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ORIGINAL

Influence of sociodemographic variables and healthy habits on the values of overweight and obesity scales in 386,924 Spanish workers

Influencia de variables sociodemográficas y hábitos saludables en los valores de escalas de sobrepeso y obesidad en 386,924 trabajadores españoles

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Abstract

Introduction: Obesity is a highly prevalent chronic and multifactorial disease that is generally associated with an increased cardiometabolic risk.
Objective: In this study we are interested in assessing the effect of different sociodemographic variables and healthy habits on the values of different scales that assess overweight and obesity.
Methodology: A descriptive, cross-sectional study was carried out in 386,924 Spanish workers to assess the effect of different sociodemographic variables (age, sex, social class, level of education) and healthy habits (physical activity, Mediterranean diet and tobacco consumption) on the values of scales that determine overweight and obesity on the basis of different criteria.
Results: All the variables analyzed increased the risk of presenting obesity with any of the criteria except educational level. The most influential variables were physical activity and Mediterranean diet.
Conclusions: The risk profile of presenting obesity corresponds to that of an elderly male, with a low socioeconomic level, sedentary, with low adherence to the Mediterranean diet and a smoker.

Key words: Obesity, physical activity, Mediterranean diet, sociodemographic variables, smoking.

Resumen

Introducción: La obesidad es una enfermedad crónica y multifactorial altamente prevalente y que generalmente se asocia a un incremento del riesgo cardiometabólico.
Objetivo: En este estudio nos interesa valorar el efecto de diferentes variables sociodemográficas y hábitos saludables en los valores de diferentes escalas que valoran sobrepeso y obesidad. Metodología. Se realiza un estudio descriptivo y transversal en 386,924 trabajadores españoles en los que se valora el efecto de distintas variables sociodemográficas (edad, sexo, clase social, nivel de estudios) y hábitos saludables (actividad física, dieta mediterránea y consumo de tabaco) en los valores de escalas que determinan sobrepeso y obesidad en base a diferentes criterios.
Resultados: Todas las variables analizadas incrementan el riesgo de presentar obesidad con cualquiera de los criterios excepto el nivel de estudios. Las variables que más influyen son la actividad física y la dieta mediterránea.
Conclusiones: El perfil de riesgo de presentar obesidad responde al de un varón de edad avanzada, con un nivel socioeconómico bajo, sedentario, con baja adherencia a la dieta mediterránea y fumador.

Palabras clave: Obesidad, actividad física, dieta mediterránea, variables sociodemográficas, tabaco.

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Introduction

Obesity is considered a progressive and chronic pathology[1] that can have biological[2], psychological[3] and even social[4] repercussions on the life course of individuals. This disease is associated with an increase in the risk of suffering cardiovascular disorders[5], and also with an increase in mortality[6] and a decrease in the quality of life[7].

The World Health Organization (WHO) considers obesity to be an excessive or abnormal accumulation of fatty tissue that can cause health problems[8].

There are different factors that have been associated with the appearance of obesity, including sedentary lifestyle[9], poor diet[10], stress[11], poor quality[12] or insufficient number of hours of sleep[13], genetic causes[14], consumption of certain drugs (antidepressants[15], antipsychotics[16] or corticoids[17]) or pathologies such as polycystic ovary disease[18] among others.

Many scales have been used to classify obesity, some of which evaluate anthropometric parameters such as height and weight (body mass index BMI[19]), waist circumference (waist/height index[20]), or hip circumference (body adiposity index BAI[21]). Others are based on the estimation of body fat (Clínica Universitaria de Navarra body fat estimator CUN BAE[22]) or visceral fat (visceral fat metabolic score METS-VF[23]).

Methods

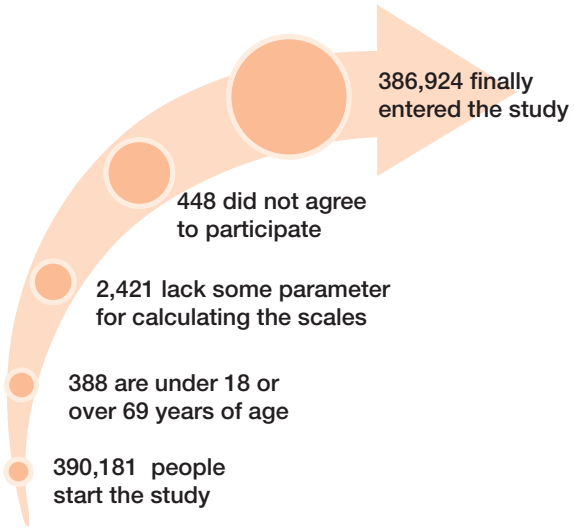
This work is based on an observational, cross-sectional and descriptive study carried out on 386,924 workers from different Spanish autonomous communities. The 60.2% (232,814 people) are men and 39.8% (154,110 people) are women. The workers included in this study are derived from those who attend the medical check-ups carried out periodically in all the participating companies. The study period covers the period January 2019 and June 2020.

In order to make the final selection of the sample, some inclusion criteria are established:

- To be between 18 and 69 years of age.
- To have an employment contract in one of the participating companies.
- Accept to be included in the study.
- Accept the transfer of the use of the data for epidemiological purposes.

The data flow diagram of the workers, after applying the inclusion criteria, is shown in **figure 1**.

Figure 1: Flow-chart of participants in the study.



Determination of variables

The people who are part of the occupational health units of the participating companies were in charge of obtaining the data necessary to carry out this study. The data were collected by means of:

- Anamnesis. An exhaustive clinical history was used to collect data on sociodemographic variables (age, sex, social class and level of education) and healthy habits (tobacco, alcohol, Mediterranean diet and physical activity).
- Anthropometric and clinical determinations. These included height, weight, waist circumference, systolic and diastolic blood pressure.
- Analytical determinations. Lipid profile and glycemia were determined.

In an attempt to avoid possible biases in the study, the techniques used to measure the variables were standardized.

Height and weight were determined with the person standing and in underwear, arms hanging and thorax and head aligned. We used a SECA model scale-measuring device and the data are expressed in centimeters and kilograms.

To assess the abdominal waist circumference we use a SECA model measuring tape placed at the level of the last floating rib and parallel to the floor. The person is standing with the abdomen relaxed. The hip circumference is also measured in this position and placing the tape measure also parallel to the floor at the level of the widest part of the buttocks.

Blood pressure is obtained with an OMROM-M3 blood pressure monitor. For a correct assessment the person is seated and must be at rest for at least 10 minutes. The

cuff is placed around the arm until it fits snugly without being too tight, which is why cuffs of different sizes are available. We perform 3 consecutive determinations separated by one minute. The figure that is evaluated is an average of the three.

Blood determinations are obtained by venipuncture and after a previous fasting of 12 hours. The samples are processed and stored refrigerated for proper preservation for a period never exceeding 48-72 hours. The analysis of the samples is performed in reference laboratories that use similar methodology. Triglycerides, total cholesterol and blood glucose are determined by enzymatic techniques, while HDL cholesterol is determined by precipitation techniques. LDL cholesterol is estimated indirectly by applying the Friedewald formula, which is valid as long as triglycerides do not exceed 400 mg/dL. If the figure is higher than 400 mg/dL, LDL is determined directly. All analytical variables are expressed in mg/dL.

Sex is established as a dichotomous variable: male and female.

Age is calculated by subtracting the date of birth from the date of the medical examination.

The educational level considered is the highest of those that have been carried out in their entirety. Three levels are established: primary studies, secondary studies and university studies.

Social class will be determined by applying the criteria of the Spanish Society of Epidemiology and based on the type of work included in the 2011 national classification of occupations (CNO-11)[24]. Three levels are established:

- Social class I. This includes management personnel, professionals with university education, professional athletes and artists.
- Social class II. Includes intermediate professions and skilled self-employed workers.
- Social class III. Includes workers with low qualifications.

In our study, we consider that a person is a smoker if he or she has consumed any type of tobacco at least once a day in the last 30 days or if he or she has quit smoking less than 12 months ago.

Adherence to the Mediterranean diet was determined by applying a questionnaire[25] consisting of 14 questions scored with 0 or 1 point. Values of 9 or more points indicate high adherence[26].

The level of physical activity is determined by means of the International Physical Activity Questionnaire (IPAQ)[27]. This self-administered questionnaire quantifies the physical activity performed in the last seven days.

The overweight and obesity scales determined are:
- Body Mass Index (BMI). It is calculated by dividing the weight expressed in kilograms by the squared height expressed in meters.

It is stratified into underweight (less than 18.5 kg/m^2), normal weight (between 18.5 and 24.9 kg/m^2), overweight (between 25 and 29.9 kg/m^2) and obese (over 30 kg/m^2).
- Body adiposity index[28] (BAI)

BAI = (Hip Circumference in centimetres / Height in metres ^ 1.5) – 18

- Clínica Universitaria de Navarra body adiposity estimator[29] (CUN BAE)

-44.988 + (0.503 × age) + (10.689 × sex) + (3.172 × BMI) - (0.026 × BMI2) + (0.181 × BMI × sex) - (0.02 × BMI × age) - (0.005 × BMI2 × sex) + (0.00021 × BMI2 × age).

Male =0 Female =1.

- Metabolic score for visceral fat[30] (METS-VF)

$$METS\text{-}VF = 4.466 + 0.011*(Ln(METS\text{-}IR))^3 + 3.239*(Ln(WHtr))^3 + 0.319*(Sex) + 0.594*(Ln(Age))$$

where

Metabolic Score for Insulin Resistance (METS-IR)[31] is obtained using the formula:
METS-IR = Ln (2 x glycaemia + triglycerides) x BMI/Ln HDL-c

Considerations and ethical aspects

In this study, the ethical rules that should govern research and the 2013 Declaration of Helsinki have been fully respected. The anonymity and confidentiality of the participants has always been guaranteed. The study received the approval of the Balearic Islands Research Ethics Committee (CEI-IB), which granted its consent under number IB 483/20.

The data of each participant are coded and only the principal investigator knows who they are. Most of the researchers who participated in this study complied with Organic Law 3/2018, enacted on December 5, 2018, on the protection of personal data and guarantee of digital rights, which allows and guarantees that study participants can access, rectify, cancel, and oppose the use of the data collected at any time.

Statistical analysis

Student's t-test was used to analyze the quantitative data, which determined the means and standard deviations. When the variables were quantitative, the chi2 test was used to calculate prevalence. Multinomial logistic regression analysis was performed and odds ratios with 95% confidence intervals were calculated. Statistical analysis was performed with SPSS 28.0 software. The accepted level of statistical significance was $p<0.05$.

Results

The anthropometric, clinical, analytical, sociodemographic and healthy habits data of the 386924 workers in the study are shown in **table I**. The mean age of the participants is slightly over 39 years. With the exception of LDL cholesterol, the variables show more negative values in the group of men. A total of 60.2% are men, while 39.8% are women. The majority of the population is between 30 and 49 years old. Most belong to socioeconomic class III and have primary education. 45.5% of the men and 52.2% of the women practice physical activity regularly, and 51.4% of the women have a high adherence to the Mediterranean diet, and 41% of the men. Thirty-three percent of the women and slightly more than 37% of the men smoke.

Tables II and **III** show the mean values of the four scales that assess overweight and obesity, and it can be seen that these mean values increase in parallel with increasing age and decreasing social class and level of education. Higher values are also observed in sedentary people and those with low adherence to the Mediterranean diet. Smokers present lower mean values. All the differences observed are statistically significant. In all the scales the values are higher in men except CUN BAE.

Tables IV and **V** show the prevalence of high values for the four overweight and obesity scales in both sexes. The trend is the same as that seen for the mean values, i.e. an increase in the prevalence of high values as age increases and socioeconomic level decreases, as well as in sedentary people and those with low adherence to the Mediterranean diet. In smokers the prevalences are also lower. In all cases the differences found are also statistically significant.

Table VI presents the results of the multivariate analysis using multinomial logistic regression. In the four scales a similar pattern is followed, all the sociodemographic variables and healthy habits influence the increase in the risk of presenting high values of the different overweight-obesity scales. This risk increases with age, as one descends in social class, in people who do little physical activity and have low adherence to the Mediterranean diet, and in non-smokers.

Table I: Characteristics of the population.

	Men n=232,814 Mean (SD)	Women n=154,110 Mean (SD)	p-value
Age (years)	39.8 (10.3)	39.2 (10.2)	<0.001
Height (cm)	173.9 (7.0)	161.2 (6.6)	<0.001
Weight (kg)	81.1 (13.9)	65.3 (13.2)	<0.001
Waist circumference (cm)	87.7 (9.1)	73.9 (7.9)	<0.001
Hip circumference (cm)	100.0 (8.4)	97.2 (8.9)	<0.001
Systolic blood pressure (mmHg)	124.4 (15.1)	114.4 (14.8)	<0.001
Diastolic blood pressure (mmHg)	75.4 (10.6)	69.7 (10.3)	<0.001
Total cholesterol (mg/dl)	195.9 (38.9)	193.6 (36.4)	<0.001
HDL-c (mg/dl)	51.0 (7.0)	53.7 (7.6)	<0.001
LDL-c (mg/dl)	120.5 (37.6)	122.3 (37.0)	<0.001
Triglycerides (mg/dl)	123.8 (88.0)	88.1 (46.2)	<0.001
Glycaemia (mg/dl)	88.1 (12.9)	84.1 (11.5)	<0.001
	%	**%**	**p-value**
20-29 years	17.9	19.5	<0.001
30-39 years	33.1	33.3	
40-49 years	29.7	29.4	
50-59 years	16.3	15.3	
60-69 years	3.0	2.5	
Primary school	61.2	51.8	<0.001
Secondary school	34.0	40.7	
University	4.8	7.5	
Social class I	5.3	7.2	<0.001
Social class II	17.4	33.2	
Social class III	77.3	59.8	
Non physical activity	54.5	47.8	<0.001
Yes physical activity	45.5	52.2	
Non healthy food	59.0	48.6	<0.001
Healthy food	41.0	51.4	
Non smokers	62.9	67.0	<0.001
Smokers	37.1	33.0	

HDL-c High density lipoprotein cholesterol. LDL Low density lipoprotein cholesterol

Table II: Mean values of overweight-obesity scales according to sociodemographic variables and healthy habits in men.

Men									
		BMI		BAI		CUN BAE		METS-VF	
	n	Mean (SD)	p-value	Mean (SD)	p-value	Mean (SD)	p-value	Mean (SD)	p-value
20-29 years	41,742	25.0 (4.1)	<0.001	24.4 (3.7)	<0.001	21.1 (6.3)	<0.001	5.9 (0.5)	<0.001
30-39 years	76,96	26.5 (4.1)		25.2 (3.7)		24.6 (5.8)		6.3 (0.5)	
40-49 years	69,068	27.4 (4.1)		26.1 (3.8)		27.1 (5.4)		6.6 (0.5)	
50-59 years	38,028	27.9 (4.0)		27.0 (3.8)		28.9 (5.0)		6.8 (0.5)	
60-69 years	7,016	28.3 (3.9)		27.9 (4.0)		30.3 (4.5)		6.9 (0.4)	
Primary school	142,494	26.8 (4.3)	<0.001	25.9 (3.9)	<0.001	25.6 (6.4)	<0.001	6.4 (0.6)	<0.001
Secondary school	79,226	26.8 (4.1)		25.4 (3.7)		25.6 (6.0)		6.4 (0.6)	
University	11,094	26.6 (3.8)		25.1 (3.6)		25.5 (5.6)		6.4 (0.5)	
Social class I	12,262	26.6 (3.8)	<0.001	25.1 (3.6)	<0.001	25.5 (5.7)	<0.001	6.4 (0.5)	<0.001
Social class II	40,65	26.7 (4.0)		25.2 (3.7)		25.5 (5.9)		6.4 (0.5)	
Social class III	179,902	26.8 (4.3)		25.8 (3.9)		25.6 (6.3)		6.4 (0.6)	
Non physical activity	126,808	29.1 (4.1)	<0.001	27.1 (3.8)	<0.001	29.2 (5.4)	<0.001	6.7 (0.5)	<0.001
Yes physical activity	106,006	24.0 (2.2)		23.9 (3.1)		21.3 (4.1)		6.1 (0.5)	
Non healthy food	137,464	28.7 (4.2)	<0.001	26.9 (3.9)	<0.001	28.6 (5.7)	<0.001	6.7 (0.5)	<0.001
Healthy food	95,35	24.0 (2.2)		23.9 (3.1)		21.2 (4.1)		6.1 (0.5)	
Non smokers	146,48	27.1 (4.1)	<0.001	25.9 (3.9)	<0.001	26.2 (6.0)	<0.001	6.4 (0.6)	<0.001
Smokers	86,334	26.2 (4.3)		25.4 (3.8)		24.6 (6.4)		6.4 (0.6)	

BMI Body mass index. BAI Body adiposity index. CUN BAE Clinica Universitaria de Navarra Body Adiposity Estimator. METS-VF Metabolic Score for Visceral Fat.

Table III: Mean values of overweight-obesity scales according to sociodemographic variables and healthy habits in women.

Women									
		BMI		BAI		CUN BAE		METS-VF	
	n	Mean (SD)	p-value	Mean (SD)	p-value	Mean (SD)	p-value	Mean (SD)	p-value
20-29 years	29,978	23.8 (4.8)	<0.001	28.4 (4.7)	<0.001	31.3 (6.9)	<0.001	5.0 (0.7)	<0.001
30-39 years	51,392	24.6 (4.9)		28.9 (4.9)		33.8 (6.6)		5.3 (0.7)	
40-49 years	45,296	25.7 (4.8)		30.1 (4.8)		36.7 (6.0)		5.6 (0.7)	
50-59 years	23,516	26.8 (4.8)		31.5 (4.8)		39.3 (5.4)		5.9 (0.6)	
60-69 years	3,928	27.5 (4.5)		32.7 (4.7)		41.2 (4.8)		6.1 (0.6)	
Primary school	79,810	25.9 (5.1)	<0.001	30.7 (4.9)	<0.001	36.3 (7.0)	<0.001	5.6 (0.7)	<0.001
Secondary school	62,690	24.5 (4.6)		28.6 (4.7)		34.1 (6.5)		5.3 (0.8)	
University	11,610	23.9 (4.4)		27.9 (4.6)		33.1 (6.3)		5.3 (0.7)	
Social class I	10,744	23.8 (4.3)	<0.001	27.8 (4.6)	<0.001	33.1 (6.2)	<0.001	5.2 (0.7)	<0.001
Social class II	51,230	24.1 (4.4)		28.3 (4.6)		33.6 (6.3)		5.3 (0.7)	
Social class III	92,136	25.9 (5.1)		30.6 (4.9)		36.3 (7.0)		5.6 (0.7)	
Non physical activity	73,684	28.3 (5.1)	<0.001	31.7 (5.1)	<0.001	39.8 (6.3)	<0.001	5.9 (0.6)	<0.001
Yes physical activity	80,426	22.3 (2.3)		27.7 (3.9)		30.9 (4.2)		5.1 (0.6)	
Non healthy food	74,828	28.0 (5.3)	<0.001	31.6 (5.2)	<0.001	39.4 (6.6)	<0.001	5.8 (0.7)	<0.001
Healthy food	79,282	22.4 (2.4)		27.8 (3.9)		31.2 (4.3)		5.1 (0.6)	
Non smokers	103,300	25.5 (5.0)	<0.001	29.9 (5.0)	<0.001	35.7 (6.9)	<0.001	5.5 (0.7)	<0.001
Smokers	50,810	24.5 (4.8)		29.2 (4.7)		34.1 (6.8)		5.4 (0.8)	

BMI Body mass index. BAI Body adiposity index. CUN BAE Clinica Universitaria de Navarra Body Adiposity Estimator. METS-VF Metabolic Score for Visceral Fat.

Table IV: Prevalence of high values of overweight-obesity scales according to sociodemographic variables and healthy habits in men.

Men									
		BMI obesity		BAI obesity		CUN BAE obesity		METS-VF high	
	n	% (CI 95%)	p-value	% (CI 95%)	p-value	% (CI 95%)	p-value	% (CI 95%)	p-value
20-29 years	41,742	10,9 (10.7-11.1)	<0.001	38,5 (38.3-38.7)	<0.001	23,0 (22.8-23.2)	<0.001	0,7 (0.5-0.9)	<0.001
30-39 years	76,960	16,7 (16.6-16.8)		48,8 (48.7-48.9)		43,6 (43.5-43.7)		3,5 (3.4-3.6)	
40-49 years	69,068	22,7 (22.6-22.8)		38,2 (38.1-38.3)		63,5 (63.4-63.6)		11,3 (11.2-11.4)	
50-59 years	38,028	27,1 (26.8-27.3)		45,9 (45.7-46.2)		78,6 (78.3-78.9)		20,3 (20.0-20.5)	
60-69 years	7,016	29,8 (28.9-30.7)		35,3 (34.4-36.2)		88,8 (87.9-89.7)		30,1 (29.2-31.0)	
Primary school	142,494	20,3 (20.3-20.3)	<0.001	45,6 (45.6-45.6)	<0.001	52,8 (52.8-52.8)	<0.001	9,3 (9.3-9.3)	<0.001
Secondary school	79,226	18,6 (18.5-18.7)		39,1 (39.0-39.2)		53,1 (53.0-53.2)		8,3 (8.2-8.4)	
University	11,094	16,4 (15.6-17.2)		35,6 (34.8-36.4)		52,1 (51.4-52.9)		6,9 (6.1-7.7)	
Social class I	12,262	17,1 (16.3-17.9)	<0.001	35,2 (34.4-36.0)	<0.001	52,4 (51.6-53.2)	<0.001	7,2 (6.4-8.0)	<0.001
Social class II	40,650	17,6 (17.3-17.8)		37,3 (37.0-37.5)		51,7 (51.4-52.0)		7,9 (7.6-8.1)	
Social class III	179,902	20,2 20.2-20.2)		44,7 (44.7-44.7)		53,2 (53.2-53.2)		9,2 (9.2-9.2)	
Non physical activity	126,808	35,9 (35.9-35.9)	<0.001	56,5 (56.5-56.5)	<0.001	80,8 (80.8-80.8)	<0.001	16,2 (16.2-16.2)	<0.001
Yes physical activity	106,006	0,1 (0.1-0.1)		26,7 (26.7-26.7)		19,5 (19.5-19.5)		0,1 (0.1-0.1)	
Non healthy food	137,464	33,1 (33.1-33.1)	<0.001	54,1 (54.1-54.1)	<0.001	76,2 (76.2-76.2)	<0.001	14,9 (14.9-14.9)	<0.001
Healthy food	95,350	0,1 (0.1-0.1)		26,8 (26.8-26.8)		19,2 (19.2-19.2)		0,1 (0.1-0.1)	
Non smokers	146,480	21,2 (21.2-21.2)	<0.001	44,1 (44.1-44.1)	<0.001	56,8 (56.8-56.8)	<0.001	8,9 (8.9-8.9)	<0.001
Smokers	86,334	16,7 (16.6-16.8)		40,8 (40.7-40.9)		46,3 (46.2-46.4)		8,8 (8.7-8.9)	

BMI Body mass index. BAI Body adiposity index. CUN BAE Clinica Universitaria de Navarra Body Adiposity Estimator. METS-VF Metabolic Score for Visceral Fat.

Table V: Prevalence of high values of overweight-obesity scales according to sociodemographic variables and healthy habits in women.

	Women								
		BMI		BAI		CUN BAE		METS-VF	
	n	% (CI 95%)	p-value	% (CI 95%)	p-value	% (CI 95%)	p-value	% (CI 95%)	p-value
20-29 years	29,978	10,5 (10.1-10.9)	<0.001	2,3 (1.9-2.7)	<0.001	24,7 (24.3-25.1)	<0.001	0,03 (0.01-0.05)	<0.001
30-39 years	51,392	12,8 (12.6-13.0)		2,9 (2.7-3.1)		35,8 (35.6-36.0)		0,3 (0.1-0.5)	
40-49 years	45,296	16,7 (16.5-16.9)		3,4 (3.2-3.6)		55,2 (55.0-55.4)		0,5 (0.3-0.7)	
50-59 years	23,516	21,7 (21.3-22.1)		4,2 (3.8-4.6)		77,6 (77.2-78.0)		1,5 (1.1-1.9)	
60-69 years	3,928	25,5 (24.4-26.6)		3,7 (2.6-4.8)		90,6 (89.5-91.7)		1,8 (0.7-2.9)	
Primary school	79,810	19,0 (18.9-19.1)	<0.001	4,2 (4.1-4.3)	<0.001	55,3 (55.2-55.4)	<0.001	0,7 (0.6-0.8)	<0.001
Secondary school	62,690	11,4 (11.3-11.5)		2,1 (2.0-2.2)		39,4 (39.3-39.5)		0,3 (0.2-0.4)	
University	11,610	9,1 (8.5-9.7)		1,7 (1.1-2.3)		33,1 (32.5-33.7)		0,3 (0.0-0.9)	
Social class I	10,744	9,2 (8.6-9.8)	<0.001	1,6 (1.0-2.2)	<0.001	33,1 (32.5-33.7)	<0.001	0,1 (0.0-0.7)	<0.001
Social class II	51,230	9,8 (9.6-10.0)		1,7 (1.5-1.9)		36,0 (35.8-36.2)		0,3 (0.1-0.5)	
Social class III	92,136	18,9 (18.8-19.0)		4,1 (4.0-4.2)		54,9 (54.8-55.0)		0,7 (0.6-0.8)	
Non physical activity	73,684	31,7 (31.6-31.8)	<0.001	6,5 (6.4-6.6)	<0.001	78,8 (78.7-78.9)	<0.001	1,1 (1.0-1.2)	<0.001
Yes physical activity	80,426	0,05 (0.0-0.2)		0,2 (0.1-0.3)		18,2 (18.1-18.3)		0,02 (0.0-0.2)	
Non healthy food	74,828	31,2 (31.1-31.3)	<0.001	6,4 (6.3-6.5)	<0.001	74,4 (74.3-74.5)	<0.001	1,0 (0.9-1.1)	<0.001
Healthy food	79,282	0,1 (0.0-0.2)		0,2 (0.1-0.3)		21,4 (21.3-21.5)		0,04 (0.0-0.1)	
Non smokers	103,300	16,8 (16.8-16.8)	<0.001	3,5 (3.5-3.5)	<0.001	50,3 (50.3-50.3)	<0.001	0,5 (0.5-0.5)	<0.001
Smokers	50,810	12,0 (11.8-12.2)		2,5 (2.3-2.7)		40,7 (40.5-40.7)		0,4 (0.2-0.6)	

BMI Body mass index. BAI Body adiposity index. CUN BAE Clinica Universitaria de Navarra Body Adiposity Estimator. METS-VF Metabolic Score for Visceral Fat

Table VI: Multinomoal logistic regression.

	BMI obesity OR (95% CI)	BAI obesity OR (95% CI)	CUN BAE obesity OR (95% CI)	METS-VF high OR (95% CI)
Female	1	1	1	1
Male	1.07 (1.05-1.09)	25.01 (24.26-25.78)	1.02 (1.00-1.04)	18.28 (17.00-19.66)
20-29 years	1	1	1	1
30-39 years	ns	ns	2.47 (2.30-2.65)	1.72 (1.62-1.83)
40-49 years	ns	ns	5.21 (4.86-5.59)	3.12 (2.94-3.31)
50-59 years	ns	ns	10.10 (9.42-10.83)	8.39 (7.86-8.97)
60-69 years	1.07 (1.02-1.12)	ns	19.30 (17.96-20.73)	28.95 (25.52-32.85)
Social class I	1	1	1	1
Social class II	1.31 (1.25-1.37)	1.24 (1.21-1.28)	1.32 (1.27-1.37)	1.11 (1.05-1.17)
Social class III	1.34 (1.30-1.38)	1.59 (1.53-1.65)	1.51 (1.47-1.55)	1.26 (1.17-1.36)
Yes physical activity	1	1	1	1
Non physical activity	24.33 (18.32-32.32)	3.39 (3.27-3.51)	10.26 (9.97-10.56)	41.84 (33.19-52.74)
Yes healthy food	1	1	1	1
Non healthy food	14.80 (10.45-20.96)	1.39 (1.34-1.44)	1.62 (1.57-1.67)	6.28 (5.02-7.86)
Non smokers	1	1	1	1
Smokers	0.74 (0.72-0.75)	0.82 (0.81-0.83)	0.63 (0.62-0.64)	1.19 (1.15-1.23)

BMI Body mass index. BAI Body adiposity index. CUN BAE Clinica Universitaria de Navarra Body Adiposity Estimator. METS-VF Metabolic Score for Visceral Fat.

Discussion

All the variables analyzed, sociodemographic and healthy habits, influence the mean values and the prevalence of high values of all the overweight and obesity scales.

In the multivariate analysis, the variables that most increase the risk of presenting obesity are physical exercise and Mediterranean diet. The only variable that shows no effect is educational level.

In our study, we found a higher prevalence of overweight-obesity with the four scales in men; these data contradict the majority of studies consulted where this prevalence is higher in women[32]. Some authors attribute this higher prevalence in women to gender inequalities, so that it is gender and not sex that is responsible[33-34].

In our study, as in practically all the other studies consulted, the prevalence of obesity increases with age[35]. Some authors have observed that excess weight and aging share a similar spectrum of phenotypes, such as compromised genome integrity, impaired mitochondrial function, accumulation of macromolecules within the cell, weakened immunity, altered tissue and body composition, and inflammatory processes[36].

The low socioeconomic level, represented by social class III, in our study is related to a higher prevalence of overweight-obesity. These data are similar to those found by different authors[37-40].

Various researchers have established nine potential

mechanisms to explain the existing disparities in obesity. These mechanisms can be grouped into three groups: health behaviors, biological factors and the socioeconomic environment[41].

A high level of physical activity is the most important protective factor against obesity, with the different scales studied in our study. This protective effect is also found in different studies.

A systematic review in 2020[42] that evaluated, among other things, the effect of physical exercise on obesity concluded that the prevalence of obesity was lower in non-sedentary persons and that physical exercise was fundamental in both preventive and intervention strategies for obesity. In the same sense, the authors of a 2021 study expressed the opinion that at least 150 minutes of moderate aerobic exercise or 75 minutes of vigorous aerobic exercise each week, and resistance and/or strengthening exercises of all muscle groups twice a week[43] are necessary to avoid obesity. Similar recommendations are stated in a systematic review[44] from 2021.

All organ systems of the body are influenced by regular physical activity and it has a number of overall health benefits. Physical activity alone does not work for weight loss; however, it is essential for maintaining weight loss. Exercise can help maintain a stable body weight, but it can also help better control appetite and food preference[45].

A 2023 review evaluating the role of exercise, either alone or combined with other treatments, in the prevention and management of obesity concludes that, although bariatric surgery and pharmacotherapy are the most effective therapies in severe obesity, physical exercise has an important role in facilitating and improving weight loss in combination with other methods[46].

Low adherence to the Mediterranean diet has been found in our study to be a predisposing factor for obesity. These data are similar to those found by other authors.

A review that evaluated four meta-analyses, which included 16 randomized controlled trials, found a greater decrease in BMI in persons with high adherence to the Mediterranean diet compared to other types of diet. In the same review, a meta-analysis of 7 prospective cohort studies found a lower risk of obesity in persons with greater adherence to the Mediterranean diet[47].

A study carried out in 268 obese persons, comparing the Mediterranean diet with the ketogenic diet, evaluated the time required to achieve a loss of 5% of initial body weight and the effect on body composition, observing that both were effective in reducing weight and fat mass, although the Mediterranean diet achieved a greater decrease in waist circumference and body fat and a greater increase in body water[48].

Strengths and limitations

The strengths of the study include, on the one hand, the enormous size of the sample, which exceeds 386,000 workers, which gives great power to the results obtained, and on the other hand, the wide variety of obesity scales used.

The main limitation is that the study was carried out in the working population, which excludes people under 18 years of age and those over 69 years of age, a situation that may prevent extrapolation of the results to the general population.

Conclusions

All the sociodemographic variables and healthy habits, especially physical activity and the Mediterranean diet, will influence the values of the overweight and obesity scales.

Conflict of Interest

The authors declare that there is no conflict of interest.

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