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Trabajo Original

Epidemiología y dietética

The effectiveness of an education program and nutritional intervention, integrated health and physical activity in postmenopausal women

Efectividad de un programa de educación e intervención nutricional y de actividad física sobre la salud integral de mujeres posmenopáusicas

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Abstract

Objectives: The aim of this study was to test the effectiveness of a nutritional education and intervention programme, promoting holistic health and physical exercise in postmenopausal women, with special emphasis on women who smoke, in order to test whether greater adherence to the diet and increased physical activity and healthy lifestyles reduce cardiovascular risk in this population group.

Material and methods: The study population consisted of 96 women (aged 46-79) living in Granada (southern Spain). At baseline, the socio-demographic characteristics were compiled and a nutritional assessment conducted, in which food consumption was assessed by 48h recall and the Mediterranean diet score (MDS) was calculated. Anthropometric data were also measured. Other data compiled included serum lipid parameters. When the initial results were obtained, a tailored intervention programme concerning nutrition and healthy lifestyle was provided to each participant. After three months, all the above parameters were re-assessed.

Results: At the beginning of the study, it was observed that the diet of the study population complied with recommended patterns. However, the nutritional intervention resulted in an improved caloric and lipid profile and decreased obesity. Among the group of smokers, serum lipid parameters also improved, reaching values similar to those of the non-smokers.

Conclusions: An appropriate adhesion to the Mediterranean diet score (MDS) was observed in the Andalusian postmenopausal women assessed in this study. For the whole study population, the nutritional intervention improved the quality of diet and reduced the percentage of obesity, while smokers also improved their lipid profile.

Key words:

Postmenopausal women. Nutrient intake. Plasma parameters. Educational intervention.

Resumen

Objetivos: el objetivo de este estudio fue comprobar la eficacia de un programa de educación e intervención nutricional, de salud integral y ejercicio físico en mujeres posmenopáusicas, incidiendo especialmente en el sector de mujeres fumadoras con el fin de reducir el riesgo cardiovascular de este sector de población.

Materiales y métodos: la población objeto de estudio estuvo constituida por 96 mujeres (46-79 años) residentes en Granada (sur de España). Al comienzo del estudio se recogieron las características sociodemográficas y se realizó una valoración nutricional; el consumo de alimentos se evaluó mediante una encuesta de 48 preguntas y un estudio de adhesión a la dieta mediterránea. Se determinaron datos antropométricos: índice de masa corporal, porcentaje de masa grasa y magra. Determinamos también el colesterol total, el colesterol LDL, HDL y los triglicéridos. Una vez obtenidos los primeros resultados, se realizó una intervención personalizada, para cada mujer participante en el estudio, de educación nutricional y de hábitos saludables. Transcurridos tres meses, se volvieron a determinar todos los parámetros anteriormente estudiados.

Resultados: al comienzo del estudio se observó que la dieta de la población se adecuaba a los patrones de dieta saludable y tras la intervención nutricional se produjo una mejora del perfil calórico y lipídico y un descenso de la obesidad. En el grupo de las mujeres fumadoras además se encontró una mejora de los parámetros lipídicos séricos, alcanzando valores semejantes a los de las no fumadoras.

Conclusiones: se observó que las mujeres posmenopáusicas andaluzas participantes en este estudio tenían una adecuada adhesión a la dieta mediterránea. La intervención nutricional mejoró en todo el grupo la calidad de la dieta y el porcentaje de obesidad y, además en las mujeres fumadoras mejoró el perfil lipídico.

Palabras clave:

Mujeres posmenopáusicas. Ingesta de nutrientes. Parámetros plasmáticos. Intervención educacional.

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INTRODUCTION

Menopause is a female physiological state determined by the cessation of the ovarian secretion of oestrogen and progestin, which results in the disappearance of menstrual bleeding. Among the Spanish population it takes place at an average age of 51.4 years (1). However, the menopause can turn into a pathological situation, as it increases the risk of cardiovascular disease, osteoporosis, breast cancer and diabetes (2). In addition, it is well documented that during the menopause women are at increased risk of obesity, due to changes in body composition. The menopause is associated with a higher percentage of body fat, especially in the abdominal area, which increases the risk of hyperinsulinaemia and insulin resistance, while and at the same time muscle mass and bone tissue are reduced (3). The nutritional needs of menopausal women differ markedly from those of men and younger women (4). Our increasingly precise knowledge of the specific nutritional needs of the adult population, the growth of this population group and the resulting increase in medical spending associated with their chronic diseases have caused educational programmes, which were previously focused on children and younger stages of adulthood, to be now extended to this population in order to improve health status and quality of life, preventing or delaying the onset of chronic diseases and reducing the costs they involve (5). It has been shown that diet is especially important in the prevention of the above-mentioned diseases, and that promoting a healthy, balanced diet by means of appropriate nutritional education is an effective treatment for menopausal women (6). One study has demonstrated a relationship between ongoing nutritional education and changes in health behaviour among different population groups (7,8). Others have highlighted the effectiveness of applying preventive measures at an early stage to detect and control risk factors in postmenopausal women, by giving up smoking, taking regular physical exercise and improving diet and hygiene habits, among other. All these changes achieve substantial reductions in cardiovascular morbidity (7-9). With the use of appropriate learning techniques and habit-changing methods dietary and nutritional experts can make a positive impact on dietary and lifestyle habits of adults, helping them achieve an optimal nutritional status and enjoy a healthy aging (7). A review of the bibliography in this respect shows that very few studies on postmenopausal women have been made to determine the effectiveness of multidisciplinary programmes in raising awareness of nutritional issues and promoting physical exercise and healthy living habits. The aim of the present study was to determine whether a programme of nutritional education and intervention for postmenopausal women, focusing also on exercise and healthy living, improves diet quality, body composition, biochemical parameters and the lifestyle habits that are associated with pathologies among postmenopausal women.

METHODS

APPROVAL

All participants were informed about the study aims and procedures and gave their written informed consent to participate before beginning the intervention. The study was reviewed and approved by the Ethics Committee of the Virgen de las Nieves Hospital (Granada, Spain).

PARTICIPANTS AND STUDY DESIGN

In this longitudinal descriptive intervention study, the sample consisted of 96 postmenopausal women aged 46-79 living in Granada (southern Spain), who took part in a three-month university-study programme, which was adapted to their academic level (they held a primary education diploma [40.66%]) and dealt with holistic health, diet and health and keep-fit exercises. The recruitment of participants was performed by researchers from the Department of Physiology at the University Granada.

The six-month intervention period was divided into two parts, first a 20-hour course on health and nutrition, followed by a 20-hour course of keep-fit exercises. This physical training programme took place two hours a week and was closely supervised and individualised. The intervention programme was adapted to the individual pace of each subject and to the participants' different situations. The intervention groups worked out 2 days/week (Wednesday and Friday, 60 min per session) for 10 weeks. Intensity was adapted during the program in a range between 50% to 80% of the frequency maximum heart (209 to 0.73 x age). Each workout included 15 minutes warm-up based on different types of motion exercises joint mobility and stretching, followed by 35 minutes of exercise working the main content session, which varies depending on the day. The session ended with a 10 minute cool down through stretching exercises and relaxation. Muscular strength endurance, balance activities and aerobic nature was exercised on Wednesday, while aerobic exercises and coordination through circuit activities were carried out on Friday. The design of the program was conducted by specialists in the field of exercise equipment belonging to researcher. Exercise sessions were led by graduates in Science Physical Activity. We worked with groups of about 20 women (the sample will be divided into five working groups organized on the basis of prior sunivel fitness).

An initial evaluation of food intake, anthropometric measurements, biochemical parameters and lifestyle was performed. When these first results were obtained, and upon completion of the course, the second part of the intervention began, in which a personalised report was prepared for each woman participating in the study and guidelines were provided for a more healthy diet and lifestyle, based on standard recommendations for postmenopausal women.

PROCEDURES

Lifestyle

The following lifestyle elements were recorded: smoking, physical exercise (subjects were classed as active if they exer-

cised for more than 300 minutes per week), place of residence (town/city, coastal rural area or inland rural area), occupation (employed outside the home or not) and education (none, elementary school, primary school, middle school, high school, college/university). Data were compiled using a questionnaire designed by the National Health Survey (Ministry of Health and Consumer Affairs, 1977) (9).

Dietary intake

Food consumption was assessed by a 48-h recall method in which participants were interviewed and asked to recall all foods consumed during the preceding 48 hours (10). Data recorded concerned type of food, amount consumed, method of preparation and ingredients used. Note was taken of the recipes, condiments, fats or oils used and the brands consumed.

In all cases, data were obtained by the same trained researcher, in order to reduce inter-examiner variations. The questionnaire was based on open-ended questions and photographs were used as a reference for portion size (11). Food intakes were converted into energy and nutrients with the help of the Spanish Food Composition database (12), using AYS44 Diet Analysis software obtained from ASDE SA (Valencia, Spain). Diet quality was determined using the MedDietScore (MDS), an index created in 2006 by Panagiotakos et al. to evaluate the degree of adherence to the traditional Mediterranean dietary pattern (13) and including eleven components of the Mediterranean diet (non-refined cereals, fruits, vegetables, potatoes, legumes, olive oil, fish, red meat, poultry, full fat dairy products and alcohol). Scores ranging from 0-5 were assigned to all components. Thus, the total score assigned ranged 0-55, with higher scores indicating greater adhesion to the Mediterranean diet pattern.

Laboratory assessment

Blood was collected from each subject after 12-hour fasting and placed in heparinised tubes. Glucose, triglycerides (TG), total cholesterol (TC), low density lipoprotein cholesterol (LDLC) and high density lipoprotein cholesterol (HDLC) were measured using commercial kits (Biosystems S.A. Barcelona). The following atherogenic indexes were calculated: TC/HDLC, TC-HDLC and (TC-HDLC)/HDLC. The following values were taken as normal: Glucose < 110 mg/dl, TC < 200 mg/dl, HDLC > 60 mg/dl, LDLC < 160 mg/dl and TG < 150 mg/dl (14).

Anthropometric measurements

Anthropometric measurements were obtained using a portable eight-polar tactile-electrode impedanciometer (InBody R20, Biospace, Gateshead, UK) to measure body weight (kg), fat mass, body fat (%), muscle mass (kg) and lean mass (%). The validity of this instrument has been reported elsewhere (15). The body mass index (BMI) was calculated as weight (in kilograms) divided by squared height (in metres) and categorised using the following SEEDO criteria: underweight (< 18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2) and obese (≥ 30.0 kg/m^2) SEEDO. BMI was also used to calculate the weight status (%).

Statistical analysis

All analyses were performed using the Statistical Package for Social Sciences (SPSS, version 20.0 for Windows [SPSS Inc., Chicago, IL]), and the level of significance was set at $p \leq 0.05$. Repeated measures of analysis of variance (ANOVA) and the Bonferroni *post hoc* method were used to compare the differences with respect to the changes observed in the two assessments. Pearson correlation coefficient was used to determine relationships between the variables. For smokers and non-smokers, standardised effect size statistics were estimated in all comparisons. Cohen's d and its exact confidence interval were used for parametric QoL variables.

RESULTS

Subjects' sociodemographic characteristics and lifestyle habits are shown in table I. The women's average age was 64.07 ± 3.48 years; 16.7% were smokers and 65.6% practiced regular exercise. Among them, 41.7% lived in towns and cities, 31.2% in coastal rural areas and 27.15% in inland rural areas. Only 1.04% worked outside their home. The largest group (40.63%) had obtained a primary school diploma.

The energy intake, macronutrient intake and MDS before and after the interventions are shown in table II. During the intervention period, total energy intake did not vary significantly, but the protein caloric contribution (%) fell significantly ($p < 0.001$); there were no changes in carbohydrates (%), lipids (%) or MDS. Consumption of saturated fatty acids decreased, both as grams consumed ($p < 0.001$) and as percentage of total fat intake ($p < 0.05$). The quality of the fat, measured by the ratio (polyunsaturated + monounsaturated) / saturated, increased ($p < 0.001$). After this nutrition education programme, the MDS remained unchanged.

Glucose, TG, TC, LDLC and HDLC, together with the following atherogenic indexes: TC/HDLC, TC-HDLC and (TC-HDLC)/HDLC, are presented in table II. After the intervention, no significant differences were observed in any of these parameters.

The anthropometric and body composition characteristics of the study participants are shown in table II. No significant differences were observed in weight, BMI, body fat (kg), lean mass (kg), body fat percentage or lean mass percentage. However, there was a significant reduction (10%) in the weight status of the obese women among the study population.

The lifestyle habit that most influenced the study parameters was smoking/non-smoking. As shown in table III, the amount of saturated fat in smokers was significantly lower after the intervention. In addition, the percentage of kilocalories provided by

Table I. Sociodemographic and lifestyle characteristics

Age (years)	64.07 ± 3.48
Smoking	
Yes	16 (16.7)
No	80 (83.3)
Physical exercise	
Yes	63 (65.6)
No	33 (34.4)
Residence	
Town/city	40 (41.7)
Coastal rural area	30 (31.2)
Inland rural area	26 (27.1)
Employed	
Yes	1 (1.04)
No	95 (98.96)
Education	
None	1 (1.04)
Elementary school	7 (7.29)
Primary school	39 (40.63)
Middle school	16 (16.66)
High School	27 (28.13)
College/university	6 (6.25)

**Age expressed as the mean ± SD. Other parameters expressed as the number of women (percentage of total population).*

polyunsaturated fat compared to total kilocalories was significantly higher among the non-smokers before the intervention, but there was no difference in this respect following the intervention (Table III). These findings lead us to conclude that the fat quality parameter in the female smokers was significantly enhanced by the intervention. However, the intervention had no impact on adhesion to the Mediterranean diet, irrespective of whether the women smoked or not.

Regarding biochemical parameters, before the intervention triglycerides, TC and LDLC were significantly lower in non-smokers, but these values were similar in both groups after the intervention.

Regarding body composition, muscle mass in non-smokers had increased by the end of the study. Initially, there were more overweight women among smokers, but the obesity rate was higher among non-smokers. However, after the education programme, the number of obese women had decreased in both groups.

DISCUSSION

It is important to acquire good nutritional habits, as they are relevant to many diseases that may occur after the menopause, such as osteoporosis, and to many factors of cardiovascular risk, both well-established ones, such as diastolic and systolic blood pressure, LDLC, HDLC and glucose levels and obesity/weight gain, and also a novel risk factor, such as inflammation, cardiac arrhythmia, endothelial cell function, TG levels, lipoprotein levels and heart rate (16).

At baseline and after the intervention the caloric intake (Table II) of the women participating in the study was adjusted to energy consumption (100.4% and 103.6% respectively) according to the standard Spanish recommendations for their age group (11). Regarding the intake of macronutrients, the diet of this population was high in proteins, low in glucose and slightly high in fats. These results are in accordance with those obtained in other Spanish regions and in other developed countries (17). This pattern is repeated in most European countries, according to studies by the WHO (18,19).

The significant decrease in protein intake observed after the nutritional intervention is important in the menopause, as excess protein tends to increase urinary calcium excretion, which may affect bone mineral density (BMD) (20). The role of protein intake remains controversial in the development of osteoporosis. Excessive protein intake may be responsible for a metabolic increase in acid production and acid renal excretion, with increased calciuria potentially favouring bone loss and hip fracture. Furthermore, studies have reported that appropriate levels of protein intake could play a role in the maintenance of BMD, through different mechanisms, e.g. by increasing IGF-1, calcium absorption and muscle strength and mass, which could all benefit the skeleton (21). Moreover, in recent years it has been suggested that high-protein diets do not appear to alter bone quality but rather enhance it when such diets are accompanied by the consumption of sufficient fruits and vegetables to correct the acidogenic potential of the protein and deficiencies in other micronutrients. However, other authors have suggested that such diets may worsen the renal profile without adversely affecting the BMD, although such effects have not been widely corroborated (22).

Following the intervention programme, the consumption of carbohydrates (55-60%) approached nutritional targets (22,23), but the differences were not statistically significant. Nevertheless, the results for our study subjects remained below recommended levels, what is in line with results for the rest of Spain (24,25) and for the rest of Europe except Finland and Ireland (26). Carbohydrates are an excellent source of dietary energy and play an important role in the control of degenerative diseases, as discussed above, and so it would be desirable to raise their proportion in the diet and lower that of fats to balance the energy profile. In fact, fat consumption is slightly higher than the recommendations of the Spanish Society of Community Nutrition for the Spanish population (SENC, 2001) (30-35%) (27). Total consumption of this nutrient was not modified by the intervention but its quality, according to the quality index (polyunsaturated fat + monounsaturated fat)/saturated fat), significantly improved after the intervention programme due to the decreased consumption of saturated fat, both in grams and as a percentage of the energy provided (Table II). One of the nutritional goals set for this population was to achieve a value of 2 or above for this quality index; the women

Table II. Comparisons of dietary intakes, MDS, laboratory values and anthropometric measurement before (B) and after (A) intervention programme (n = 96)

Parameters	B intervention	A intervention	p values*
Dietary intake and MDS			
Total energy intake (kcal/day)	1,863.8 ± 592.7	1,920.1 ± 582.6	0.507
Proteins (%)	18.8 ± 4.5	16.8 ± 3.2	0.000
Carbohydrates (%)	41.9 ± 10.1	44.8 ± 14.1	0.107
Lipids (%)	38.9 ± 8.5	37.8 ± 8.4	0.353
Fat intake (g)	71.9 ± 26.5	67.0 ± 18.8	0.144
Saturated fat (g)	17.6 ± 7.8	14.2 ± 6.0	0.001
Monounsaturated fat (g)	30.8 ± 12.9	28.9 ± 9.8	0.262
Polyunsaturated fat (g)	9.2 ± 4.3	9.2 ± 4.7	0.999
Saturated fat (%)	16.5 ± 17.5	12.9 ± 5.6	0.001
Monounsaturated fat (%)	19.0± 5.8	19.9 ± 4.3	0.233
Polyunsaturated fat (%)	7.9 ± 3.2	8.4 ± 3.4	0.286
Fat quality	2.3 ± 1.0	2.9 ± 0.9	0.001
Mediterranean Diet Score	33.8 ± 4.9	32.9 ± 4.5	0.200
Biochemical parameters			
Glucose (mg/dL)	95.8 ± 33.3	92.2 ± 14.7	0.200
Triglycerides (mg/dL)	113.8 ± 65.1	113.3 ± 50.4	0.946
Total cholesterol (TC) (mg/dL)	217.4 ± 34.4	221.9 ± 30.2	0.335
HDLC (mg/dL)	63.2 ± 12.1	60.2 ± 9.6	0.059
LDLC (mg/dL)	131.1 ± 29.7	135.5 ± 23.0	0.496
TC/HDLC	3.6 ± 1.0	3.8 ± 0.8	0.126
TC – HDLC	154.2 ± 36.6	161.7 ± 31.4	0.128
(TC – HDLC)/HDLC	2.6 ± 1.0	2.8 ± 0.8	0.126
Anthropometric measurements			
Weight (kg)	69.1 ± 11.4	67.8 ± 9.8	0.321
Fat mass (kg)	31.8 ± 6.8	31.3 ± 6.0	0.743
Body fat (%)	47.0 ± 9.0	47.4 ± 10.6	0.746
Muscle mass (kg)	37.1 ± 6.1	36.7 ± 5.7	0.692
Lean mass (%)	54.1 ± 4.5	54.7 ± 4.5	0.599
Body mass index (kg/m^2)	28.4 ± 3.8	27.7 ± 3.3	0.537
Weight status % (UW,NW,OW,OB)	0/24/41/35	0/22/53/25	

*Data are expressed as mean ± SD. HDL: high density lipoprotein; LDL: low density lipoprotein; UW: Underweight; NW: Normal weight; OW: Overweight; OB: Obese; *Statistical difference between groups p < 0.05.*

in our study presented values in this respect ranging from 2.3 to 2.9 after the intervention, which reflects an improvement in the quality of fat intake. It is recommended that saturated fat intake should not exceed 10% of the total energy, that polyunsaturated fat should be less than 7% and that monounsaturated fat should represent 15-20% (28); the corresponding percentages for participants were all closer to these recommendations after the intervention. In southern Spain, fat intake is mainly derived from olive oil (29), unlike the Western diet, thus ensuring a sufficient consumption of monounsaturated fatty acids and compounds such as vitamin E and lycopene, which has an antioxidant effect. Moreover, the lower consumption of saturated fats and appropriate levels of polyunsaturated and monounsaturated fats help reduce the risk of coronary heart disease (CHD).

The question of whether saturated fat is a risk factor for cardiovascular disease (CVD) has attracted considerable controversy (30). Nevertheless, medical, heart-health and governmental authorities, such as the World Health Organization (31), the American Dietetic Association (32), the Dieticians of Canada (33), the British Dietetic Association (34), the American Heart Association (35), the

Table III. Parameters studied in women smokers and non-smokers before and after the intervention

Parameters	Smokers before intervention n = 16	Non-smokers before intervention n = 80	Effect size†	Smokers after intervention n = 16	Non-smokers after intervention n = 80	Effect size†
Total energy intake (kcal/day)	1,904 ± 667	1,877 ± 555	0.05 (- 0.36, 0.45)	1,836 ± 561	1,963 ± 569	- 0.22 (- 0.63, 0.18)
Proteins (%)	21.3 ± 8.5	18.3 ± 3.0[a]	0.69 (0.27, 1.10)	17.5 ± 5.0	16.7 ± 2.8[d]	0.25 (- 0.16, 0.65)
Carbohydrates (%)	40.5 ± 13.0	44.1 ± 12.3	- 0.27 (- 0.70, 0.11)	42.5 ± 21.6	42.6 ± 14.2	- 0.001 (- 0.41, 0.40)
Lipids (%)	38.6 ± 11.3	38.0 ± 8.0	0.07 (- 0.33, 0.47)	39.4 ± 3.9	36.4 ± 9.2	0.35 (- 0.06, 0.76)
Saturated fat (g)	18.3 ± 11.0	17.5 ± 13.8	0.06 (- 0.34, 0.46)	10.3 ± 4.1[c]	14.2 ± 6.0[d,b]	- 0.68 (- 1.1, - 0.26)
Monounsaturated fat (g)	29.4 ± 11.6	31.1 ± 13.2	- 0.13 (- 0.54, 0.27)	27.2 ± 10.7	29.2± 9.7	- 0.20 (- 0.61, 0.20)
Polyunsaturated fat (g)	10.8 ± 5.7	8.9 ± 3.9	0.44 (0.04, 0.86)	8.2 ± 2.8	9.4 ± 5.0	- 0.25 (- 0.66, 0.15)
Saturated fat (%)	8.6 ± 3.9	9.1 ± 3.8	- 0.13 (- 0.54, 0.37)	7.2 ± 2.9	5.2 ± 1.9[b]	0.96 (0.53, 1.38)
Monounsaturated fat (%)	15.1 ± 5.4	14.5 ± 4.9	0.12 (- 0.28, 0.52)	14.0 ± 5.0	14.6 ± 6.9	- 0.09 (- 0.50, 0.31)
Polyunsaturated fat (%)	4.3 ± 1.5	5.2 ± 2.1[a]	- 0.44 (- 0.86, - 0.04)	4.2 ± 2.0	4.4 ± 1.7	-0.11 (-0.52, 0.29)
Fat quality	2.3 ± 0.7	2.4 ± 0.7	- 0.14 (- 0.55, 0.26)	3.6 ± 1.0[c]	2.7 ± 0.4[d,b]	1.66 (1.19, 2.13)
Mediterranean Diet Score	31.2 ± 4.8	32.3 ± 3.7	- 0.80 (- 1.22, - 0.38)	31.7 ± 4.6	33.2 ± 4.4	- 0.34 (- 0.75, 0.07)
Glucose (mg/dL)	99.1 ± 7.7	95.2 ± 22.4	0.19 (- 0.22, 0.59)	99.5 ± 27.7	95.1 ± 22.4	0.19 (- 0.22, 0.59)
Triglycerides (mg/dL)	145 ± 64	107 ± 66[a]	0.57 (0.16, 0.98)	111.1 ± 52.0	124.3 ± 41.1	- 0.31 (- 0.71, 1.0)
Total cholesterol (mg/dL)	236 ± 47	214 ± 30[a]	0.68 (0.27, 2.0)	231 ± 46	220 ± 26	0.37 (- 0.04, 0.77)
HDL cholesterol (mg/dL)	58.8 ± 5.7	64.1 ± 13.7	- 0.52 (- 0.82, 0.007)	57.4 ± 8.3	66.7 ± 9.8	- 0.97 (- 1.40, -0.54)
LDL cholesterol (mg/dL)	150 ± 30	136 ± 24[a]	0.60 (0.15, 1.0)	136 ± 24,4	138 ± 30.	- 0.07 (- 0.47, 0.34)
Weight (kg)	63.8 ± 6.1	70.2 ± 12.0	- 0.57 (- 0.98, - 0.16)	63.9 ± 5.0	68.6 ± 10.4	- 0.48 (- 0.89, -0.07)
Fat mass (kg)	28.4 ± 4.6	32.4 ± 6.9	- 0.61 (- 1.02, - 0.19)	29.3 ± 3.8	31.7 ± 6.33	- 0.40 (- 0.81, 0.007)
Body fat (%)	46.5 ± 5.6	45.3 ± 4.3	0.26 (- 0.14, 0.67)	45.3 ± 0.5	46.5 ± 5.6	- 0.22 (- 0.63, 0.18)
Muscle mass (kg)	34.3 ± 3.9	37.6 ± 6.4[a]	- 0.54 (- 0.96, - 0.13)	34.3 ± 3.9	37.2 ± 5.8[b]	- 0.52 (- 0.93, - 0.11)
Lean mass (%)	54.0 ± 4.5	54.5 ± 4.5	- 0.11 (- 0.52, 0.29)	54.8 ± 4.6	54.5 ± 4.4	0.07 (- 0.34, 0.47)
Body mass index (kg/m^2)	28.5 ± 4.0	28.0 ± 2.3	0.22 (- 0.18, 0.63)	27.7 ± 3.5	27.6 ± 2.3	0.04 (- 0.36, 0.44)
Weight status % (UW,NW,OW,OB)	0/12.5/62.5/25	0/26.3/37.4/36.3		0/12.5/75/12.5	0/24.4/48.7/26.9	

*Data are expressed as mean and SD. UW: Underweight; NW: Normal-weight; OW: Overweight; OB: Obese; [a]Smokers vs non-smokers before the intervention; [b]Smokers vs non-smokers after the intervention; [c]Smokers before the intervention vs smokers after before the intervention; [d]Non-smokers before the intervention vs non- smokers after the intervention; †Calculation of the value of Cohen´s d and the effect-size correlation, using the means and standard deviations of two groups;*Statistical difference between groups $p < 0.05$.*

British Heart Foundation (36), the World Heart Federation (36), the British National Health Service (37), the United States Food and Drug Administration (38) and the European Food Safety Authority (39) claim that saturated fat constitutes a risk factor for CVD.

It has been suggested that general dietary patterns rather than single nutrients should be studied, since food items might have a synergistic and antagonistic effect on health. The Mediterranean diet has long been associated with a lower incidence of CHD and cancer, and Panagiotakos et al. have developed a diet score that incorporates the inherent characteristics of this dietary pattern (13).

Adhesion to the Mediterranean diet, as measured by the MDS, was sufficient before the intervention programme and was not modified (Table II). It has been reported that this parameter varies with age, tending to be lower among younger persons, while the older population maintains the traditional Mediterranean diet pattern (40), which is consistent with our findings. Numerous epidemiological studies have shown that good adherence to Mediterranean dietary patterns is systematically associated with a significantly lower risk of various chronic diseases, neurodegenerative diseases, some cancers, overweight and obesity, etc. (41-45), and in general with greater nutritional adequacy (46), longevity and quality of life (47). In a cohort of 380,296 American men and women, greater versus lower adhesion to a Mediterranean dietary pattern was associated with 22% lower cardiovascular mortality (48). Similar findings have been reported for adherence to the Mediterranean dietary pattern and a reduced risk of incident CHD and stroke (49).

In plasma, this dietary pattern is reflected in the acquisition of adequate serum levels, as recommended by the American Heart Association, for certain biochemical parameters. In our study population, these parameters remained unchanged after the intervention. It should be noted that high levels of HDLC were maintained, which may be related to the high consumption of olive oil in southern Spain (Table II). According to previous studies, HDLC levels are significantly higher in premenopausal and postmenopausal women compared with age-matched men ($p > 0.001$). Therefore, this may be considered a gender-specific protective factor (50).

With respect to weight status, there was a decrease of 10% among the obese women in our study population after the intervention programme. As energy intake did not decrease, this result suggests that energy expenditure increased due to the exercise element of the intervention programme, which leads us to conclude that to this extent the programme was effective.

Body mass index (BMI) (Table II) did not vary significantly after the intervention. On average, the women in the study group were classed as overweight, and presented no correlation between BMI and energy intake. The menopause stage favours fat accumulation. Thus, menopausal women often gain around 10% of their pre-menopause weight. We studied Spanish and Moroccan menopausal women, observing a prevalence of 80% of overweight and obesity (51). Similar results have also been found in Scandinavian women (52) and in women of this age group living in southern Spain (53).

Moreover, body fat is redistributed during menopause. Fat, which was previously deposited in thighs, hips and breasts in a more peripheral and typically female distribution, with the onset of oestrogen deficiency becomes preferentially deposited in the waist and abdomen. That is, it acquires a central distribution, as it is typical of the male population. The effects of these changes are not only aesthetic; weight gain and the central distribution of fat are considered risk factors for cardiovascular disease (54).

Among the sociodemographic and lifestyle characteristics under study (Table I), smoking has the strongest influence on the parameters recorded. Although the women participating in this study were not persuaded to give up smoking, their metabolic parameters and physical health were improved following the intervention programme.

Smoking is the main avoidable cause of disease, disability and premature death among the Spanish population. It has been reported that the number of smokers has increased more rapidly among women than among men (55). In addition, research results suggest that the atherogenic effect of smoking may be enhanced during the menopausal transition, due to impaired reparative vascular processes, impaired reverse cholesterol transport and the rapidly changing status of the sex hormones (56).

Scientific evidence shows that smokers' diet is generally less appropriate than that of non-smokers. It has been hypothesised, although this is difficult to establish conclusively, that smokers are less concerned for their health, and thus take less interest in dietary issues (57-58). Smoking can modify food preferences, taste and, ultimately, eating habits. The smoking population tends to be more sedentary, with the corresponding nutritional implications, due to the very act of smoking (59).

In view of the known relationship between smoking and the increased prevalence of various diseases, an educational intervention programme focused on nutrition, exercise and healthy living habits could help counteract the harmful effects of smoking. In the present study, before the intervention, the smokers consumed more protein (in excess of recommended levels) and less polyunsaturated fat ($p < 0.008$) than the non-smokers. After the intervention, however, these parameters were comparable among the two groups of women. In addition, after the intervention the consumption of saturated fat fell by 44% among smokers, but by only 19% among non-smokers. We observed an initially negative correlation ($r = - 0.241$, $p < 0.05$) between MDS and smoking, which had disappeared following the intervention programme.

Several epidemiological studies have reported that smoking status is strongly associated with the prevalence of metabolic disorders in women (60). At the outset of the present study, TG, TC and LDLC were significantly lower in non-smokers, but these differences disappeared after the intervention. In both groups of women, TC levels were higher than recommended, but were significantly higher among the smokers. Table III shows that following the educational intervention differences in the serum values disappeared. This improvement among the non-smokers is associated with a reduced risk of their developing metabolic disorders.

In general, smokers have a lower BMI than non-smokers (61-62) but in the present study no significant differences were found

in body weight or composition. After the intervention, the number of women with obesity had fallen by 12.5% and 9.4% among the smokers and non-smokers respectively.

Regarding the influence of the intervention on lifestyle, the female smokers who participated in this study, despite not having given up smoking, appeared to be more inclined to change their unhealthy lifestyle habits. The educational intervention resulted in improvements in the percentage of energy provided by protein, in the quality of fat consumed and in serum profile, and the number of obese women decreased significantly, to a greater extent than among the non-smokers. Among the non-smokers, protein intake became more appropriate and the quality of fat consumed was improved.

CONCLUSIONS

The postmenopausal women assessed in this study presented good adhesion to the MDS. Improvements in the quality of their diet, following the intervention programme, are reflected in the caloric profile and anthropometric measurements obtained. The intervention had a more evident effect among smokers, whose lipid profile was significantly enhanced and who also presented a higher reduction in the percentage of obesity.

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REFERENCES

1. Asociación Española para el Estudio de la Menopausia. http://www.aeem.es/quees.asp (Accessed December 1, 2008).
2. Cassidy A. Diet and menopausal health. Nurs Stand 2005;19(29):44-52.
3. Pischon T, Nothlings U, Boeing H. Obesity and cancer. Proc Nutr Soc 2008;67(2):128-45.
4. Mataix J. Nutrición y alimentación humana: nutrientes y alimentos. Madrid: Ergón; 2009.
5. Dubnov-Raz G, Pines A, Berry EM. Diet and lifestyle in managing postmenopausal obesity. Climacteric 2007;10(2):38-41.
6. Úbeda N, Basagoiti M, Alonso-Aperte E, Varela-Moreiras G. Hábitos alimentarios, estado nutricional y estilos de vida en una población de mujeres menopáusicas españolas. Nutr Hosp 2007;22(3):313-21.
7. Higgins MM. A call for research: what works when teaching older adults to improve their nutrition practices?. J Am Diet Assoc 2004,104(1):69.
8. Manios Y, Moschonis G, Katsaroli I, Grammatikaki E, Tanagra S. Changes in diet quality score, macro- and micronutrients intake following a nutrition education intervention in postmenopausal women. J Hum Nutr Diet 2007a;20:126-31.
9. Ministry of Health and Consumer Affairs. Encuesta nacional de salud. Madrid; 1977.
10. Bingham SA, Cassidy A, Cole TJ, Welch A, Runswick SA, Black AE, et al. 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.
11. Gómez J, Montellano MA, García L, Llopis J. Manual de fotografías para encuestas alimetarias. Granada: Servicio de Publicaciones de la Universidad de Granada; 1992.
12. Mataix J, Mañas M, Llopis J, Martínez de Victoria E, Juan J, Borregón A. Tablas de composición de alimentos españoles. Granada: Universidad de Granada; 1998.
13. 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.
14. Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute scientific statement. Circulation 2005;112(17):2735-52.
15. Malavolti M, Mussi C, Poli M, Fantuzzi AL, Salvioli 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;30:380-91.
16. Sidney S, Rosamond WD, Howard VJ, Luepker RV. The "Heart Disease and Stroke Statics-2013 Update" and the need for a national cardiovascular surveillance system. Circulation 2013:49.
17. Consejería de Salud. Valoración del estado nutricional de la Comunidad Autónoma Andaluza. Consejería de Salud; 2000.
18. Wordl Health Organization (WHO), Food an Agriculture Organization (FAO). Diet, Nutrition an the Prevention or Chronic Diseases. Report of a Join WHO/FAO Expert Consultation. World Health Organ Tech Rep Ser 2003, 916:i-vii;1-149.
19. 1WHO Regional Office for Europe. Health-for-All Database (HFA-DB). Copenhagen, WHO Regional Office for Europe 2007. Available at http://www.euro.who.int/hfadb.
20. Llopis J, Mataix J**.** Hueso y dieta. Nutrición y salud ósea. Granada: Puleva Food; 2004.
21. Surdykowski AK, Kenny AM, Insogna KL, Kerstetter JE. Optimizing bone health in older adults: the importance of dietary protein. Aging health 2010;6(3):345-57.
22. Aranda P, Aparicio VA. Proteins. In: Libro Blanco de la Nutrición en España. Fundación Española de Nutrición (FEN); 2013. p. 125-34.
23. Mann J, Cummings JH, Englyst HN, Key T, Liu S, Riccardi G, et al. FAO/WHO scientific update on carbohydrates in human nutrition: conclusions. Eur J Clin Nut 2007;61(1):S132-7.
24. Marshall TA. Dietary Guidelines for Americans, 2010: an update. J Am Dent Assoc 2011;142(6):654-6.
25. Ministerio de Agricultura, Alimentación y Medio Ambiente. Datos sobre el Consumo alimentario en España. Available at: http://www.magrama.es/es/alimentacion/temas/consumo-y-comercializacion y-distribucion-alimentaria/panel-de-consumo-alimentario/ultimos-datos/ default.aspx.
26. Ruiz-Roso B, Pérez-Olleros L. Avance de resultados sobre el consumo de fibra en España y beneficios asociados a la ingesta de fibra insoluble. Rev Esp Nutr Com 2010;16(3):147-53.
27. Elmadfa I, ed. European Nutrition and Health Report 2009. Vol. 62. Forum of Nutrition; 2009.
28. Ros E. Guía para una alimentación cardiosaludable. Aporte de grasa**.** In: Guías Alimentarias para la población española. Recomendaciones para una dieta saludable. Sociedad Española de la Nutrición Comunitaria. Madrid: IM&C, S. A.; 2001. p. 413-21.
29. Mataix J, Lopez-Frias M, Martinez-de-Victoria E, Lopez-Jurado M, Aranda P, Llopis J. Factors associated with obesity in an adult Mediterranean population: influence on plasma lipid profile. J Am Coll Nutr 2005;24(6):456-65.
30. Siri-Tarino PW, Sun Q, Hu FB, Krauss RM**.** Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease. Am J Clin Nutr 2010;91(3):535-46.
31. Diet, nutrition and the prevention of chronic diseases. World Health Organ Tech Rep Ser 2003, 916:i-viii, 1-149, backcover.
32. Kris-Etherton PM, Innis S, Ammerican Dietetic Asocition, Dietitians of Canada. Position of the American Dietetic Association and Dietitians of Canada: dietary fatty acids. J Am Diet Assoc 2007;107(9):1599-611.

33. Food Fact Sheet – Cholesterol. British Dietetic Association; 2010. Available at: www.bda.uk.com/foodfacts/ cholesterol.
34. Frequently Asked Questions about Fats. American Heart Association 2011. Available at: http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Frequently-Asked-Questions-About-Fats_UCM_306069_Article.jsp.
35. Roger VL, Go AS, Lloyd-Jones DM, Benjamin EJ, Berry JD, Borden WB, et al. Heart Disease and Stroke Statistics—2012 Update A Report from the American Heart Association. Circulation 2012;125(1):e2-e220.
36. Fox K, Poole-Wilson P, Clayton T, Henderson R, Shaw T, Wheatley D, et al. 5-year outcome of an interventional strategy in non-ST-elevation acute coronary syndrome: the British Heart Foundation RITA 3 randomised trial. The Lancet 2005;366(9489):914-20.
37. Luepker RV, Apple FS, Christenson RH, Crow RS, Fortmann SP, Goff D, et al. Case definitions for acute coronary heart disease in epidemiology and clinical research studies a statement from the AHA council on epidemiology and prevention; AHA statistics committee; World heart federation council on epidemiology and prevention; the European Society of Cardiology Working Group on Epidemiology and Prevention; Centers for Disease Control and Prevention; and the National Heart, Lung, and Blood Institute. Circulation 2003;108(20):2543-9.
38. U.S. FDA. Draft guidance for industry and FDA Staff Heart valves-investigational device exemption (IDE) and premarket approval (PMA) applications 2010.
39. Hoenselaar R. Saturated fat and cardiovascular disease: the discrepancy between the scientific literature and dietary advice. Nutrition 2012;28(2): 118-23.
40. Evaluación nutricional de la dieta española. I. energía y macronutrientes. Sobre datos de la Encuesta Nacional de Ingesta Dietética (ENIDE). Available at: http://www.aesan.msc.es/AESAN/docs/docs/evaluacion_riesgos/estudios_evaluacion_nutricional/valoracion_nutricional_enide_macronutrientes.pdf.
41. Serra-Majem L, Roman B, Estruch R. Scientific evidence of interventions on the Mediterranean Diet: a systematic review. Nutr Rev 2006;64:27-47.
42. 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.
43. Martinez-Gonzalez MA, Bes-Rastrollo M, Serra-Majem L, Lairon D, Estruch R, Trichopoulou A. Mediterranean food pattern and the primary prevention of chronic disease: recent developments. Nutr Rev 2009;67(1):111-6.
44. Vernele L, Bach-Faig A, Buckland G, Serra-Majem L. Association between the Mediterranean diet and cancer risk: a review of observational studies. Nutr Cancer 2010;62(7):860-70.
45. Serra-Majem L, Bes-Rastrollo M, Román B, Pfrimer K, Sánchez- Villegas A, Martínez-González MA. Dietary patterns and nutritional adequacy in a Mediterranean country. Br J Nutr 2009;101(2):21-8.
46. Trichopoulou A, Costacou T, Bamia C and Trichopoulos D. Adherence to a Mediterranean diet and survival in a Greek population. N Engl J Me 2003;348:2599-608.
47. Mitrou PN, Kipnis V, Thiebaut A, Reedy J, Subar AF, Wirfalt E, et al. Mediterranean dietary pattern and prediction of all-cause mortality in a US population: results from the NIH-AARP Diet and Health Study. Arch Intern Med 2007;167(22):2461.
48. Fung TT, Chiuve SE, McCullough ML, Rexrode KM, Logroscino G, Hu FB. Adherence to a DASH-style diet and risk of coronary heart disease and stroke in women. Arch Intern Med 2008;168(7):713-20.
49. Collins P. HDL-C in post-menopausal women: an important therapeutic target. Int J cardiol 2008;124(3):275-82.
50. Aparicio VA, Ortega FB, Carbonell-Baeza A, 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.
51. Aparicio VA, Carbonell-Baeza A, Ruiz JR, Aranda P, Tercedor P, Delgado-Fernández M, et al. Fitness testing as a discriminative tool for the diagnosis and monitoring of fibromyalgia. Scand J Med Sci Sports 2013;23(4):415-23.
52. Mataix J, López-Frías M, Martínez-de-Victoria E, López-Jurado M, Aranda P, Llopis J. Factors associated with obesity in an adult Mediterranean population: influence on plasma lipid profile. J Am Coll Nutr 2005;24(6):456-65.
53. Rosano GM, Vitale C, Marazzi G, Volterrani M. Menopause and cardiovascular disease: the evidence. Climacteric 2007;10(1):19-24.
54. Grau M, Subirana I, Elosua R, Solanas P, Ramos R, Masiá R, et al. Trends in cardiovascular risk factor prevalence (1995-2000-2005) in northeastern Spain. Eur J Cardiovasc Prev Rehabil 2007;14:653-59.
55. Pitha J, Lesná K, Sekerkova A, Poledne R, Kovář J, Lejsková M, et al. Menopausal transition enhances the atherogenic risk of smoking in middle aged women. Int J Cardiol 2013;168(1):190-6.
56. Ortega R. Nutrición del fumador. In: Nutriguía. Madrid: Editorial Complutense; 2000. p. 322-31.
57. Dallongeville J, Marécaux N, Fruchart J-C, Amouyel P. Cigarette smoking is associated with unhealthy patterns of nutrient intake: a meta-analysis. J Nutr 1998;128(9):1450-7.
58. Informe del Comité Científico de la AESA sobre el impacto del consumo de tabaco en la alimentación y la nutrición. Revista del comité científico 2006:31-54. AESA-2006-002.
59. Kwaśniewska M., Pikala M., Kaczmarczyk-Chałas K, Piwonńska A, Tykarski A, Kozakiewicz K, et al. Smoking status, the menopausal transition, and metabolic syndrome in women. Menopause 2011;19(2),194-201.
60. Chatkin R, Mottin CC, Chatkin JM. Smoking among morbidly obese patients. BMC Pulm Med 2010;10:61-6.
61. Chatkin R, Mottin CC, Chatkin JM. Smoking among mozbidly obese patiens. BMC Pulm Med 2010;10:61-6.
62. Chiolero R, Faeh D, Paccand F, Cornuz J. Consequences of smoking for body weight, body fat distribution, and insulin resistance. Am J Clin Nutr 2008;87(4):801-9.