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pacientes con obesidad severa  
antes de la cirugía bariátrica**

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## **OR 2239 OBESIDAD Y SÍNDROME METABÓLICO**

### **Characterization of the pattern of food consumption in severely obese patients prior to bariatric surgery**

*Caracterización del patrón de consumo de alimentos en pacientes con obesidad severa antes de la cirugía bariátrica*

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#### **ABSTRACT**

**Introduction:** severe obesity is increasing rapidly in several countries, as well as the number of bariatric surgeries performed.

However, the pattern of food consumption of the population is not well defined.

**Objectives:** the aim of the present study was to describe the food consumption pattern (comparing men and women) of severely obese patient candidates to bariatric surgery and to determine the promoting and protecting factors.

**Methods:** food consumption and nutrient intake were measured by a validated food frequency questionnaire (FFQ), including food and beverages. Multivariate principal component analysis (PCA) was done to analyze the component that best relates to the food pattern consumption dividing the different food groups in promoters and protectors.

**Results:** significant differences in the food consumption pattern of men and women with severe obesity addressed for bariatric surgery were found. A positive correlation was found between the food groups that are protective factors for obesity such as the fiber ( $r = 0.84$ ), vegetables ( $r = 0.767$ ) and fruits ( $r = 0.83$ ), whereas a negative correlation was found with those factors that are promoters of obesity such as fats ( $r = -0.341$ ), saturated fats ( $r = -0.411$ ), soft drinks ( $r = -0.386$ ), and fast food ( $r = -0.17$ ). Multivariate analysis of principal components revealed that calorie consumption is the component that correlates better with the pattern.

**Conclusions:** there are significant differences in the food consumption pattern of men and women with severe obesity addressed for bariatric surgery and these differences should be taken into account when planning nutritional intervention. Therefore, a healthy lifestyle behaviour should be highly encouraged among the severe obese population.

**Key words:** Food intake patterns. Surgery for obesity. Severe obesity. Dietetic support. Food preferences.

## **RESUMEN**

**Introducción:** la obesidad mórbida así como el número de cirugías bariátricas que se practican van en aumento en varios países. Sin embargo, el patrón de consumo alimentario de estos pacientes no está bien definido.

**Objetivos:** describir el patrón de consumo de alimentos (comparando hombres y mujeres) de pacientes con obesidad severa candidatos a cirugía bariátrica y determinar los factores promotores y protectores de la obesidad.

**Métodos:** el consumo de alimentos y la ingesta de nutrientes se midieron mediante un cuestionario de frecuencia de consumo de alimentos validado que incluye alimentos y bebidas. Se realizó un análisis multivariado de componentes principales para determinar qué componente se relaciona mejor con el consumo de patrones alimentarios promotores y protectores de obesidad.

**Resultados:** el estudio mostró diferencias significativas en el patrón de consumo de alimentos entre hombres y mujeres. Se encontró una correlación positiva entre los grupos de alimentos considerados factores de protección para la obesidad, como la fibra ( $r = 0,84$ ), las verduras ( $r = 0,767$ ) y las frutas ( $r = 0,83$ ), mientras que la correlación fue negativa con los factores promotores de la obesidad como las grasas ( $r = -0,341$ ), las grasas saturadas ( $r = -0,411$ ), los refrescos ( $r = -0,386$ ) y la comida rápida ( $r = -0,17$ ). El análisis multivariado de los componentes principales reveló que el consumo de calorías es el componente que se correlaciona mejor con el patrón.

**Conclusiones:** existen diferencias significativas en el patrón de consumo de alimentos entre hombres y mujeres con obesidad severa y estas deben tenerse en cuenta al planificar la intervención nutricional. Asimismo, un consumo alimentario saludable debe promocionarse en la población obesa.

**Palabras clave:** Patrones de ingesta alimentaria. Cirugía bariátrica. Obesidad severa. Soporte dietético. Preferencias alimentarias.

## **INTRODUCTION**

The prevalence of severe obesity (defined as body mass index [BMI]  $\geq 40.0$  kg/m<sup>2</sup>) is increasing alarmingly in different developed countries in the last years (1,2). However, the reasons for the rapid increase or the possible determinant factors are not well understood. Relatively few works exist addressed to study lifestyle behaviors of severely obese individuals (such as promoting/protecting factors [3] or consumption of certain food [4,5]), depending on gender. No study was found that characterizes the pattern of food consumption for men and women with morbid obesity prior to bariatric surgery.

Severe obesity entails far more serious health consequences than moderate obesity and is linked with impaired quality of life and health-care spending (6). Nowadays, bariatric surgery procedures are the most successful and durable treatments for severe obesity, as they lead to a significant and sustained weight loss and an improvement in obesity-related comorbid conditions and quality of life (7). Nevertheless, bariatric surgery is not exempt from certain risks (8) and lifestyle behaviors and food pattern identification for planning effective and early preventive interventions for severe obesity remains essential. However, there is little research directly assessing in a globally manner the association between food consumption pattern and severe obesity (4,5,9).

Therefore, the aim of the present study was to describe the food consumption pattern (comparing men and women) of severely obese patient candidates to bariatric surgery and to determine the promoting and protecting factors.

## **PATIENTS AND METHODS**

An observational study was conducted comprising 163 (109 female) severely obese patients who were candidates for bariatric surgery. Their mean age was 45 for both men and women and the BMI was  $44.9 \pm 6.1$  for men and  $45.6 \pm 5.6$  for women ( $p = 0.06$ ); hypercholesterolemia was found in 31.7% of men and 19.9% of

women ( $p = 0.06$ ); hypertension was found in 85% of men vs 72.4% of women ( $p = 0.04$ ); diabetes mellitus was found in 28.3% of men vs 19.9% of women ( $p = 0.18$ ); and smoking habits were present in 25% of men vs 32.1% of women ( $p = 0.31$ ). Patients were recruited from our reference center and all of them met the bariatric surgery criteria of the National Institutes of Health (10). Subjects provided written informed consent for the procedure and the study protocol was approved by the ethical review board of our institution.

Anthropometric measures such as body weight and height were taken. Individuals wore underwear. BMI was determined as weight divided by height squared ( $\text{kg}/\text{m}^2$ ).

Food consumption and nutrient intake were measured by a validated food frequency questionnaire (FFQ) (11) administered by a trained interviewer. The FFQ comprised 165 items, including food and beverages. For each food item, participants were asked about their usual consumption of the nine frequency categories, ranging from never or less than once per month to six or more times per day. The FFQ included frequency of consumption of soft drinks (sugar-sweetened carbonated beverages) and fast food products (hamburger, cheeseburger or similar and French fries). A revised Goldberg method (12) was used to identify implausible energy reporters.

The Mediterranean diet score was coded as follows: mMDS: low = 3 (1<sup>st</sup> tertile mMDS), medium = 2 (2<sup>nd</sup> tertile mMDS), and high = 1 (3<sup>rd</sup> tertile mMDS).

Categorical variables were expressed as percentage and 95% confidence interval and continuous variables as mean and standard deviation or the median and interquartile range. Differences in normally and non-normally distributed continuous variables were compared using the Student's t-test and the Mann-Whitney U test, respectively. Categorical variables were compared using the  $\chi^2$  test. Multivariate principal component analysis (PCA) was done to analyze the component that best relates to the food pattern consumption

dividing the different food groups in promoters and protectors. For all of the analyses, a p-value < 0.05 was considered as statistically significant, and they were conducted using SPSS for Windows (version 20.0) statistical software package (SPSS Inc., Chicago, Ill., USA).

## RESULTS

No significant differences were found between the two groups for age ( $p = 0.8$ ) and BMI ( $p = 0.06$ ), whereas height, weight and glycaemia values were higher among men ( $p < 0.001$ ,  $p < 0.001$  and  $p = 0.001$ , respectively).

Lower intakes of fruits ( $p = 0.006$ ), dairy products ( $p = 0.087$ ), vegetables ( $p = 0.003$ ), nuts ( $p = 0.853$ ), fish ( $p = 0.04$ ) and Olive oil ( $p = 0.02$ ) were observed among men, whereas the contrary was found for Spanish food ( $p = 0.038$ ), soft drinks ( $p = 0.214$ ) and fast food ( $p = 0.18$ ) (Table I). Additionally, men reported lower intakes of calories, cholesterol and fiber ( $p = 0.04$ ,  $p = 0.03$  and  $p = 0.001$ , respectively) (Table I). In the multivariate components analysis, we found that there are two principal components that explain about 70% of variability.

The first component that best correlates to the food pattern consumption is the consumption of calories ( $r = 0.997$ ) and it explains about 40% of variability, whereas the second factor correlates with the diet quality. There is a positive correlation between the food groups that are protective factors for obesity such as the fiber ( $r = 0.84$ ), vegetables ( $r = 0.767$ ) and fruit ( $r = 0.83$ ), and a negative correlation with those factors that are promoters of obesity such as fats ( $r = -0.341$ ), saturated fats ( $r = -0.411$ ), soft drinks ( $r = -0.386$ ), and fast food ( $r = -0.17$ ). The protective factors are associated to the Mediterranean food consumption pattern whereas the promotor factors of obesity are related to a more occidental food consumption pattern (Fig. 1).

## DISCUSSION

The main result of our study indicates that there are significant differences in the food consumption pattern of men and women with severe obesity addressed for bariatric surgery. In other words, the consumption of the different foods and nutrients show significant differences that should be taken into account when planning nutritional intervention. Moreover, a very interesting finding of our study is the relation of the food pattern and the presence of obesity. This finding is in accordance with other cohort studies indicating a favorable and additive effect of lifestyle variables on disease outcomes (13,14). However, and as far as we are aware, this is the first study that has investigated the food pattern differences between men and women with severe obesity.

Regarding quality diet, it is well established that a low adherence to a Mediterranean diet is a risk factor for high prevalence of obesity (15,16). However, studies addressed specifically to a Mediterranean diet and severe obesity are still lacking. In the current study, both groups (men and women) come from a Mediterranean population, but the food consumption related to the Mediterranean diet differs significantly between them. We found that men showed a lower consumption of fruits, dairy products, vegetables and nuts and a higher consumption of fast food and soft drinks than women. This data suggests that severely obese men drift more from a healthy diet pattern than women with a similar BMI.

A previous study (4) had similar outcomes in severe obese patients, concluding that relatively high rates of fast food consumption (three times per week or more) are connected to an increasing rate of severe obesity. Non-specific studies have been done relating consumption of soft drinks and severe obesity, but it is quite well established that an elevated consumption of sugar-sweetened beverages is strongly associated with positively weight changes (17). Specifically, Malik et al. (18) demonstrated that an increase of one-serving per day in sugar-sweetened beverages was associated to an additional weight gain of 0.12-0.22 kg over one year in adults. So,



moderate consumption of those food products may exert an important role in preventing obesity.

The current study reinforces the importance of healthy lifestyle behaviors also in obese patients as they play a crucial role in preventing an increase in obesity degree. Moreover, and from a clinical point of view, the identification of such obesogenic lifestyle behaviors and food pattern consumption especially matters in severe obese facing bariatric surgery since the risk of regaining weight after the first two years of surgery depends partially on dietary and lifestyle behaviors (19). However, some limitations of our design and methods should be acknowledged. Food frequency questionnaires measuring past food intake are vulnerable both to random and systematic measurement errors. Although care was taken to provide clear instructions on how to fill out the form, some misreporting cannot be ruled out. Nonetheless, this study has several important strengths, including the high number of severely obese patients participating in the study. Additionally, dietary intake data was recorded using validated questionnaires.

In summary, we have showed that the consumption of different foods and nutrients is different between men and women and should be taken into account when planning nutritional intervention. The current findings might help in the development of public health strategies and are aimed at controlling the alarming increase of severe obesity.

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**Table I. Food group and nutrient daily intake in men and women with severe obesity**

	Men*	Women†	p-value
<i>Food groups</i>			
Fruits	101.4 (80.7;122.1)	141.5 (121.7;161.2)	0.006
Vegetables	134.9 (103.1;166.7)	189.6 (170.5;208.7)	0.003
Cereal	77.6 (69.3; 85.8)	71.5 (66.4; 76.6)	0.214
Fish	26.9 (22.1; 31.9)	29.5 (25.7; 33.3)	0.424
Meat	86.6 (77.2; 96.1)	90.6 (84.4; 96.8)	0.495
Dairy products	130.3 (102.1; 158.6)	107.9 (96.2; 119.7)	0.087
Olive oil	8.8 (7.1; 10.5)	11.2 (9.9; 12.3)	0.029
Legumes	14.6 (9.5; 20.8)	15.8 (9.5; 24.6)	0.222
Nuts	1.7 (0; 3.4)	1.8 (0; 3.6)	0.853
Fruit juices	3.3 (0; 15.3)	7.1 (0; 25.1)	0.177
Spanish food‡	18.7 (15.4; 22.1)	15.1 (13.3; 16.8)	0.038
Fast food	4.1 (2.1; 6.1)	2.6 (1.7; 3.5)	0.187
Carbonated drinks	11.1 (0; 88.3)	8.7 (0; 52.8)	0.214
<i>Energy and nutrients</i>			
Energy, kcal	2604.2 (2370.8; 2837.7)	2926.6 (2719.1; 3134.1)	0.042
Carbohydrates§, %	38.6 (36.7; 40.4)	38.2 (37.1; 39.3)	0.748
Protein§, %	18.6 (17.8; 19.5)	19.1 (18.5; 19.8)	0.377
Fat§, %	42.3 (40.7; 43.8)	43.6 (42.5; 44.7)	0.190
Saturated fat§, %	13.2 (12.6; 13.8)	13.1 (12.6; 13.4)	0.592
Monounsaturated fat§, %	20.1 (19.1; 21.2)	21.3 (20.6; 22.1)	0.082
Polyunsaturated fat§, %	6.2 (5.7; 6.8)	6.5 (6.2; 6.9)	0.400
Cholesterol	433.1 (387.1; 479.2)	505.3 (457; 553.6)	0.033
Dietary fiber	8.2 (7.2; 9.1)	10.1 (9.4; 10.9)	0.001

\*Data are given either in median and 25<sup>th</sup> and 75<sup>th</sup> percentiles or in mean and standard deviation, as appropriate. Units as indicated or in g of nutrient/1,000 kcal. \*Men. †Women. ‡Including “*paella*” (traditional rice dish either with meat, fish, or seafood) and “*canelones*” (traditional dish of pasta stuffed with meat in a *bechamel* sauce). §% of energy intake.

**Nutrición  
Hospitalaria**

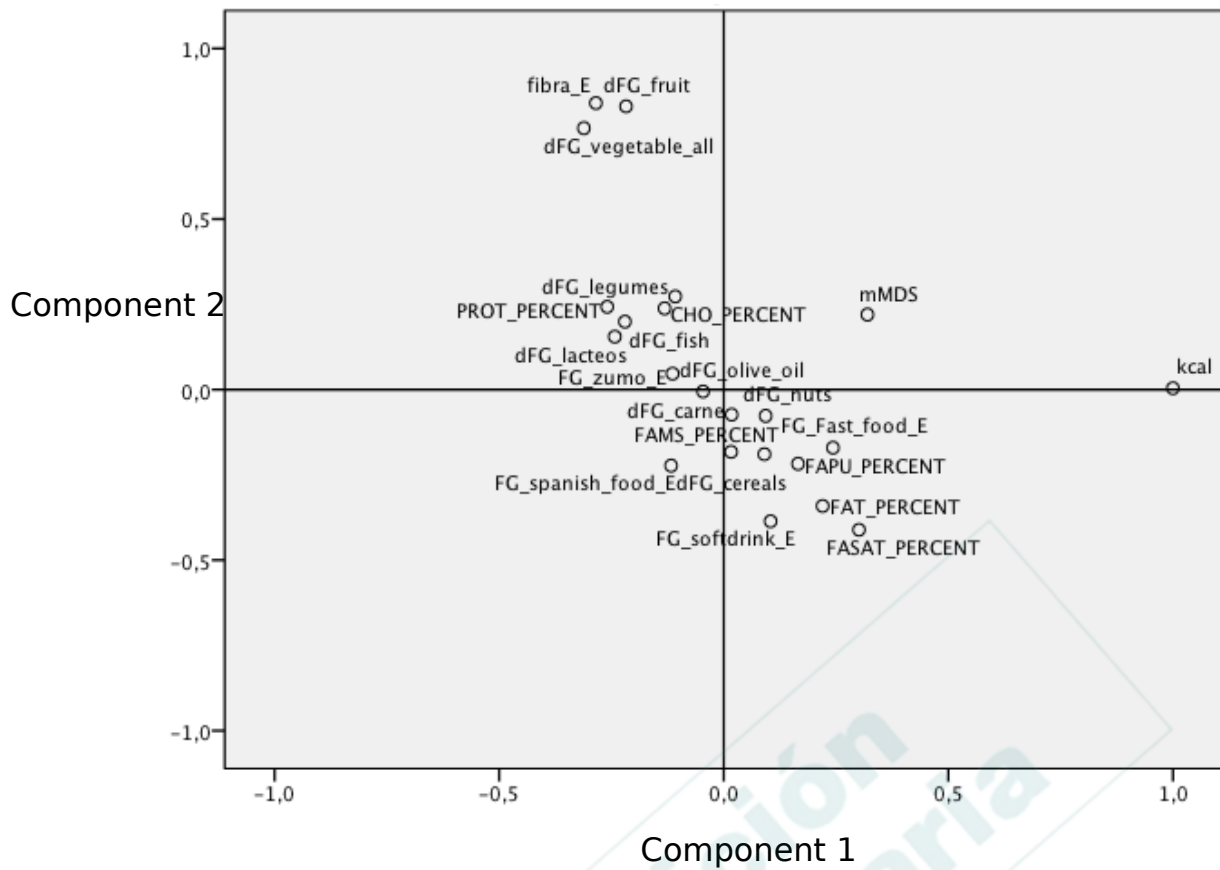


Fig. 1. Multivariate principal component analysis. Two extracted components. Only female cases were used in the analysis.