients in Ghana. *Nutrition*. 2013;29(2):470-3.
6. Belafsky PC, Mouadeb DA, Rees CJ, Pryor JC, Postma GN, Allen J, et al. Validity and reliability of the Eating Assessment Tool (EAT-10). *Ann Otol Rhinol Laryngol*. 2008;117(12):919-24.
7. Crary MA, Mann GD, Groher ME. Initial psychometric assessment of a functional oral intake scale for dysphagia in stroke patients. *Arch Phys Med Rehabil*. 2005;86(8):1516-20.
8. World Health Organization (WHO). Physical Status: The use and interpretation of Anthropometry. Geneva, Switzerland: WHO, 1995.
9. Janssen I, Baumgartner RN, Ross R, Rosenberg IH, Roubenoff R. Skeletal muscle cutpoints associated with elevated physical disability risk in older men and women. *Am J Epidemiol*. 2004;159(4):413-21.
10. Chumlea WC, Guo SS, Kuczmarski RJ, Flegal KM, Johnson CL, Heymsfield SB, et al. Body composition estimates from NHANES III bioelectrical impedance data. *Int J Obes Relat Metab Disord*. 2002;26(12):1596-609.
11. Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa de Orçamentos Familiares 2008-2009: Tabelas de composição nutricional dos alimentos consumidos no Brasil. Rio de Janeiro: IBGE, 2011.
12. Institute of Medicine (IOM). Dietary References Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: National Academy Press; 2006.
13. Zaloga, GP. Nutrition in Critical Care. St. Louis: Mosby, 1994. p.765-78.
14. Walser M. Creatinine excretion as a measure of protein nutrition in adults of varying age. *J Parenter Enteral Nutr*. 1987;11 Suppl 5:S73-8.
15. Luchesi KF, Kitamura S, Mourão LF. Braz J Otorhinolaryngol. Dysphagia progression and swallowing management in Parkinson's disease: an observational study. *Braz J Otorhinolaryngol*. 2015;81(1):24-30.
16. Cereda E, Barichella M, Pezzoli G. Controlled-protein dietary regimens for Parkinson's disease. *Nutr Neurosci*. 2010;13(1):29-32.
17. Vilming ST. Diet therapy in Parkinson disease. *Tidsskr Nor Lægeforen*. 1995;115(10):1244-7.
18. Lesmes IB, Peláez RB, Cuerda C, Cambor M, Velasco C, Higuera I, García-Peris P. Manejo nutricional en las enfermedades neurológicas crónicas. *Nutr Hosp*. 2014;29 Suppl 2:S38-46.
19. Oehlschlaeger MHK, Pastore CA, Cavalli AS, Gonzalez MC. Nutritional status, muscle mass and strength of elderly in Southern Brazil. *Nutr Hosp*. 2015;31(1):363-70.
20. Ådén E, Carlsson M, Poortvliet E, Stenlund H, Linder J, Edström M, et al. Dietary intake and olfactory function in patients with newly diagnosed Parkinson's disease: a case-control study. *Nutr Neurosci*. 2011;14(1):25-31.
21. Today's Dietitian [Internet]. Athletes and Protein Intake. Jun 14 [cited 2015 Mar 3]. Available from: <http://www.todaysdietitian.com/newarchives/060114p22.shtml>
22. Aquilani R, Opasich C, Verri M, Boschi F, Febo O, Pasini E, Pastoris O. Is nutritional intake adequate in chronic heart failure patients? *J Am Coll Cardiol*. 2003;42(7):1218-23.
23. Martin WF, Armstrong LE, Rodriguez NR. Dietary protein intake and renal function. *Nutr Metab (Lond)*. 2005;2:25.
24. Berry EM, Growdon JH, Wurtman JJ, Caballero B, Wurtman RJ. A balanced carbohydrate: protein diet in the management of Parkinson's disease. *Neurology*. 1991;41(8):1295-7.
25. Etminan M, Gill SS, Samii A. Intake of vitamin E, vitamin C, and carotenoids and the risk of Parkinson's disease: a meta-analysis. *Lancet Neurol*. 2005;4(6):362-5.
26. Parkinson Study Group. Effects of tocopherol and deprenyl on the progression of disability in early Parkinson's disease. *N Engl J Med*. 1993;328(3):176-83.
27. Zesiewicz TA, Wecker L, Sullivan KL, Merlin LR, Hauser RA. The controversy concerning plasma homocysteine in Parkinson disease patients treated with levodopa alone or with entacapone: effects of vitamin status. *Clin Neuropharmacol*. 2006;29(3):106-11.



Original/Otros

Association between LAP Index (lipid accumulation product) and metabolic profile in hospitalized patients

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Abstract

Introduction: lipid Accumulation Product (LAP) Index correlates to cardiovascular risk factors in general population but it has not been tested in hospitalized patients.

Objectives: we aimed to evaluate associations between LAP Index and metabolic profile in a tertiary hospital.

Methods: Cross-sectional study with 90 inpatients. Lipid profile, fasting glucose, systolic and diastolic blood pressure measurements were obtained from electronic medical records. Weight, height and waist circumferences (WC) were assessed; Body Mass Index (BMI) and LAP Index were calculated. Data were expressed as mean $\pm$ standard deviation or percentage. Pearson's correlation and Multiple Linear Regression were used to assess the objectives.

Results: mean age of participants was 55.03 ± 14.86 years and 47.8% (n = 43) were men. After adjustment for sex, age and physic activity LAP Index (log-transformed) was significantly associated with HDL-cholesterol ($p < 0.001$), fasting glucose ($p = 0.02$), systolic blood pressure ($p = 0.03$) and a trend toward total cholesterol ($p = 0.07$).

Conclusion: There are independent association between LAP Index (log-transformed) and metabolic profile in hospitalized patients.

(Nutr Hosp. 2015;31:2771-2774)

DOI:10.3305/nh.2015.31.6.8957

Key words: Obesity. Abdominal. Inpatients. Biological Markers. Blood Pressure.

ASOCIACIÓN ENTRE EL ÍNDICE DE PAL (EL PRODUCTO DE ACUMULACIÓN LIPÍDICA) Y EL PERFIL METABÓLICO EN PACIENTES HOSPITALIZADOS

Resumen

Introducción: el índice PAL (Producto de Acumulación Lipídica) se correlaciona con factores de riesgo cardiovascular en la población general, pero no ha sido probado en pacientes hospitalizados.

Objetivos: evaluar las asociaciones entre el índice PAL y el perfil metabólico en un hospital de tercer nivel.

Métodos: estudio transversal con 90 pacientes hospitalizados. Se obtuvieron de los registros médicos electrónicos el perfil lipídico, la glucosa en ayunas y las mediciones de la presión arterial sistólica y diastólica. Fueron evaluados el peso, la talla y la circunferencia de la cintura (CC); se calcularon el Índice de Masa Corporal (IMC) y el Índice de PAL. Los datos se expresan como media $\pm$ desviación estándar o porcentaje. Para evaluar los objetivos se utilizaron la correlación de Pearson y la regresión lineal múltiple.

Resultados: la edad promedio de los participantes fue de 55.03 ± 14.86 años y el 47,8% (n = 43) eran hombres. Después de ajustar por sexo, edad y actividad física, el índice PAL (transformado-log) se asoció significativamente con el HDL-colesterol ($p < 0,001$), la glucosa en ayunas ($p=0,02$), la presión arterial sistólica ($p = 0,03$) y una tendencia hacia el colesterol total ($p = 0,07$).

Conclusión: en los pacientes hospitalizados existe una asociación independiente entre el índice PAL (transformado-log) y el perfil metabólico.

(Nutr Hosp. 2015;31:2771-2774)

DOI:10.3305/nh.2015.31.6.8957

Palabras clave: Obesidad. Abdominales. Pacientes hospitalizados. Marcadores biológicos. Presión arterial.

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Recibido: 13-III-2015.

Aceptado: 3-IV-2015.

Abbreviations

BMI: Body mass index.
CVD: Cardiovascular disease.
HDL: High density lipoprotein.
IPAQ: International Physical Activity Questionnaire.
LAP: Lipid Accumulation Product.
LDL: Low density lipoprotein.
T2DM: Type-2 diabetes mellitus.
TG: Serum triglycerides.
IR: Insulin resistance.
SPSS: Statistical Package for the Social Science.
WC: Waist circumference.

Introduction

Obesity is the fifth leading cause of worldwide mortality and it is a well-known risk factor for metabolic abnormalities such as dyslipidemia, insulin resistance, higher values of blood pressure and cardiovascular disease. Central obesity seems to be associated with a worse metabolic profile when compared to general obesity¹. Abdominal fat is composed by subcutaneous and visceral adipose tissue; however, visceral fat is more strongly correlated with cardiovascular risk factors, metabolic and cardiovascular disease than subcutaneous fat².

Traditional anthropometric indicators as body mass index (BMI) and waist circumference (WC) do not distinguish visceral and subcutaneous fat. So, anthropometric indexes of easy applicability and low cost have been proposed as an alternative to imaging methods for visceral fat detection³. The Lipid Accumulation Product (LAP) is one of these indexes; it is based on a combination of two safe and inexpensive measurements, WC and serum triglycerides (TG)⁴, which tend to rise with age suggesting an overaccumulation of lipids over time⁵. It is known that LAP values are strongly correlated with visceral fat⁶.

Studies have shown that LAP Index is associated with metabolic syndrome⁷, type-2 diabetes mellitus (T2DM)⁸, hypertension⁹ and cardiovascular disease¹⁰. In addition, LAP Index has been evaluated in general population^{4,8-10} and also in individuals with higher risk for cardiovascular disease (CVD)¹¹, in women with polycystic ovary syndrome¹² and individuals with T2DM¹³. Most of these studies suggest that LAP is a better index to predict a worse metabolic profile and CVD when compared to other traditional anthropometric indexes^{8,9,11}.

To evaluate obesity seems crucial in the hospital setting. However, many inpatients are not able to walk and/or to verify measures as weight and height. WC, in this case, could be a good anthropometric indicator to assess obesity independently of BMI calculation. Despite the superiority of LAP in evaluating cardiovascular risk factors when compared to WC and BMI in many populations, it has not been tested in hospitalized patients. The aim of this study was to verify a possible association between LAP Index and metabolic profile among inpatients.

Methods

This cross-sectional study enrolled 90 subjects, aged 18 to 80 years without cardiovascular disease admitted in a tertiary hospital in Porto Alegre/Brazil. Patients with more than 24h of hospitalization, who do not have biochemical data available in their medical records, who had WC <60cm, TG > 15 mmol/L, BMI > 40 kg/m² or relevant chronic diseases (i.e. cancer, heart failure, AIDS) were excluded. The Ethics Committees of the Institute of Cardiology of Rio Grande do Sul (4656/11) and of Nossa Senhora da Conceição Hospital (11-159) approved the protocol, which was in accordance with the Declaration of Helsinki and all patients signed a consent term to participate.

Demographic data (age, sex and self-reported skin color) and information regarding education (years at school) and lifestyle characteristics [smoking, abusive alcohol consumption (≥ 30 g for men and ≥ 15 g for women)] were collected using a standardized questionnaire. IPAQ (International Physical Activity Questionnaire) short version was used to detect the levels of physical activity¹⁴.

Weight (kg) was measured with patients in light clothes, barefoot, in a 100g scale (Cauduro®) and height was obtained with a Sunny® stadiometer with 0.1cm scale. BMI was calculated by the weight (kg)/height (m)². WC was obtained with a plastic, flexible, inelastic measuring tape in the middle point between the lower costal rib and the iliac crest in a perpendicular plane, with patient standing in both feet and with both arms hanging freely¹⁵.

Serum lipids (total cholesterol, HDL-cholesterol, LDL-cholesterol and triglycerides) and fasting glucose were measured by colorimetric enzymatic method, at the certified laboratory by the Nossa Senhora da Conceição Hospital and its values were obtained from medical records. Measurements of systolic and diastolic blood pressure (SBP, DBP) were also collected from medical records, and the mean of the three first measures of the morning was used for analyses. LAP Index, in cm.mmol.l, was calculated for men [(WC (cm)-65) x TG (mmol)] and women [(WC (cm)-58) x TG (mmol)]⁴.

Statistical analyses were performed using SPSS (Statistical Package for the Social Science, version 17.0, IL, USA). Means $\pm$ SD and percentages were described and correlations were tested by Pearson's correlation test; non-parametric variables were log-transformed. We tested the potential relationship between LAP and metabolic profile using multiple linear regression models, with the adjustment for age, sex and physical activity. The statistical significance level was set at a two-tailed type I error of 0.05.

Results

A total of 43 men and 47 women were assessed, with an average of 55.03 ± 14.86 years and 78.9% whites;

14.4% were current smokers and 18.9% had abusive alcohol consumption. Prevalence of obesity according to BMI ≥ 30 kg/m² was 28.1%.

Table I shows the characteristics of the sample. In general, patients have a high prevalence of sedentarism and the levels of total cholesterol, LDL-cholesterol and BP were considered acceptable. However, subjects showed high levels of fasting glucose and lower levels of HDL-cholesterol. Men had higher values of WC when compared to women, but according to WC acceptable cutoff values (<88 cm) the women showed higher risk for cardiovascular disease when compared to men (<102 cm).

Regarding to anthropometric indexes and metabolic profile, BMI was significantly correlated with SBP ($r=0.28$, $p<0.001$) and HDL-cholesterol ($r=-0.27$, $p<0.05$); WC was correlated only with HDL-cholesterol ($r=-0.35$, $p<0.001$) and LAP (log-transformed) was significantly correlated with total cholesterol ($r=0.22$, $p<0.05$), HDL-cholesterol ($r=-0.44$, $p<0.001$), fasting glucose (log-transformed: $r=0.20$, $p<0.05$) and SBP ($r=0.26$, $p<0.05$). None of the anthropometric indexes were significantly correlated with LDL-cholesterol and DBP.

After adjustment for confounding factors (Table II), BMI remained associated with HDL-cholesterol ($p=0.02$) and SBP ($p=0.02$), WC showed an inverse association with HDL-cholesterol ($p=0.009$) and LAP was significantly associated with HDL-cholesterol ($p<0.001$), fasting glucose ($p=0.02$) and SBP ($p=0.03$); however, there was no association between LAP and total cholesterol after adjustment for age, sex and physical activity ($p=0.07$, trend toward).

Discussion

To our knowledge, this is the first study that evaluated a possible relationship between LAP Index and metabolic profile in hospitalized patients, showing that LAP had a greater discriminatory power to detect a worse metabolic status when compared to other traditional anthropometric measurements as BMI and WC, after controlling for physical activity and other factors. Our study showed also a high prevalence of overall obesity and sedentarism, reflecting the nutritional status and the lifestyle behavior observed in the general population.

Similar to our findings, other authors also detected correlations with LAP Index and fasting glucose, HDL-cholesterol and SBP in both general population and in patients at higher cardiovascular risk^{4,8,11}. Likewise, they did not find significant results regarding DBP⁴, LDL-cholesterol and LAP Index after controlling for other variables, and also showed significant associations with BMI and BP⁹ and regarding waist circumference and HDL-cholesterol¹. In many population overall adiposity remains strongly associated with both BP and lipid profile; body composition differs substantially according to several ethnics, and most of the studies that evaluated LAP Index were made among Americans, European and Eastern people. However, our results from a highly mixed Brazilian population remain similar, showing that the LAP Index seems really to discriminate biochemical markers and BP independently of general adiposity.

Insulin resistance (IR) is often observed in individuals with visceral obesity, independently of the glycemia levels. Furthermore, IR is involved in a variety of conditions such as dyslipidemia, hypertension and T2DM. In our sample, we did not evaluate indicators of IR; however, inpatients had higher values of WC in concomitance with elevated blood glucose levels. Thus, some individuals may have a silent Ir, and the LAP Index have been strongly associated with this condition in patients with and without T2DM^{8,11-13}.

Table I
Characteristics of the sample (n=90)

	Mean $\pm$ SD, [n(%)]
Age (years)	55.03 $\pm$ 14.86
Gender	
Male	43 (47.8)
Female	47 (52.2)
Scholarity (years)	7.02 $\pm$ 3.89
IPAQ (level of physical activity)	
Very actives/actives	26 (28.9)
Irregularly actives	27 (30.0)
Sedentary	37 (41.1)
Waist circumference, in cm	
Male	97.52 $\pm$ 11.89
Female	95.46 $\pm$ 15.57
Body Mass Index (BMI, Kg/m ²)	26.88 $\pm$ 4.91
Lipid Accumulation Product Index (LAP, cm.mmol.l)*	3.91 $\pm$ 0.75
Total cholesterol (mg/dL)	191.62 $\pm$ 50.33
HDL-cholesterol (mg/dL)	
Male	42.50 $\pm$ 18.23
Female	48.17 $\pm$ 19.40
LDL-cholesterol (mg/dL)	117.26 $\pm$ 43.79
Fasting glucose (mg/dL)	137.68 $\pm$ 109.79
Systolic blood pressure (SBP, mmHg)	122.87 $\pm$ 12.92
Diastolic blood pressure (DBP, mmHg)	77.09 $\pm$ 7.97

IPAQ - International Physical Activity Questionnaire;

*variables log-transformed.

Table II
Multivariate analysis* for the association of waist circumference and LAP Index with metabolic profile

Variable	β	SE	CI 95%	P-value
Body Mass Index (kg/m ²)				
HDL-cholesterol (mg/dL)	-0.9	0.4	-1.7 – -0.1	0.02
Systolic blood pressure (mmHg)	0.7	0.3	0.1 – 1.2	0.02
Waist circumference (cm)				
HDL-cholesterol (mg/dL)	-0.4	0.2	-0.8 – -0.1	0.009
LAP Index (cm.mmol.l)**				
Total cholesterol (mg/dL)	14.1	7.7	-1.2 – 29.4	0.07
HDL-cholesterol (mg/dL)	-10.8	2.5	-15.8 – -5.8	<0.001
Fasting glucose (mg/dL)**	0.22	0.1	0.0 – 0.4	0.02
Sistolic blood pressure (mm Hg)	4.1	1.9	0.4 – 7.9	0.03

*Multiple Linear Regression adjusted for gender, age and physical activity.
LAP: Lipid Accumulation Product; ** variable log-transformed

Some limitations of this exploratory study are the sample size, the lack of an imaging method to confirm a truthful correlation between LAP Index and visceral adipose tissue and its cross-sectional design, which differently from a longitudinal study does not detect the real risk between LAP Index and the worsening of metabolic status. Besides, no data was available about cholesterol, BP and glucose lowering drugs. However, we emphasize that our data are very informative since LAP Index is an easy and practical tool to detect interactions between excess of adiposity and metabolic data with more precision when compared to WC alone, and it could be used including in patients whose weight and height could not be evaluated.

In conclusion, we found a positive relation of LAP Index and metabolic profile in hospitalized patients, independently of age, sex and levels of physical activity. Our data need to be confirmed in other populations, but this simple tool for assessment of visceral adiposity should be considered in the clinical practice.

References

- Arimura ST, Moura BM, Pimentel GD, Silva ME, Sousa MV. Waist circumference is better associated with high density lipoprotein (HDL-c) than with body mass index (BMI) in adults with metabolic syndrome. *Nutr Hosp* 2011;26(6):1328-32
- Smith JD, Borel AL, Nazare JA et al. Visceral adipose tissue indicates the severity of cardiometabolic risk in patients with and without Type 2 Diabetes: results from the INSPIRE ME IAA study. *J Clin Endocrinol Metab* 2012;97:1517-1525.
- Carneiro Roriz AK, Santana Passos LC, Cunha de Oliveira C, Eickemberg M, de Almeida Moreira P, Ramos Sampaio L. Discriminatory power of indicators predictors of visceral adiposity evaluated by computed tomography in adults and elderly individuals. *Nutr Hosp* 2014;29(6):1401-7.
- Kahn HS. The "lipid accumulation product" performs better than the body mass index for recognizing cardiovascular risk: a population-based comparison. *BMC Cardiovasc Disord* 2005;5:26-30.
- Dobbelsteijn CJ, Joffres MR, MacLean DR, Flowerdew G. A comparative evaluation of waist circumference, waist-to-hip ratio and body mass index as indicators of cardiovascular risk factors. The Canadian Heart Health Surveys. *Int J Obes Relat Metab Disord* 2001;25:652-61.
- Roriz AK, Passos LC, de Oliveira CC, Eickemberg M, Moreira P de A, Sampaio LR. Evaluation of the accuracy of anthropometric clinical indicators of visceral fat in adults and elderly. *PLoS One* 2014;9(7):e103499.
- Taverna MJ, Martínez-Larrad MT, Frechtel GD, Serrano-Ríos M. Lipid accumulation product: a powerful marker of metabolic syndrome in healthy population. *Eur J Endocrinol* 2011;164(4):559-67.
- Kahn HS. The Lipid Accumulation Product is better than BMI for identifying diabetes: a population-based comparison. *Diabetes Care* 2006 jan;29(1):151-3.
- Gao X, Wang G, Wang A, Xu T, Tong W, Zhang Y. Comparison of lipid accumulation product with body mass index as an indicator of hypertension risk among Mongolians in China. *Obes Res Clin Pract* 2013;7(4):e308-14.
- Hosseiniapanah F, Barzin M, Mirbolouk M, Abtahi H, Cheraighi L, Azizi F. Lipid accumulation product and incident cardiovascular events in a normal weight population: Tehran Lipid and Glucose Study. *Eur J Prev Cardiol* 2014; pii: 2047487314558771. [Epub ahead of print]
- Ioachimescu AG, Brennan DM, Hoar BM, Hoogwerf BJ. The Lipid Accumulation product and all-cause mortality in patients at high cardiovascular risk: a PreCIS database study. *Obesity (Silver Spring)* 2010;18(9):1836-44.
- Xiang S, Hua F, Chen L, Tang Y, Jiang X, Liu Z. Lipid accumulation product is related to metabolic syndrome in women with polycystic ovary syndrome. *Exp Clin Endocrinol Diabetes* 2013;121(2):115-8.
- Mirmiran P, Bahadoran Z, Azizi F. Lipid Accumulation Product is associated with insulin resistance, lipid peroxidation, and systemic inflammation in type 2 diabetic patients. *Endocrinol Metab (Seoul)* 2014 Dec 29;29(4):443-9.
- Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003;35(8):1381-95.
- Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign, Illinois: Human Kinetics Books, 1988.



Original/Perspectivas

Association of eating behaviors and BMI among elementary school students from Mexico

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Abstract

The aim of this study was to analyze the association of cognitive restraint (CR), uncontrolled eating (UE), and emotional eating (EE) with body mass index (BMI) among elementary schools children in Mexico. 5th and 6th grade students were recruited from two schools. Weight, height, and waist circumference were measured and BMI was calculated. Overweight and obese children were classified according to the World Health Organization's (WHO) BMI z-score. The TFEQ -R18 questionnaire was applied to assess behavioral patterns. Gender differences of UE and EE were observed. Private school children had higher scores of CR and UE. Children with CR were three times more likely to have abdominal obesity (AO) and children with OW or O were more likely to have UE. Children attending the private school and those with AO had higher CR scores; private school children, those with overweight or obesity and with AO had higher UE scores.

(Nutr Hosp. 2015;31:2775-2777)

DOI:10.3305/nh.2015.31.6.8845

Key words: *Eating behavior. Children. Obesity. Overweight. Abdominal obesity. Mexicans.*

ASOCIACIÓN DE LAS CONDUCTAS ALIMENTARIAS CON EL IMC EN ESTUDIANTES DE PRIMARIA DE MÉXICO

Resumen

El objetivo de este estudio fue analizar la asociación de la restricción cognitiva (CR), el consumo incontrolado (UE) y el consumo emocional (EE) con el índice de masa corporal (IMC) entre alumnos de primaria en México. Se reclutaron estudiantes de quinto y sexto grado de dos escuelas. Se midieron el peso, la estatura y la circunferencia de cintura y se calculó el IMC. El sobrepeso (SP) y la Obesidad (OB) se clasificó de acuerdo al puntaje Z de IMC de la OMS. Se aplicó el cuestionario TFEQ -R18 para valorar los patrones de conducta. Se observaron diferencias de UE y de EE. Los niños de las escuelas privadas presentaron mayores puntajes de CR y UE. Los niños con CR presentaron tres veces más probabilidades de tener obesidad abdominal (OA) y los niños con SP u OB tenían más posibilidades de tener UE. Los niños que atendían escuelas privadas y los que tenían OB tenían mayores puntajes de CR; los niños de escuelas privadas, los que tenían OW u OB y OA tenían más puntaje en UE.

(Nutr Hosp. 2015;31:2775-2777)

DOI:10.3305/nh.2015.31.6.8845

Palabras clave: *Conductas alimentarias. Niños. Obesidad. Sobrepeso. Obesidad abdominal. Mexicanos.*

Dear Dr. Culebras (Perspective)

During 2012, from a representative sample of 6 – 12yo children in Tijuana, a 46% prevalence of overweight (OW) and Obesity (O) was observed in the same age group¹, and during 2013, among 18 to 30 yo college students was observed a prevalence of O and abdominal obesity (AO) of 12 and 33% among men and 14 and 17% among women, respectively².

OW and O have multifactorial origins, including the environmental factors associated such as decreased physical activity (PA), high caloric intake, increased availability of energy dense foods, and changes in dietary behavior have also been included^{3,4}. Some authors have suggested that there are three patterns of eating beha-

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Recibido: 11-II-2015.
Aceptado: 8-III-2015.

vivors that may explain the mechanism of self-regulation of food intake in children⁵. These patterns are: cognitive restriction (CR), uncontrolled eating (UE), and emotional eating (EE)⁵. CR is defined as, “the tendency of some people to restrict their food intake to control their weight”, and UE is defined as a behavior or trend where quantities of food are over ingested due to different stimuli and situations⁵. EE refers to food intake as a response to various negative emotions, such as anxiety, depression, anger, or loneliness⁵. The aim of the study was to assess whether eating behaviors such as CR, UE, and EE were associated with BMI and socioeconomic status (SES) among 5th and 6th grade (9 to 12yo) elementary schools students in a Mexico-California border city.

This study was conducted in the morning and evening shifts from a public school (73%) and in the morning shift at a private school (27 %) in the city of Tijuana, Mexico. Eighty three percent (535) of the 5th and 6th graders participated in the study. The children's weight, height, and waist circumference (WC) were measured and recorded during the months of September through November 2013. Height, weight and WC were measured with standards techniques. WC values were compared with the 90th percentile of NHANES III for age and sex for Mexican-Americans. BMI was calculated using the following formula: BMI=weight/height² (kg/m²). BMI values were compared with WHO cutoff points (2006)⁶ according to age and sex. BMI z scores for age/gender were calculated using the ANTHRO plus software (v 1.0.4, WHO, 2007) .

For the evaluation of behavioral patterns, a validated, adapted version of the questionnaire, “The Three-Factor Eating Questionnaire-R18” (TFEQ-R18)^{7,8}, was applied. The questionnaire measures three behavioral patterns: CR, UE, and EE. The TFEQ-R18 has 18 items with four possible answers: always, sometimes, rarely, and false. The answers to the 18 items have a value ranging from one to four. Each item point was added to evaluate each behavior.

Means and frequencies were calculated and BMI and SES were categorized. Quartiles of eating behavior variables were calculated. To observe ranks differences between sex, SES, and eating behaviors, the Mann-Whitney test was used. Binomial logistic regression was conducted to know whether the probability of having a specific eating behavior depend on sex, BMI categories, SES, and type of school. A level of signifi-

cance was considered from an alpha level equal to or less than 0.05.

A total of 535 students (93% of the sample) participated in the study 9 to 12yo. Mean age was 10.4, mean WC 68.7, mean BMI z-score was 0.7 ± 1.3 . The prevalence of AO was 10.2% in boys and 12.7% in girls; prevalence of OW was 27.9% in boys and 21.3% in girls; prevalence of O was 24.2% in boys and 24.1% in girls. Table I shows the differences of obesity, and AO prevalence, behavioral patterns according to SES.

Boys had higher UE (p=0.005) and EE (p=0.005) than girls. The children with higher SES (p=0.033) and children from private schools (p=0.0001) had higher CR. Private school children also had higher scores in UE (p=0.013) than children from public schools. Children with AO had higher CR (p=0.0001) than those with a normal WC. Children with CR were three times more likely to have AO (OR=3.03, 95% CI 1.71-5.36) than children with normal WC, and children with OW and or O had higher UE (p=0.047) than those with normal weight.

The study shows that high SES, private school children, and children with AO, had higher scores in CR. Private school children, children with AO, and children with O had higher UE. Children with CR were three times more likely to have AO and children with OW or O had higher UE. Boys had higher UE and greater EE than girls.

Our results on UE are consistent with those reported by Braet et al., (2008), among 13 to 17yo teenagers⁹.

Although findings of this study warrant further studies, this behavior might be a high risk factor for O among boys, which is health priority problem in México². This study also found that children with CR were higher than those found in the meta-analysis conducted by Lowe¹⁰. However, that meta-analysis only included normal-weight populations and Mexican children were not included in that study. Mexican children living in the Mexico-US border city might behave different due to social, economic and cultural environment.

We also found a high prevalence of O in high SES, and positive associations between CR and high SES, as well as higher scores of CR and UE in private schools. These results might suggest that a specific violent environment is not similar to those living in developed or developing countries with different levels of exposed to a safety/violent environment.

Table I
Differences of SES, Obesity Prevalence and Eating Behavior according to SES at schools

SES	N	AO (%)	O (%)	OW (%)	CR score Mean	UE score Mean	EE score Mean
Middle	367	11.4	25.9	22.1	2.24	2.02	1.51
High	168	11.9	20.2	29.2	2.33	2.05	1.48
<i>P < 0.005</i>		0.878	0.586	0.362	0.036	0.471	0.603

SES: Socioeconomic Status; AO: Abdominal Obesity; O: Obesity; OW: Overweight; CR: Cognitive Restriction; UE: Uncontrolled eating; EE: Emotional eating.

Among the strengths of this study is the large size of the sample population participating in this type of study; to our knowledge, this is the first time a study like this is conducted in this age group in Latin America. The questionnaire used had high levels of reproducibility and internal consistency. And the results of this study suggest that eating behavior disorders are more likely to occur among children with O at earlier stages of life or during adolescence among Mexican children.

The limitations of the study include that this is a cross-sectional study that cannot analyze cause-effect relationships; it is limited to two large schools; thus, its generalization is limited. Further prospective studies are warranted to confirm the associations found here.

In conclusion, children of high SES and in private schools, as well as children with AO, had higher scores of CR; private school children, children with AO, and OW/O children had greater UE. Our results indicate the need of programs address to elementary school children and their parents encouraging better food attitudes by parents and relatives, as well as the need to reduce an obesity toxic environment. It is also warranted validated questionnaires for Mexican living in cities with different environments.

References

1. Bacardí-Gascón M, Jones EG, Jiménez-Cruz A. Prevalence of obesity and abdominal obesity from four to 16 years old children living in the Mexico-USAborder. *Nutr Hosp* 2013;28(2):479-85.
2. Gomez-Miranda LM, Bacardí-Gascón M, Caravali-Meza NY, Jimenez-Cruz A. Consumo de bebidas energéticas, alcohólicas y azucaradas en jóvenes universitarios de la Frontera México-USA. *Nutr Hosp* 2015; 31 (1):191-195.
3. Cline KP, Spradlin TE and Plucker JA. Child Obesity in Indiana: A growing Public Policy Concern. [6022]. 2005;3(1). Available from: Education Commission of the states. Web site. http://ceep.indiana.edu/projects/PDF/PolicyBrief_Childhood_Obesity.pdf . Accessed March 23th, 2013.
4. Bacardí-Gascón M, Jimenez-Moran E, Santillana-Marin E, Jiménez-Cruz A. Efecto de la Desnutrición pre y posnatal sobre componentes del Metabolic Syndrome en etapas posteriores de la vida: Estudio Sistemático. *Nutr Hosp* 2014;29 (05):997-1003.
5. Birch LL, Deysher M. Caloric compensation and sensory specific satiety: evidence for self-regulation of food intake by young children. *Appetite* 1986;7(4):323-31.
6. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: length/height-for-age, weight-for-age, weight-for length, weight-for-height and body mass index for-age: methods and development. Geneva: World Health Organization, 2006.
7. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *J Psychosom Res* 1985;29(1):71-83.
8. De Lauzon-Guillain B, Basdevant A, Romon M, Karlsson J, Borys JM, Charles MA., et al. . Is restrained eating a risk factor for weight gain in a general population? *Am J Clin Nutr* 2006 Jan;83(1):132-8.
9. Braet C, Claus L, Goossens L, Moens E, Van Vlierberghe L, Soetens B. Differences in eating style between overweight and normal-weight youngsters. *J Health Psychol* 2008;13(6):733-43.
10. Lowe MR, Doshi SD, Katterman SN, Feig EH. Dieting and restrained eating as prospective predictors of weight gain. *Front Psychol* 2013; 2; 4:577.

Cartas al director

Evaluación de la grasa corporal por impedancia bioeléctrica y su correlación con indicadores antropométricos



Body fat assessment by bioelectrical impedance and its correlation with anthropometric indicators

Sr. Editor:

Hemos leído con interés el trabajo de Diniz y colaboradores¹ titulado: “Body fat assessment by bioelectrical impedance and its correlation with anthropometric indicators”, publicado en su revista.

Creemos que es necesario exponer algunas puntualizaciones metodológicas, referentes a la relación que se establece con los índices antropométricos propuestos en el estudio con la grasa estimada.

Consideraciones iniciales serían:

- No se conoce la ecuación de predicción de la masa grasa por bioimpedancia eléctrica (BIA).
- La BIA no es un método de referencia, lo cual significa que ya deben existir diferencias con una medida realizada con un método patrón o *gold standard*^{2,3}, por lo cual intentar obtener o relacionar otras medidas para derivar otras, aumentaría sin duda el error de estimación.

De mayor o menor manera, todos estos índices y variables barajados se relacionan con la grasa estimada con BIA, o bien con otros métodos de evaluación de la grasa corporal⁴, aunque entre todos ellos se presentan diferencias, pero la utilización de los coeficientes de correlación (CC) solamente describen de qué manera dos variables están relacionadas y qué cantidad de la variabilidad de una medida es explicada por la otra medida. Es importante destacar que la asociación significativa de dos variables no implica una relación de causalidad.

Otro concepto importante es saber cuál es la variable explicativa (VE), que es la variable que explica en mayor o menor medida la variable resultado (VR). Cuando se obtiene la ecuación, cada una de ellas debe estar situada en el eje adecuado. En este caso, consideramos que la VE (variables e índices antropométricos) debería colocarse en el eje *x* y la estimación de grasa por BIA en el eje *y*. El CC es el mismo, pero la ecuación es diferente, con lo cual conoceremos la magnitud de los cambios de la VR por cada unidad de la VE⁵.

Se plantean como conclusiones del trabajo que la relación existente de las medidas antropométricas con la gra-

sa estimada con BIA serviría como sustituto o instrumento para la estimación de la grasa, para la identificación del exceso de grasa corporal, y en ello no estamos de acuerdo, pues sirva como ejemplo, extraído de la observación de la Figura 1, derecha superior, que a un 20% de grasa por BIA le podrían corresponder valores entre 65 y 85 cm de perímetro de cintura. En el caso que nos ocupa, el perímetro de cintura solo explicaría el 48% de la variación de la grasa estimada, por ello argumentamos que los índices estudiados no son buenos métodos para la estimación de la grasa corporal. Además, toda ecuación de regresión, debe acompañarse del error estándar de estimación, que nos informará de las diferencias entre el valor predicho y observado y, por tanto, de la precisión de la misma.

Referencias

1. Diniz Araújo ML, Coelho Cabral P, Kruze Grande de Arruda I, Siqueira Tavares Falcão AP, Silva Diniz A. Body fat assessment by bioelectrical impedance and its correlation with anthropometric indicators”, *Nutr Hosp* 2012; 27(6):1999-2005.
2. Alvero-Cruz JR, Diego Acosta AM, Fernández Pastor VJ, García Romero J. : Métodos de evaluación de la composición corporal: Tendencias actuales II. *Archivos de Medicina del Deporte* 2005, 105:45-49.
3. Thibault R, Pichard C. The Evaluation of Body Composition: A Useful Tool for Clinical Practice. *Ann Nutr Metab* 2012; 60:6-16.
4. Loftin M., Nichols J., Going S., Sothorn M., Schmitz K. H., Ring K., Tuuri G., Stevens J. Comparison of the validity of anthropometric and bioelectric impedance equations to assess body composition in adolescent girls. *Int J Body Compos Res* 2007, 5(1): 1-8.
5. Continuous data analyses: correlation and regression. In *Medical Statistics*. Peat J and Barton B. Blackwell Publishing Inc. Massachusetts, 2005. 156-201 p.

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Recibido: 3-IX-2013.
Aceptado: 12-IX-2013.

DOI:10.3305/nh.2015.31.6.6942

Cartas al director

Variabilidad de frecuencias de trastornos de la conducta alimentaria (TCA). ¿Problema de población o de instrumento?



*Frequency variability of eating disorders.
Problem of population or instrument?*

Sr. Editor:

En el cuarto número, volumen 30 de su revista, Martínez-González et al. publicaron un artículo acerca de los TCA en estudiantes universitarios, reportando una frecuencia de riesgo de TCA de 19,5%, utilizando como instrumento el cuestionario SCOFF.¹ Esto difiere de un trabajo no publicado, realizado en estudiantes de Medicina Humana y Enfermería de la Universidad Nacional Pedro Ruiz Gallo, donde encontramos una frecuencia del 29,1% utilizando SCOFF y del 8,8% con el cuestionario EAT-26.²

Según el Diagnostic and Statistical Manual of Mental Disorders, 5.^a edición (DSM-V), los TCA, ahora llamados Trastornos de la Nutrición y Alimentación (Feeding and Eating Disorders), incluyen además de la Anorexia Nerviosa (AN) y la Bulimia Nerviosa (BM), al Trastorno por Atracón (TA), la Pica, la Rumiación y el Trastorno de la ingesta de alimentos por evitación/restrictiva.

Al efectuar una búsqueda bibliográfica acerca de los TCA en estudiantes universitarios en distintos países de Latinoamérica, hallamos gran variabilidad entre las

frecuencias reportadas, que van desde 1 hasta 39,5% (Tabla I).

Según lo observado, creemos que el factor más importante de dicha variabilidad es el instrumento, por lo que revisamos los artículos originales que validaron los instrumentos más usados, encontrando lo siguiente:

EAT-40 (Eating Attitudes Test): Garner D y Garfinkel P (1979),³ usaron un grupo de mujeres con AN (según los criterios de Feighner et al., 1972) y un grupo control. Este instrumento resulta útil para evaluar la sintomatología de AN. Posteriormente desarrollaron una versión en la que eliminaban 14 ítems (EAT-26) por considerarlos redundantes.⁴

SCOFF: Morgan J et al. (1999),⁵ aborda las principales características de AN y BN según criterios DSM-IV en mujeres de 18-40 años. Los valores de validez fueron: Sensibilidad cercana al 100% para AN y BN, Especificidad 87,5%. Este cuestionario parece muy sensible como instrumento de cribado para la detección de trastornos de la alimentación.

En nuestra búsqueda, las frecuencias reportadas en estudios que utilizaron SCOFF se encuentran entre 14,5-39,5% y entre 1-8,7% en quienes usaron EAT-26, lo cual es comprensible, teniendo claro que este último solo sirve para evaluar AN, mientras que el primero evalúa AN y BN. Por lo expuesto, no es correcto utilizar estos instrumentos para perseguir objetivos similares, como han venido haciendo muchos autores. Además, conociendo la última edición DSM-V, ningún instrumento conocido hasta la fecha resulta suficiente para englobar el término TCA, por lo que sería necesario a futuro desarrollar nuevos instrumentos de acuerdo a los criterios actuales, si se pretende continuar utilizando este término.

Tabla I
Frecuencias reportadas de trastornos de la conducta alimentaria en Latinoamérica

<i>Autor/ año</i>	<i>País</i>	<i>Instrumento</i>	<i>Población</i>	<i>Frecuencia</i>
Rueda G. et al. (2005)	Colombia (Bucaramanga)	SCOFF	Mujeres universitarias	21,2%
Behar R. et al. (2007)	Chile (Valparaíso)	EAT-40	Estudiantes de nutrición y dietética	15%
Álvarez et al. (2009)	México (México D.F.)	EAT-26	Primer año de Medicina	5,8%
Sáenz et al. (2011)	Colombia (Cartagena)	EAT-26 SCOFF	Estudiantes universitarios	7,8% 14,2%
Bazán S. (2011)	Perú (Chiclayo)	SCOFF	Estudiantes universitarios	39,5%
Wall et al. (2012)	México (Juárez)	EAT-26	Estudiantes universitarios	8,7%
Chonlón K. et al. (2013)	Perú (Chiclayo)	EAT-26	Estudiantes Ciencias de la salud	1%
Martínez et al. (2014)	España	SCOFF	Estudiantes universitarios	19,5%

Referencias

1. Martínez-González L, Fernández Villa T, Molina de la Torre A J, Ayán Pérez C, Bueno Cavanillas A, Capelo Álvarez R, et al. Prevalencia de trastornos de la conducta alimentaria en universitarios españoles y factores asociados: proyecto uniHcos. *Nutr Hosp* 2014; 30(4):927-34.
2. Rivera-Paico M L, Plasencia-Dueñas E A, Castro-Maldonado B, Callirgos Lozada C C, Chafloque Carhuas J. Factores asociados a trastornos de la conducta alimentaria en estudiantes de medicina humana y enfermería de la Universidad Nacional Pedro Ruiz Gallo 2012. En: Libro de Resúmenes del XXVI Congreso Científico Nacional de la Sociedad Científica Médico Estudiantil Peruana. Chiclayo-Perú. Universidad Nacional Pedro Ruiz Gallo; 2012.
3. Garner D, Garfinkel P. The Eating Attitudes Test: an index of the symptoms of anorexia nervosa. *Psychological Medicine* 1979; 9: 273-9.
4. Garner D, Olmsted M, Bohr Y, Garfinkel P. The Eating Attitudes Test: Psychometric features and clinical correlates. *Psychol Med* 1982; 12:871-8.
5. Morgan J, Reid F, Lacey H. The SCOFF questionnaire: assessment of a new screening tool for eating disorders. *BMJ* 1999; 319:1467-8.

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Recibido: 21-II-2015.

Aceptado: 8-III-2015.

Con relación a la carta al director:

Variabilidad de frecuencias de trastornos de la conducta alimentaria (tca). ¿Problema de población o de instrumento?, remitida por el estudiante Esteban Alberto Plasencia-Dueñas, en la que comenta algunos aspectos relacionados con nuestro artículo:

Martínez-González et al. Prevalencia de trastornos de la conducta alimentaria en universitarios españoles y factores asociados: proyecto uniHcos. *Nutr Hosp*. 2014;30(4):927-934; y en el uso del derecho a réplica, queremos ampliar algunas de las cuestiones no abordadas en el artículo de referencia.

En primer lugar, agradecer los comentarios de Plasencia-Dueñas que en líneas generales son acertados y correctos. Efectivamente, ya habíamos observado, en la revisión bibliográfica previa a la elaboración del artículo, cómo las prevalencias de los trastornos de la conducta alimentaria (TCA) presentaban importantes variaciones en función del instrumento utilizado para su medición. La premura de espacio y que el principal objetivo era conocer los factores de riesgo tal vez nos llevaron a no dar relevancia a lo que acertadamente sí da Plasencia-Dueñas. En la tabla adjunta (Tabla I) se pueden observar las prevalencias reportadas en los artículos referenciados en función de, entre otros, el instrumento de medida.

Efectivamente, como bien señala Plasencia-Dueñas, las diferencias son importantes según el instrumento de medida utilizado, siendo el SCOFF¹ el que mayores prevalencias reporta, debido a su elevada sensibilidad y moderada especificidad en la detección de todos los TCA; mientras el EAT-26² o el EAT-40³ presentan menores prevalencias. Sin embargo, también es conveniente señalar que el EAT-26 no es un test exclusivo para detectar AN, ya que consta de tres subescalas: dieta, bulimia y preocupación por la comida y control oral. Pero no solo el instrumento de medida está en la fuente de variabilidad, en las tablas, la reportada por Plasencia-Dueñas y por nosotros, se puede observar también una variabilidad en función del sexo, la edad y también, posiblemente, la localización geográfica cuando se utilizan los mismos tests.

Por todo ello, a nuestro parecer, las fuentes de variabilidad son muchas, entre ellas el instrumento de me-

Tabla I
Frecuencias reportadas de trastornos de la conducta alimentaria

Autor/año	País	Instrumento	Población	Frecuencia (%)
Gadalla, 2008	Canadá	EAT-26	Población femenina >15 años	2,8
Gadalla, 2008	Canadá	EAT-26	Población masculina >15 años	0,5
Álvarez et al. 2009	México	EAT-26	Estudiantes universitarios	5,8
Sánchez et al. 2010	España	EAT-26	Estudiantes universitarios	18,8
Jáuregui-Lobera et al. 2009	España (2006/07)	EAT-40	Estudiantes secundaria y bachillerato	7,1
Jáuregui-Lobera et al. 2009	España (2006/07)	EAT-40	Estudiantes secundaria y bachillerato	9,4
Jáuregui-Lobera et al. 2009	España (2007/08)	SCOFF	Estudiantes secundaria y bachillerato	21,3
Jáuregui-Lobera et al. 2009	España (2007/08)	SCOFF	Estudiantes secundaria y bachillerato	22,8
Dooley-Hash et al. 2012	EE. UU.	SCOFF	Estudiantes 14-20 años	16,0
Fragkos & Frangos, 2013	Grecia	SCOFF	Estudiantes universitarios	39,7

dida, pero también la población; si bien es cierto que para comparar prevalencias, se debe de realizar entre aquellos trabajos que utilicen los mismos instrumentos, y dada la diversidad de los TCA, se hace necesario avanzar en el desarrollo y diseño de instrumentos de medida más válidos y fiables.

Referencias

1. Morgan JF, Reid F, Lacey JH. The SCOFF questionnaire: assessment of a new screening tool for eating disorders. *Bmj*. 1999;319(7223):1467-8.
2. Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The eating attitudes test: psychometric features and clinical correlates. *Psychological medicine*. 1982;12(04):871-8.
3. Garner DM, Garfinkel PE. The Eating Attitudes Test: An index of the symptoms of anorexia nervosa. *Psychological medicine*. 1979;9(02):273-9.

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DOI:10.3305/nh.2015.31.6.8849

Cartas al director

**Cribado nutricional en pacientes
con insuficiencia cardiaca:
análisis de 5 métodos**

*Nutritional screening in heart failure
patients: 5 methods review*



Estimado Director

Ya el título del artículo **“Cribado nutricional en pacientes con insuficiencia cardiaca: análisis de 5 métodos”**, suscrito por Luis Guerra-Sánchez en el n.º 2 de Nutrición Hospitalaria de este año¹, ha suscitado mi interés por comprobar cómo se va avanzando en la utilización de métodos de cribado, en este caso en la insuficiencia cardiaca, con el atractivo objetivo de: “Determinar un método rápido y fiable, que no precise de entrenamiento previo, en pacientes con insuficiencia cardiaca”.

Pero ya en la introducción se aprecia que el estudio buscaba la forma de “detectar precozmente la malnutrición o el riesgo de desarrollarla”. Y esos son dos objetivos muy diferentes que no deben confundirse.

Solo por ello es lógica la discrepancia que muestra entre los resultados obtenidos con los diferentes métodos, ya que estos persiguen distintos objetivos, además de los cambios introducidos en CONUT, que también la justifican.

Los métodos estudiados, como el propio *gold standard*, buscan **desnutrición ya establecida** excepto CONUT, que busca **el riesgo nutricional**. No se puede confundir la forma de evidenciar lo que le ha pasado al paciente con buscar la manera de adelantarnos a que eso mismo le pase, como tampoco se puede comparar la medicina curativa con la preventiva.

Lo que debe buscarse con el cribado nutricional en la práctica clínica no es la desnutrición ya establecida y demostrada antropométricamente, como pretendía Kondrup y se plasmó en la Resolución ResAP(2003)3 del Consejo de Europa, porque es demasiado tarde para prevenirla, pues el daño ya está hecho.

Actualmente, debemos aspirar a conocer cuanto antes, de inmediato, qué grado de riesgo tiene ahora y qué futuro le espera al paciente en función al grado de afectación de su equilibrio nutricional actual, cambiante día a día. Y esta información solo la aporta con la suficiente inmediatez, precisión, objetividad y eficiencia, el medio interno del que se nutre la célula. Para esto no sirven unos lentos parámetros antropométricos.

Por la misma razón, para la comparación de la utilidad de las herramientas de cribado nutricional, debe-

mos usar como referencia los distintos resultados finales de cada episodio clínico, su capacidad pronóstica o predictiva, y no un determinado perfil de desnutrición.

No obstante, y para aclarar un dato del interés de los autores en la comparación de diferentes sistemas de cribado con referencia a la SGA, me permito recordar un cuadro comparativo de Ursula G. Kyle et al.², que hemos modificado añadiéndole los estadísticos de CONUT (Tabla I), ya publicado en esta revista³. La agrupación correcta del riesgo detectado por CONUT, como se validó para equipararlo a SGA⁴, es fundir en “normal-bajo” desde 0 a 4 puntos. No procede **añadir factores de corrección en función de la edad, porque está comprobado no son necesarios**⁵ y alteran los resultados.

Resumiendo: seleccionar unos pocos parámetros analíticos y quizás clínicos o funcionales para ser añadidos a sistemas casi tan simples, ergonómicos y automatizables como CONUT, sería suficiente para que clínicos de diversas especialidades pudieran disponer de sistemas automáticos de seguimiento y monitorización en distintas situaciones clínicas, como la insuficiencia cardiaca, renal, respiratoria, hepática, etc.^{6,7,8}, controlando tanto el riesgo actual como la evolución a corto y largo plazo, pudiendo rectificar procedimientos terapéuticos o nutricionales sobre la marcha.

En conclusión, Sr. Director, consideramos que:

- El sistema de cribado nutricional del futuro para la detección precoz del riesgo nutricional debe basarse casi exclusivamente en parámetros analíticos tomados directamente del medio interno, pesebre del que se nutre la célula.

Tabla I

Comparación estadística de la evaluación nutricional con SGA frente a los valores de varias herramientas manuales de cribado: NRI, MUST, NRS-2002 y el sistema automático CONUT

<i>Nombre (n=)</i>	<i>NRI (237)</i>	<i>MUST (995)</i>	<i>NRS - 2002 (995)</i>	<i>CONUT (161)</i>
Sensibilidad	43.1	61.2	62.0	78.26
Especificidad	89.3	78.6	93.1	89.13
Valor pron. positivo	76.2	64.6	85.1	84.38
Valor pron. negativo	66.3	76.1	79.4	84.54
Índice Kappa	0.24	0.26	0.48	0.68

Modificado de Ursula G. Kyle et al. Clinical Nutrition Vol. 25, Num. 3, pág. 409-417, jun. 2006.

- Las variables plasmáticas son los únicos parámetros que permiten detectar con la necesaria rapidez tanto la agravación como la mejoría en el equilibrio nutricional o trófico. Inútil pretenderlo con parámetros antropométricos que tardan semanas en manifestar sus cambios.
- Con frecuencia, conocido el riesgo y su origen, no se trata solo de nutrir sino de evitar a tiempo que progrese la desnutrición ocasionada por la terapia, modificándola en lo posible.
- Y, finalmente, que la referencia ideal para la validación de una herramienta de cribado del riesgo nutricional no es su coincidencia con el diagnóstico (tardío) de desnutrición, sino su grado de acierto en predecir el egreso o resultado final del proceso clínico, midiéndolo por estancias, complicaciones, costes asistenciales, mortalidad y reingresos.

Agradeciendo de antemano su consideración,

Referencias

1. Guerra-Sánchez L., Martínez-Rincón C., Fresno-Flores M. Cribado nutricional en pacientes con insuficiencia cardíaca: análisis de 5 métodos; en *Nutr. Hosp.* 2015;31(2):890-899. DOI: <http://dx.doi.org/10.3305/2Fnh.2015.31.2.7665>.
2. Ursula G. Kyle et al. Statistical comparison of nutritional assessment and screening tools values at hospital admission. *Clinical Nutrition* 2006;25(3):409-17.
3. José Ignacio de Ulibarri Pérez, Guillermo Fernández, Francisco Rodríguez Salvanés, Ana María Díaz López. Cribado nutricional; control de la desnutrición clínica con parámetros analíticos; *Nutr. Hosp.* 2014;29(4):797-811 ISSN 0212-1611 - CODEN NUH0EQ - http://www.aulamedica.es/gdcr/index.php/nh/article/view/7275/pdf_132
4. A. González-Madroño, A. Mancha, F. J. Rodríguez, J. Culebras and J. I. de Ulibarri. Confirming the validity of the CONUT system for early detection and monitoring of Clinical Undernutrition. Comparison with two logistic regression models developed using SGA as the gold standard. *Nutr Hosp.* 2012;27(2):574-581 ISSN 0212-1611. <http://www.nutricion-hospitalaria.com/pdf/5630.pdf>
5. A. González-Madroño; F. Rodríguez; G. Fernandez; A. Mancha; A. Díaz; J.I. Ulibarri. Association Between Age and an Automatic Nutritional Screening Tool . ESPEN 2012 Congress Barcelona, Spain, PP211-SUN [Poster]. DOI: [http://dx.doi.org/10.1016/S1744-1161\(12\)70262-4](http://dx.doi.org/10.1016/S1744-1161(12)70262-4)
6. Kotaro Nochioka, MD, PhD; Yasuhiko Sakata, MD, PhD; Jun Takahashi, MD, PhD; et al. Prognostic Impact of Nutritional Status in Asymptomatic Patients With Cardiac Diseases – A Report From the CHART-2 Study –*Circulation Journal* Vol.77, September 2013. <http://www.ncbi.nlm.nih.gov/pubmed/23811683>
7. Narumi T, Arimoto T, Funayama A, Kadowaki S, et al. The prognostic importance of objective nutritional indexes in patients with chronic heart failure. *J Cardiol.* 2013 Nov;62(5):307-13. doi: 10.1016/j.jcc.2013.05.007. Epub 2013 Jun 24. PMID: 23806549 [PubMed - in process]. <http://www.ncbi.nlm.nih.gov/pubmed/23806549>
8. Koji Fukushima, Yoshiyuki Ueno, Naoki Kawagishi, et al. The Nutritional Index 'CONUT' Is Useful for Predicting Long-Term Prognosis of Patients with End-Stage Liver Diseases Tokyo. *J. Exp. Med.* 2011, 224, 215-219.

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Recibido: 27-II-2015.

Aceptado: 8-III-2015.

Tras la atenta lectura de su carta, agradecemos los comentarios y el interés demostrado por nuestro trabajo.

La insuficiencia cardíaca es la única enfermedad cardiovascular cuya incidencia y prevalencia están creciendo en el mundo occidental. La edad y comorbilidad de estos pacientes hacen que sean una población sensible a padecer desnutrición y que esta ensombrezca su pronóstico. Es nuestro objetivo encontrar un método fiable, sencillo y que no precise de habilidades clínicas avanzadas para detectar la desnutrición. Partimos de la base de que hay más de 70 métodos de cribado nutricional, y que no todos expresan con la misma fortuna el estado nutricional de los pacientes con distintas situaciones clínicas. Aunque al final la desnutrición pudiera seguir siendo una, son múltiples las maneras de acceder a ella. Es por ello, que tal como sugiere la ASPEN, intentamos encontrar el método que mejor se adapte a los pacientes con insuficiencia cardíaca.

La desnutrición es un estado complicado, multifactorial y que afecta en primer lugar a la unidad celular, extremo en el que estamos de acuerdo con el firmante de la carta. Es para nosotros una realidad compartida, que los edemas alteran la antropometría de estos pacientes, por lo que medidas como el peso no son del todo fiables y se encuentran sometidas a rápidas alteraciones que a veces no se relacionan con el estado nutricional. También somos conscientes de que la concentración de albúmina se encuentra anormalmente alterada en estos pacientes, caracterizados por un aumento en su volumen hídrico. La albumina sérica, en ocasiones, muestra más la severidad de la enfermedad que el estado nutricional; sirva para confirmarlo los estudios realizados sobre el comportamiento de esta proteína en pacientes con anorexia nerviosa^{1,2,3,4}. Como ya indicábamos en el artículo, más de la mitad de los pacientes de nuestra muestra estaban tratados con hipolipemiantes, lo que condiciona que las cifras de colesterol no se relacionen con la ingesta. Posiblemente todo ello reste validez a CONUT en esta población en concreto, independientemente de su seguro óptimo comportamiento en otras situaciones clínicas. De cualquier modo, no es nuestro objetivo señalar a esos pacientes que debido a estados inflamatorios y patológicos muy limitados en el tiempo, no llegan a alterar el equilibrio nutricional “cambiante día a día”, tal y como comenta. Queremos identificar a los pacientes en los

que la desnutrición llega a traducirse en expresión clínica, ya que son estos sobre los cuales obtenemos un beneficio tratando y cuidando de manera precoz.

De cualquier manera, nosotros hemos seguido trabajando y hemos aumentado el tamaño muestral ($n = 349$). Nos hemos hecho eco de la metodología que nos proponía en su carta y hemos eliminado la corrección por edad y recodificado la clasificación de CONUT en tres categorías: normal-bajo (< 4 puntos), riesgo (5-8 puntos) y desnutrición (≥ 9 puntos). Una vez “repuntuada” y recodificada, hemos calculado nuevamente la sensibilidad, especificidad y valores predictivos, los cuales reflejamos en la Tabla I. También hemos calculado la curva ROC, que se puede apreciar en el Gráfico 1. Con la nueva codificación CONUT se vuelve más específico para los pacientes con IC. Aun así, sigue mostrando diferencias sustanciales con la clasificación nutricional por la VSG. Circunstancia que no nos sorprende, precisamente porque hay que adaptar el método a la población.

Ya conocíamos el trabajo de Kyle⁵ al que ustedes hacían referencia, y al cual añaden los resultados de

otro trabajo con distintos criterios de inclusión, distinta metodología y un tamaño muestral bastante más reducido. Nuestro trabajo no es superponible al de Kyle y cols. Esto se debe a la distinta metodología. Kyle y cols. tenían como criterio de exclusión que los pacientes presentasen edemas, precisamente porque estos pueden actuar como factor de confusión en la valoración nutricional. En nuestra muestra, la mayoría los presentaban, son pacientes con descompensación de insuficiencia cardíaca crónica y en los que es frecuente encontrarlos.

Parece difícil encontrar un único instrumento para todas las situaciones clínicas y hacemos nuestra la recomendación de la ASPEN de adaptarnos a la población con la que trabajamos. Nuestra intención es avanzar en el conocimiento y estudiar cuáles son las acciones que más años puedan dar a la vida y más vida puedan dar a los años. Es por eso que nuestro grupo queda abierto a futuras colaboraciones con ustedes o cualquier otro grupo, para intentar encontrar ese “patrón oro” tan anhelado por todos.

Tabla I

Valoración diagnóstica de CONUT eliminando la edad y recodificando como “sin riesgo” a los individuos de menos de 4 puntos, referidos a la VSG, en una muestra de 349 pacientes con episodio de descompensación de insuficiencia cardíaca. Se muestran los intervalos de confianza al 95%

	<i>Sensibilidad</i>	<i>Especificidad</i>	<i>VPP</i>	<i>VPN</i>	<i>RVP</i>	<i>RVN</i>	<i>Kappa</i>
CONUT sin edad y “recodificado”	40,6 (33,0-48,1)	69,0 (61,8-76,1)	56,8 (47,7-65,9)	53,6 (46,8-60,3)	1,31 (0,98-1,74)	0,86 (0,74-1,01)	0,035 ($p = 0,063$)

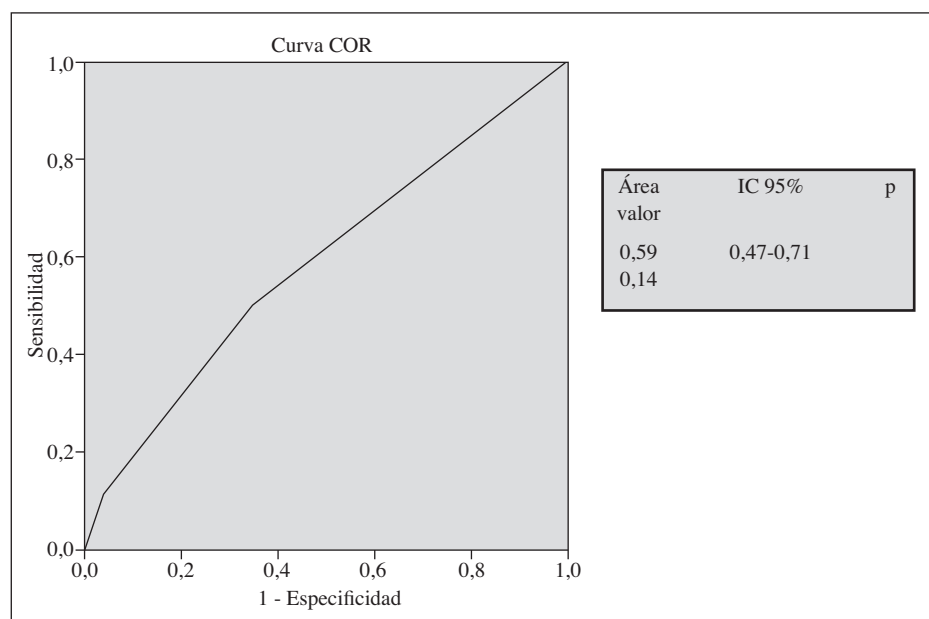


Gráfico 1.—Curva ROC de CONUT en una muestra de 349 pacientes con episodio de descompensación de insuficiencia cardíaca.

Referencias

1. Nova E, Lopez-Vidriero I, Varela P, Toro O, Casas J, Marcos A. Indicators of nutritional status in restricting-type anorexia nervosa patients: a 1-year follow-up study. *Clin Nutr.* diciembre de 2004;23(6):1353-9.
2. Waterlow JC. On serum albumin in anorexia nervosa. *Nutrition.* 1996; 12(10):720-1.
3. Caregaro L, Favaro A, Santonastaso P, Alberino F, Di Pascoli L, Nardi M, et al. Insulin-like growth factor 1 (IGF-1), a nutritional marker in patients with eating disorders. *Clin Nutr.* junio de 2001;20(3):251-7.
4. Smith G, Robinson PH, Fleck A. Serum albumin distribution in early treated anorexia nervosa. *Nutrition.* Octubre de 1996;12(10):iv - 684.
5. Kyle UG, Kossovsky MP, Karsegard VL, Pichard C. Comparison of tools for nutritional assessment and screening at hospital admission: A population study. *Clin Nutr.* junio de 2006;25(3):409-17.

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DOI:10.3305/nh.2015.31.6.8894



Fe de erratas

Effectiveness of the Brazilian Conditional Cash Transfer Program - Bolsa Alimentação - on the variation of linear and ponderal increment in children from northeast of Brazil

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Abstract

Background: social programs can improve the conditions required for families provide sufficient care and attention for an adequate health and nutrition.

Objective: This study evaluates the effectiveness of the Brazilian's conditional cash transfer program - Bolsa Alimentação (PBA) on children anthropometric status.

Methods: a cohort of 1847 children, followed for 12 months: 1615 PBA children; 232 non-PBA. There were 316 (14.6%) missing children during the study. A quasi-experimental study adopting the before-after strategy was applied and the effectiveness approach was used to assess the impact of the program on children nutritional status. Multilevel analysis with three levels was used in the statistical analysis. The mean increment variations of height-for-age and weight-for-age were the outcome variables and the participation in the PBA was the exposition. Four participation groups were established: children not exposed to the program (internal control group); exposed to the program throughout the 12 months, exposed to the program only in the last 6 months; and exposed to the program only in the first 6 months. Repeated measures were obtained at baseline and at 12 months.

Results: it was found that the exposure to the program was associated to a mean variation in weight-for-age of 0.34 Z-score (IC = 0.04; 0.63) and height-for-age of 0.38 (IC = 0.05; 0.70) for children who were regular program beneficiaries during the follow-up. The exposure to the program in other periods was not statistically associated with a mean variation in the indicators.

EFFECTIVIDAD DEL PROGRAMA DE TRANSFERENCIA DE INGRESO -BOLSA ALIMENTAÇÃO (PBA)- SOBRE LA VARIACIÓN DEL INCREMENTO DEL PESO Y DE LA TALLA DE NIÑOS EN EL NORDESTE DEL BRASIL

Resumen

Objetivo: evaluar la eficacia del programa de transferencia de ingreso brasileño -Bolsa Alimentação (PBA)- sobre la variación media del incremento del peso y de la talla de niños.

Métodos: cohorte de 1.847 niños seguida durante 12 meses: 1.615 eran niños PBA; 232 eran niños no PBA. Se ha registrado la pérdida de 316 (14,6%) niños durante el estudio. Se adopta el diseño casi-experimental y la estrategia antes-después con el enfoque de eficacia para evaluar el impacto del programa sobre el estado antropométrico de los niños. La regresión lineal multinivel fue usada en el análisis estadístico. La variación media del incremento del crecimiento de la talla y del peso para la edad fueron los resultados, y la participación en el programa la variable de exposición principal. Se establecieron cuatro grupos de participación en el programa: niños no expuestos al programa (control interno; expuestos al programa durante 12 meses de acompañamiento, expuestos al programa solo en los últimos 6; niños expuestos al programa solo en los primeros 6 meses. Las medidas repetidas se obtuvieron al inicio y a los 12 meses del seguimiento.

Resultados: después de ajustar los efectos por los factores de confusión, la exposición al programa se asoció a una variación media de peso por edad de 0,34 Z-score (IC = 0,04; 0,63) y talla para la edad de 0,38 Z-score (IC = 0,05; 0,70) para los niños que fueron expuestos al programa durante los 12 meses. La exposición al programa en otros períodos de seguimiento no fue estadísticamente asociado con una variación media de peso o talla para la edad.

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Recibido: 10-VIII-2014.

Aceptado: 1-X-2014.

Conclusions: Cash transfers direct to the family were associated to anthropometric deficits reduction in childhood.

(Nutr Hosp. 2015;31:2786-2794)

DOI:10.3305/nh.2015.31.2.7909

Key words: *Conditional cash transfer program. Brazilian's Program Bolsa Alimentação (PBA). Program evaluation. Child growth. Effectiveness. Quasi-experimental study.*

Introduction

The nutritional and health state in childhood is determined by a complex relationship between biological, social, economic and cultural factors. Under adverse conditions, the availability and access to food is limited and basic services are inaccessible, forcing the family into a state of poverty and vulnerability. Poverty is multi-dimensional, restricting the family's capacity to provide the child the care and attention needed to ensure potential development¹ and contributing to mortality² and morbidity characterized by high rates of infectious, parasites, protein-energy malnutrition and micronutrient deficiencies³.

Many countries, including some Latin American countries such as Mexico, Nicaragua, Colombia and Honduras, have adopted strategies that include conditional cash transfer (CCT), combined with education and health actions to reduce the burden of morbidity and nutritional deficits produced by poverty^{3,4}.

Based on these efforts, Brazil set up the national CCT program *Bolsa Alimentação* (PBA) in 2001 to benefit families with monthly *per capita* income less than half a minimum wage (US\$27.97/month at the time)⁵. The PBA was the largest Brazilian CCT program at that time and it was a national intervention that included supportive strategies to improve the health and nutritional status of pregnant and lactating women and children from six to 72 months old⁶.

Thus, each family received R\$15.00 (US\$4.20) per beneficiary, up to a maximum of R\$45.00 (US\$12.60). This monthly allowance was transferred directly to the mother's "magnetic card" (the mother was usually the beneficiary responsible) and could be withdrawn at a bank or lottery agency^{5,6}. Some families also received other federal cash transfer programs (*Bolsa Escola* and gas for cooking) that were also developed concurrently with the PBA. And in 2004 the PBA was replaced by other federal cash transfer program (the *Bolsa Família* program) that involved all other cash transfer activities by the Brazilian government. Therefore, the PBA was the first cash transfer program in relation to the children's health with specific objectives in the food and nutrition field⁷.

The PBA is an inclusive program, with predominantly preventative focus, targeting not only individuals who are malnourished or with nutritional deficits, but also those who are at nutritional risk. It has as

Conclusiones: transferencias directas de ingresos a la familia se asociaron con la reducción de los déficits antropométricos en la infancia.

(Nutr Hosp. 2015;31:2786-2794)

DOI:10.3305/nh.2015.31.2.7909

Palabras clave: *Programas de transferencia de ingresos. Programa Bolsa Alimentação de Brasil (PBA). Evaluación del programa. El crecimiento infantil. Eficacia. Estudio casi-experimental.*

conditions for receiving benefits the compliance with such health-related actions as maintaining childhood immunizations up-to-date, participation in growth monitoring and nutrition education activities and pre-natal care⁵. It is consensus that programs with this focus improve the nutritional status of mothers and children in poor countries^{8,9}. Unfortunately, records of PBA assessment on child health and nutrition are still insufficient to cover all dimensions of the possible effects of this program. On the other hand, the results found in the literature are sometimes contradictory. Moris et al¹⁰ has registered negative impact on weight for children under 3 years old exposed to the PBA in some communities in Northeastern Brazil. However, publication of the Brazilian government reported positive effects of the PBA on the weight and height recovery in malnourished or at risk children when compared to those excluded of the program⁶. Studies produced have identified positive results of CCT program on the Colombian children linear gain and decline in the stunting rate among Columbians, Mexican and Nicaraguan children from 1 to 59 months old⁴.

This intervention aimed to evaluate the program effectiveness under actual operational conditions and adopted an inference strategy about plausibility assessment by controlling biological, economics and social variables¹¹.

Materials and methods

Study Design

This investigation was structured as a follow-up study and employed the quasi-experimental approach, carried from October 2002 to November 2003. It was adopted the inference based plausibility assessment strategy in order to evaluate the program effectiveness under actual operational conditions on the basis of Habbicht *et al* recommendation¹¹.

Selection of districts and population study

A sample of municipal districts of Brazil (Cipó, Pirai do Norte, and Irará) was selected for convenience and included those that had been part of the PBA in October 2002 to February 2003, for the collection of

baseline information. Additional selection criteria included: location within 350 km from Salvador city (the capital of the Bahia state); population between 10.000 and 30.000; and municipalities located in different geographical regions with similar socioeconomic characteristics, including rising poverty levels.

The district of Irará is located in northern Bahia and 64% of its 25000 inhabitants live in poverty conditions. Cipó is in the arid Northeast, has 13376 inhabitants and 52.4% of its families live in poverty. Piraf do Norte is located in the Southern part of the state, has 20183 inhabitants and 44% of its families live in poverty¹².

At the beginning of the study, 1414 families from the three districts were registered on the Program, although 186 (13.15%) could not be located. We counted 2163 children at 72 months old from the 1228 identified families in both urban and rural areas. At the beginning of the follow-up 1571 children had been receiving program benefits for less than 30 days and 592 had not received any benefits yet.

At 12 months of follow-up 1847 children were evaluated which 1615 had received program benefits continuously for 12 months while 232 had not. We recorded a loss of 316 (14.6%) children previously identified (Fig. 1). Children were evaluated at baseline (October 2002 to February 2003) and at 12 month follow-up (September to November 2003).

Creating study groups

The PBA's strategic policy is based on universal coverage for low income families; therefore, it was not possible to adopt a methodological strategy of randomized intervention or deliberately create a comparison group based on the exclusion of the program, which would have been unethical.

However, during the data analyses, we were able to set up four groups with different intensities of the PBA exposure, including an internal control group composed by children who did not receive program benefits, due to municipal administrative failures despite being enrolled and fulfilling PBA eligibility criteria.

Such administrative problems included failure to send the information necessary to authorize creation of the Social Identification Number needed to receive payment; and incorrect names and/or addresses (including missing and/or additional accent or cedillas incompatible with the computer system).

Some PBA families who had been receiving benefits from the program were inexplicably removed. In these cases, the condition 'exposed' was changed to 'not exposed'. The reverse situation also occurred, in which case the child's condition was changed front of "not exposed" to "exposed". Once the child had been in the same situation for 6 months or more in the program they were included in the group correspondent. This period of 6 months is considered sufficient for the

physiological impact of a cash transfer program on the child's anthropometric status¹³. Furthermore, it is the point at which the family must be assessed to ascertain whether it still meets PBA requirements. The duration of child participation in the PBA can be extended if these requirements are met and the family continues to be meet economic eligibility criteria.

We created four program exposure groups but similar in the main characteristics evaluated and with different levels of intervention intensity: (1) a group of children who were continuously benefited from the program throughout the 12 months of follow-up; (2) children whose families had been receiving benefits but who were excluded from the PBA in the last 6 months of the follow-up; (3) children whose families were recipients during the last 6 months of the follow-up; and (4) children who were non-recipient during the 12 month period (internal control).

Data collection

The weight and height measurements were made in duplicate at baseline and at 12 months follow-up and

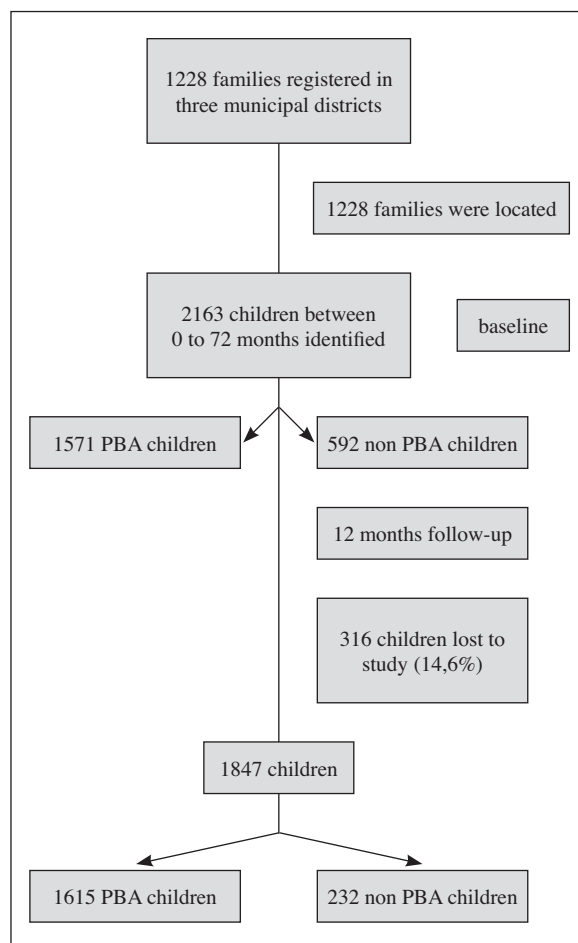


Fig. 1.—Selection of the population study. Bahia, Northeast Brazil, 2002-2003.

were standardized according WHO (World Health Organization) recommendations¹⁴.

To measure weight we used electronic scales with 100g precision (Fillizola, model E-150/3P). To measure the height of children 2 or more years old we used the Leicester Height Measure (London, England); for those under 2 years we measured length with a wooden infantometer accurate to 0.1 cm. Child age was registered in accordance with birth certificate or vaccination records.

Covariates associated with child nutritional status and that could be changing over follow-up were collected at baseline, and at 12 months of the follow-up. Regularity and duration of receipted benefits, monthly amounts and length of PBA were verified through bank statements provided by the mothers at the time of interview.

Information concerning social, economic and morbidity conditions was obtained through parent or caregiver response to structured questionnaires. Evaluation of food intake was carried out through 24-hour recalls, in accordance with Willet¹⁵. A booklet containing pictures of food and standard liquid measurements, produced and used in other investigations of our group, was used to enable interviewees to recall the size of portions served¹⁶. Dietary intake at school or crèche was also noted and included in the form of dietary consumption of each child. Appropriately trained nutritionists gathered all data.

Data analysis

The anthropometric indicators (weight-for-age and height-for-age) were the outcome measured. These outcome variables were defined as variations in anthropometric indicators (changes in weight-for-age and height-for-age) throughout the follow-up period, expressed in Z-scores¹⁷. Both variables were considered the main dependent variable, time-variant and were included as continuous variables in the statistical analysis. The PBA exposure was the main independent variable. Differentiated duration of exposition to PBA was considered in the group's compositions.

Covariates were represented by a range of factors, including: child age and sex, residence area, the family's social and economic conditions, physical and sanitary home conditions, diarrhea and coughs history, as reported by the mother within 15 days prior to interview, food intake, income received from other programs (*Bolsa Escola* and gas for cooking), weekly food expenditure and seasonality. The season was defined according to the intervals in which the anthropometric measurements were taken¹⁵.

The physical and sanitary home conditions, family structure, food intake and morbidity burden variables were introduced in the model as variant in the time. All other variables in this block were treated as invariant in the time.

Interaction terms (exposure of program versus age; exposure of program versus season and exposure of program versus participation in other social programs) were tested in the multivariate analysis. When appropriate, the variable was transformed into its respective dummy.

Hierarchical linear model derived from a multilevel analysis with level-3 model was used in the statistical analysis^{18,19}. The level 1 was represented for the household level; level 2 for children; and level 3 for the municipalities. An appropriate correlation matrix for database with imbalanced data and results derived from robust statistics was adopted. Two different multivariate regression models were subsequently specified for variations in weight-for-age and height-for-age.

We adopted the forward technique in selecting which variables to include in each level of the model²⁰. The covariates were included in the statistics analysis as defined in table I. The qui-square test was used to compare the main characteristics between the groups. Covariates that were significantly associated with the outcome, were retained in the end. A two-tailed test was used in the analysis.

Anthropometric status was evaluated using the program ANTHRO¹⁷. Information on food consumption was processed by Virtual Nutri software²¹ and statistical analyses were performed by Stata for Windows.

Ethical aspects

The Ethics Committee of the Federal University of Bahia approved the study protocol. Consenting mothers or guardians were asked to authorize the child's participation by signing an informed consent form. If the child presented any nutritional disorders, they were offered appropriate assistance and, when necessary, referred to the local health service.

Results

A total of 2163 children up to 72 months old were originally included in the study, but 316 (14.6%) were lost during the follow-up. Subject losses were due to family migration to other districts or due the child absence from home at the time of the interview. Except for the participation in other social programs - whose losses were highest amongst children who were not program recipients - no other characteristic differed between the followed and lost groups (data not shown in tables).

The municipalities' variables included were child mortality rate, maternal education, the municipality clean water percentage, and the Gini coefficient, a measure to evaluate the degree of income concentration. However, these variables were homogeneously distributed among municipalities not allowing the convergence of the correlations. And so in the multilevel analysis it was not possible to include the level 3.

Table I
Household environment, biological, social, health and nutritional characteristics of children from the Bolsa Alimentação program according to program participation, Bahia, Northeast Brazil, 2002-2003

Variables	Recipient (%)	Non-recipient (%)	p value
Residential area (1849)			
Urban	465 (85.2)	81 (14.8)	0.05
Rural	1152 (88.4)	151 (11.6)	
Gender of child			
Male	827 (87.1)	122 (12.9)	0.68
Female	790 (87.8)	110 (12.2)	
Child's age (months)			
< 36	585 (86.7)	90 (13.3)	0.45
≥ 36	1023 (87.9)	141 (12.1)	
Gender of head of household			
Male	335 (89.1)	41 (10.9)	0.28
Female	1282 (87.0)	191 (13.0)	
Maternal schooling			
≤ 4 years of school	1158 (87.5)	165 (12.5)	0.88
> 4 years of school	459 (87.3)	67 (12.7)	
Water supply in home			
Adequate	530 (88.9)	66 (11.1)	0.19
Inadequate	1087 (86.8)	166 (13.2)	
Sanitary conditions in home			
Adequate	272 (88.3)	36 (11.7)	0.62
Inadequate	1345 (87.3)	196 (12.7)	
Garbage disposal			
Adequate	523 (88.8)	66 (11.2)	0.23
Inadequate	1094 (86.8)	166 (13.2)	
Flooring in home			
Adequate	146 (89.0)	18 (11.0)	0.52
Inadequate	1471 (87.3)	214 (12.7)	
N° of bedrooms			
< 2	255 (86.1)	41 (13.9)	0.45
≥ 2	1351 (87.7)	189 (12.3)	
Indoor toilet facility			
Yes	878 (88.7)	112 (11.3)	0.09
No	715 (86.0)	116 (14.0)	
Electricity in home			
Yes	1241 (86.8)	188 (13.2)	0.07
No	367 (90.2)	40 (9.8)	
Sibling <5 years old			
< 2	638 (88.5)	83 (11.5)	0.88
≥ 2	804 (88.3)	107 (11.7)	
No of inhabitants in home			
<5	524 (89.4)	62 (10.6)	0.08
≥5	1093 (86.5)	170 (13.5)	
Participation in other social programs			
Yes	1381 (87.7)	194 (12.3)	0.47
No	229 (86.1)	37 (13.9)	
Weekly food expenditure			
1st tertile (>63.6)	22 (91.7)	2 (8.3)	b
2nd tertile (>42.4 a 63.6)	17 (65.4)	9 (34.6)	
3rd tertile (≤42.4)	1578 (87.7)	221 (12.3)	

Table I (cont) <i>Household environment, biological, social, health and nutritional characteristics of children from the Bolsa Alimentação program according to program participation, Bahia, Northeast Brazil, 2002-2003</i>			
<i>Variables</i>	<i>Recipient (%)</i>	<i>Non-recipient (%)</i>	<i>p value</i>
Cough^a			
Yes	645 (40.2)	72 (31.9)	0.02
No	960 (59.8)	154 (68.1)	
Diarrhea^a			
Yes	96 (84.2)	18 (15.8)	0.25
No	1508 (87.9)	208 (12.1)	
Anthropometric deficit (<-2 Z-scores)			
Height-for-age	187 (84.6)	34 (15.4)	0.18
Weight-for-age	140 (83.8)	27 (16.2)	0.14

^aat 15 days prior to interview; ^bunable to apply the test of statistical significance

We evaluated the validity of the assumptions criteria for the hierarchical modeling by the absence of multicollinearity demonstrated by the Variance Inflation Factor (VIF) and the normality of dependent variables distribution indicated by the residue analysis. We also evaluated the existence of interaction and none of the tested terms of interaction was significant²⁰.

Household environment, biological, social, health and nutritional children characteristics at the ending of the follow-up, taking into account the composition of the groups, are presented in table I. Except for the variable cough ($p=0.02$), there were not statistically significant differences for these variables between the groups in the beginning of the study (Table I), which did not influence the results identified in this research.

The table II presents the results of multilevel multivariate analysis for variation in the weight-for-age anthropometric indicator. It was observed a positive increase of 0.34 Z score (CI95%; 0.04; 0.63) in the weight-for-age anthropometric indicator for children continuously exposed to the program for 12 months compared to those who never received the intervention. The analysis was adjusted for children age and sex, number of sibling <5 years old in the home, electricity at home, maternal schooling, family participation in social programs, and calorie intake (Table II).

For height-for-age, the increase observed was of 0.38 Z score (CI95% 0.05; 0.70), for children continuously exposed to the program for 12 months compared to those who had never received the intervention (Table III). For shorter PBA participation (in the first or in the last six months) the variation on both anthropometric indicators (weight-for-age and height-for-age) was not significantly.

The influence of the home level in the impact for weight-for-age and height-for-age was respectively 45% and 48%, while the child level contributed 55% and 52% for the increase in the weight-for-age and height-for-age indicators, respectively. These results indicate the variability among the households and children

scores and the relevance of using the multilevel model in statistical analysis.

Discussion

The impact assessments of the Brazilian CCT program - *Bolsa Alimentação* – PBA on the child's health and nutrition are scarce. So far, this seems to be the only non-governmental publication from this program that includes data from baseline and robust design on the impact of anthropometric status of Brazilian children. We report a significant impact of PBA in anthropometric indicators improvements in target children between six months to 72 months old for height-for-age and weight-for-age at 12 months of exposure at PBA when compared to growth in non-recipient children in a quasi-experimental study with 12 months of follow-up. For shorter PBA participation the variation in these anthropometric indicators were not significantly different between participating groups.

We note that the positive influence on target children's growth occurred regardless of the age and sex and that no interaction statistically significant was observed between program levels participation and these variables.

The physiological mechanisms of catch-up growth in childhood are not completely known. Traditional studies were originated at 60's²² 80's^{23,24} and 90's²⁵ years and most of them were done with hospitalized children. But even for these children is not surprising a high catch-up growth rate when the weight-for-height ratio reaches approximately 80%, which occurs towards the end of the fifth or sixth treatment month, when started to be registered the weight gain deceleration and the linear growth speed increase²³. The longitudinal catch-up growth tends to start after the weight recovery, but than begins to be two to three times greater than normal for an infant of the same age, reaching average speeds of up to 30g per kilogram of weight per day^{22, 23,25}.

Table II
Multivariate multilevel linear analysis for repeated data variation in the weight-for-age anthropometric indicator and covariates of children participating in the Brazilian Bolsa Alimentação program. Bahia, Northeast Brazil, 2002-2003

Fixed Effects	Coefficients	SE	CI(95%)	P-value	Explained Variance	Wald
Level 1 - household					45%	11,7
Electricity	-0.18	0.07	-0.32; -0.05	0.007		
Programs participation	0.17	0.06	0.05; 0.29	0.005		
Maternal education	-0.18	0.06	-0.30; -0.06	0.004		
Rubbish	-0.17	0.06	-0.29; -0.04	0.010		
Level 2 - Child					55%	20,3
Bolsa Alimentação (PBA)						
Continuously benefited	0,34	0.15	0.04; 0.63	0.002		
Not recipient/recipient	0.24	0.15	-0.06; 0.55	0.12		
Recipient/not recipient	0.23	0.17	-0.10; 0.57	0.17		
Age	-0.001	0.001	-0.002; 0.00	0.07		

Perhaps for this reason the investigators Morris and colleagues¹⁰ - studying Brazilian mothers and children weigh at the sixth month of the follow-up who participated in the PBA - have sharply concluded that the sixth month weight were probably in the deceleration phase of physiological weight growth with consequent decline of the weight gain speed ratio. And the authors comment: This rule was once enforced in a Brazilian federal program called *Incentivo para o Combate de Carenças Nutricionais*, which made milk powder available to mothers of underweight children. Many (probably the majority) of the mothers in our sample had previously been beneficiaries of this program, and there have been anecdotal—and impossible to substantiate—reports of beneficiary mothers deliberately keeping their children malnourished to qualify for the benefits. Many (probably the majority) of the mothers in our sample had previously been beneficiaries of this program, and there have been anecdotal—and impossible to substantiate—reports of beneficiary mothers deliberately keeping their children malnourished to qualify for the benefits (p.2340)¹⁰. But there are not scientific reports that Brazilian mothers of these programs are wicked. These authors had not the information about children height, making impossible, at that time, the detection of interventions effects on children growth. Thus, a single analysis of weight gain could not explain or even detect some of the possible interventions impacts⁶.

Furthermore, the Brazilian Ministry of Health noted that the PBA families tend to use a higher percentage of their program resources on food than non-beneficiaries. Thus, the beneficiary families have a higher Marginal Propensity to Food Consumption (PMCA), i.e., they spend proportionally more with food for each US\$ 1.00 added to the family income⁶. This organ also registered an average over a period of one year variation of -0.21 deciles height-for-age for children six years old excluded from the study and -0.03 for recipients' children. For children between one and two years old excluded and not excluded this value was -3.08 and -2.25 respectively,

and for children of three years old the mean deciles were -1.26 from excluded children to -0.91 for recipients children.⁶ It is possible that the larger deficit is the possibility of recovery when conditions improve life, which makes it more credibility to our results.

Thus, whether contributing factors to impaired growth are eliminated,^{22,23,25} especially when the anthropometric deficits in children under 5 years old were elevated for height-for-age (17.9%) and weight-for-age (8.3%), as in the Northeast of Brazil - one of the poorest areas in the country²⁶ and when the child dietary intake is improved, the preventive health actions is received, the health workers advice the mothers to improve the maternal behavior practice related to the children care of the program, as indicated by the Brazilian Ministry of Health report,⁶ the compensatory growth, even in older children, can happen.

The PBA impact on compensatory growth in children up to six years old identified in this study is reinforced by the mortality rate decrease reported by Rosella et al in PBA children under 5 years old in the same geographic region (Northeast of Brazil) where this study was conducted,²⁷ using PBA secondary databases of 5565 Brazilian municipalities from 2004 to 2009 period (it started one year after the ending of our follow-up).

The authors showed that where the PBA had consolidated coverage there was a decrease in the mortality rate by 17% (RR 0.83: 95% CI 0.79-0.88), which 53% were respectively attributed to incidence decrease of diarrhea (RR 0.47: 95% CI 0.37 to 0.61) and 65% to malnutrition (RR 0.35: 95% CI .24 to .50)²⁷.

Program effectiveness assessments have shown a positive impact on growth in children younger than six years old from poor countries^{28,29,30,31,32,33}. For example in 'Progres-Oportunidades' developed in Mexico, Leroy et al²⁸ identified a linear gain of 1.5 cm (p<0.05) (corresponding to 0.41 Z score for height-for-age) and an absolute weight gain of 0.76 kg in one-year period (p<0.05) in children. In Mexican children from 24 to 68 months old, Rivera

Table III
Multivariate multilevel linear analysis for repeated data variation in the height-for-age anthropometric indicator and covariates of children participating in the Brazilian Bolsa Alimentação program. Bahia, Northeast Brazil, 2002-2003

<i>Fixed Effects</i>	<i>Coefficients</i>	<i>SE</i>	<i>CI(95%)</i>	<i>P-value</i>	<i>Explained Variance</i>	<i>Wald</i>
Intercept	-0.69	0.19	-1.07; -0.32	0.000		
Level 1 - Household					48%	14,8
Electricity	-0.32	0.07	-0.46; -0.17	0.000		
Programs Participation	0.14	0.07	0.006; 0.27	0.04		
Maternal Education	-0.27	0.07	-0.40; -0.13	0.00		
Level 2 – Child						
Bolsa Alimentação (PBA)					52%	21,0
Continuously benefited	0.38	0.17	0.05; 0.70	0.02		
Not recipient/recipient	0.20	0.17	-0.14; 0.54	0.24		
Recipient/not recipient	0.28	0.19	-0.10; 0.65	0.15		
Age	0.001	0.001	0.00; 0.002	0.09		
Gender	0.11	0.05	0.01; 0.20	0.02		
Siblings <5y old	-0.38	0.06	-0.499; -0.252	0.00		
Calorie diet availability						
Tercile 1	-0.25	0.07	-0.38; -0.11	0.000		
Tercile 2	-0.17	0.06	-0.29; -0.04	0.01		

et al²⁹ identified an overall association between the program participation and the growth improve. Fernald et al^{30, 31} reported positive impact on the growth of Mexican children in the Opportunity program children from 24 a 68 months old and an improvement was observed in children younger;³² but other investigators have found different results³³.

But we observed that the PBA had a positive impact on the growth of older children (6 months to 72 months old). This impact - age and sex independent - observed in this study can be expected, even in older children, in the first years of the program implementation, when children living conditions were more precarious and anthropometric deficits were more pronounced, such as the scenario where this study was developed. These results suggest that it may be more likely that the CCT program exerts more effect on the catch-up growth of younger children, but these effects can also be seen in older children. It is known for some time that eliminating the conditions that limit the adequate growth in school-aged children and even in adolescents is possible that the catch-up growth occurs in specifics contexts,³⁴ as the PBA context, whose effectiveness in the first year of the implantation, it revealed the possibility of breaking the association between poverty and health and nutritional status of children from the poorest urban and rural areas.

Positive effects on children catch-up growth of children was registered for a recent review of cash transfer programs in other Latin American countries, particularly in Nicaragua, Honduras and Colombia⁴.

Despite the extremely positive results observed in the Brazil's CCT program (PBA) first implantation year, other factors continue to impede the adequate linear or

weight growth in Brazilian children living in extreme poverty, such as more than 2 sibling <5 years old in the home, absence of electricity at home, low maternal schooling, the family necessity to participate in social programs, low food intake, specially micronutrient, as observed in this study. These observations reinforce the need to deal with the social and health inequalities combat to ensure the Brazilian children growth according to their genetic potential.

Finally, we should note the limitations imposed by the study design and follow-up losses. The follow-up losses were relatively low (14.6%) and did not influence significantly the group composition at the end of the study. These losses occurred in a random mannered and possibly not introduced selection bias in the study greater proportion in a district that suffered a long period of drought that led to temporary migration of families in search of less adverse conditions.

And we emphasize that all variables were homogeneously distributed between recipient and no recipient children followed, with the exception of reported coughs (Table I).

However, it is worth noting the homogeneity observed in anthropometric variables distribution at the beginning and in the ending of the group set up, and between those lost in the program and those who remained until the end. This is important since this variable is directly related to the program impact.

We acknowledge the diversity of actions linked to the PBA; including immunizations, nutritional education and prenatal care among others; which makes it more difficult to identify the isolated effect of cash transfers on child's physical growth³⁵. We also recognize that the operational

combination of these actions, including health actions, does not always have an additive effect, but may have a multiplicative one¹ that increases the potential of actions linked to the program. However, the study design allows us to control for the influence of various external factors that could influence the results, and we also included an internal control group.

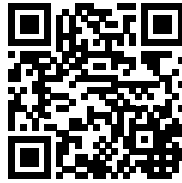
An appropriated statistical technique was used; it is also expected to correct the regression to the mean, making the results more robust and reliable.

We recognize that the study design does not allow us to make inferences based on causality, however inferences can be made based on an assessment of the plausibility of the intervention¹¹ which point to the effectiveness of the PBA in reducing anthropometric deficits in Brazilian children living in poverty.

Thus, it is possible to conclude by the study plausibility that reinforces the findings that recipients PBA children had better growth than those whose not recipients, indicating that the cash transfers programs reach vulnerable families and promote positive response on the children growth.

References

1. Walker SP, Wachs TD, Gardner JM, et al. International Child Development Steering Group: Risk factors for adverse outcomes in developing countries. *The Lancet* 2007; 369:145-157.
2. Victora CG, Wagstaff A, Schellenberg JA, Gwatkin D, Claeson M, Habicht JP. Applying an equity lens to child health and mortality: more of the same is not enough. *The Lancet* 2003; 362: 233-41.
3. Allen L, Gillespie S. What works? A review of the efficacy and effectiveness of nutrition interventions. United Nations Administrative Committee on Coordination/Sub Committee on Nutrition (ACC/SCN); Nutrition Policy paper n.19, Geneva 2001.
4. Bhutta ZA, Ahmed T, Black RE, et al. What works? Interventions for maternal and child undernutrition and survival. *Maternal and Child Undernutrition* 3. *The Lancet* 2008; 371: 417-40.
5. BRASIL. Medida Provisória nº. 2.206 (10 de Agosto de 2001). *Cria o Programa Nacional de Renda Mínima vinculado à saúde: "Bolsa-Alimentação" e dá outras providências*. Diário Oficial da República Federativa do Brasil, nº 154-E, Brasília, 2001.
6. BRASIL. *Avaliação do Programa Bolsa Alimentação, Segunda Fase*. Série C. Projetos, Programas e Relatórios. Brasília, 2001.
7. BRASIL. Presidência da República Casa Civil Subchefia para Assuntos Jurídicos LEI No 10.836, DE 9 DE JANEIRO DE 2004. *Cria o Programa Bolsa Família e dá outras providências*. http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/lei/110.836.htm
8. Sarah Bailey and Kerren Hedlund. The impact of cash transfers on nutrition in emergency and transitional contexts. A review of evidence. January, 2012. www.odi.org.uk/hpg. Accessed March 10, 2014.
9. Doetinchem O, Xu K, Carrin G. Conditional cash transfers: what's in it for health? World Health Organization; 2008.
10. Moris SS, Olinto P, Flores R, Nilson EAF, Figueiró AC. Conditional Cash Transfers Are Associated with a Small Reduction in the Rate of Weight Gain of Preschool Children in Northeast Brazil. *Journal of Nutrition* 2004; 134: 2336-2341.
11. Habicht JP, Victora CG, Vaughan JP. Evaluation designs for adequacy, plausibility and probability of public health program performance and impact. *Int J Epidemiol* 1999; 28:10-18.
12. Peliano AMT. *O Mapa da Fome II: informações sobre a incidência por municípios da Federação* (Documento de Política n.15). Brasília: IPEA; 1993.
13. Miller CM, Tsoka M, Reichert K. The Malawi Social Cash Transfer and the impact of \$14 per month on child health. *World Health*. 2010; 571.
14. World Health Organization (WHO). Child growth standards: training course on child growth assessment. 2008; 1-57.
15. Willett W. *Nutritional Epidemiology*. New York: Oxford University Press. 2012; 1-552.
16. Magalhães LP, Oliveira VA, Santos JM: Guia para estimar o consumo alimentar. Edited by Escola de Nutrição - Universidade Federal da Bahia, 1996: 1-56 [in Portuguese].
17. WHO. Child Growth Standards. Geneva, 2006. www.who.int/childgrowth/standards. Accessed March 14, 2014.
18. Twisk JWR. *Applied longitudinal data analysis for epidemiology. A practical guide*. United Kingdom: Cambridge University Press; 2013.
19. Rothman KJ; Greenland S. *Modern Epidemiology*. Artmed; 2011.
20. Hosmer DW, Lemeshow S. *Applied Logistic Regression*. New York: John Wiley & Sons; 1989.
21. Philippi ST, Szarfarc SC, Laterza CR. Virtual Nutri – v.1 for Windows. Sistema de Análise Nutricional. Edited by Departamento de Nutrição da Faculdade de Saúde Pública. Universidade de São Paulo; 1966.
22. Galvan RG, Mariccal CA, Viniegra CA, Perez OB. *Desnutrición en el niño*. México: Impresiones Modernas S.A.; 1969.
23. Waterlow JC. *Protein Energy Malnutrition*. London: Edward Arnold; 1992.
24. Brown KH, Black RE, Becker S. Seasonal changes in nutritional status and the prevalence of malnutrition in a longitudinal study of young children in rural Bangladesh. *Am J Clin Nutr* 1982; 36: 303-313.
25. Costello A. Growth velocity and stunting in rural Nepal. *Archives of Disease in Childhood*. 1989; 64: 1478-1482.
26. BEMFAM/PNDS. Sociedade Civil de Bem Estar Familiar no Brasil. Pesquisa Nacional sobre Demografia e Saúde (PNDS). Brasília; 1996 (in Portuguese).
27. Rosella D, Aquino RA, Santos CT, Paes-Sousa R, Barreto ML. Effect of a conditional cash transfer program on childhood mortality: a nationwide analysis of Brazilian municipalities. *The Lancet* 2013; 382: 57-64.
28. Leroy JL, García-Guerra A, García R, Dominguez C, Rivera J, Lynnette MN. The 'Oportunidades' Program increases the linear growth of children enrolled at young ages in urban Mexico. *The Journal of Nutrition* 2008; 138:793-798.
29. Rivera JA, Alvarez DS, Sotres D, Habicht JP, Shamah T, Villalpando, S. Impact of the Mexican Program for Education, Health, and Nutrition (Progresá) on Rates of Growth and Anemia in Infants and Young Children. A Randomized Effectiveness Study. *JAMA* 2004; 291: 2563-70.
30. Fernald LCH, Gertler PJ, Neufeld LM. Role of cash in conditional cash transfer programs for child health, growth, and development: an analysis of Mexico's Oportunidades. *The Lancet* 2008; 371: 828-37.
31. Fernald LCH, Gertler PJ, Neufeld LM. 10-year effect of Oportunidades, Mexico's conditional cash transfer program, on child growth, cognition, language, and behavior: a longitudinal follow study. *The Lancet* 2009; 374: 1997-2005.
32. Gertler PJ. Final report the impact of progresá on health. International Food Policy Research Institute, 2000. http://www.ifpri.org/themes/progresá/pdf/Gertler_health.pdf. Accessed February 18, 2014.
33. Maluccio J, Flores R. Impact Evaluation of a Conditional Cash Transfer Program: The Nicaraguan Red de Protección Social. Food Consumption and Nutrition Division; Discussion Paper. Nº 184, IFPRI: Washington D.C. 2004.
34. James H, Gitter S, Slavchevska V. How effective are cash transfer at improving nutritional status. *World Development* vol 48, pp. 133-155, 2013.
35. Victora CG, Fenn B, Bryce J, Kirkwood BR. Co-coverage of preventive interventions and implications for child-survival strategies: evidence from national surveys. *The Lancet* 2005; 366:1460-66.



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MADRID, 23 DE OCTUBRE DE 2014

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ALICANTE, 7 AL 9 DE MAYO DE 2015

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