

Original article

Prevalence of obesity and associated cardiovascular risk factors in the Spanish population: the ENPE study

Carmen Pérez-Rodrigo,^{a,b} Gotzone Hervás Bárbara,^b Marta Gianzo Citores,^b and Javier Aranceta-Bartrina^{a,b,c,d,e,*}^a Departamento de Fisiología, Facultad de Medicina y Enfermería, Universidad del País Vasco (UPV/EHU), Leioa, Vizcaya, Spain^b Sociedad Española de Nutrición Comunitaria (SENC), Spain^c Departamento de Ciencias de la Alimentación y Fisiología, Universidad de Navarra, Pamplona, Navarra, Spain^d Instituto Universitario de Investigaciones Biomédicas y Sanitarias (IUIBS), Universidad de Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain^e Centro de Investigación Biomédica en Red Fisiopatología de la Obesidad y Nutrición (CIBEROBN), Instituto de Salud Carlos III, Madrid, Spain

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ABSTRACT

Introduction and objectives: Obesity is a significant public health problem associated with an increased risk of cardiovascular risk factors (CVRF). The aim of this study was to determine the prevalence of overweight and abdominal obesity (AO) in the Spanish population aged ≥ 3 years and to analyze the influence of sociodemographic and lifestyle factors and their association with CVRF.

Methods: The sample was drawn from the ENPE study (n = 6800). The study protocol included individual anthropometric measurements, sociodemographic factors, food intake (food frequency questionnaire), physical activity, lifestyles, and health problems.

Results: The estimated overall prevalence of obesity (22.0%; 95%CI, 21.0–23.0) and AO (64.7%; 95%CI, 63.5–65.8) was higher in men, in persons aged ≥ 65 years, and in those with a lower socioeconomic level or from southern regions. Lifestyle pattern was significantly associated with obesity and AO (P = .011), which were less likely in people with an active lifestyle pattern (P < .0001). Obesity (OR, 1.85; 95%CI, 1.24–2.78) and AO (OR, 2.16; 95%CI, 1.1–4.24) were positively associated with CVRF. Clustering of CVRF with obesity and/or AO was higher in women (12.6%; 95%CI, 11.4–13.9) and in persons aged ≥ 65 years (32.7%; 95%CI, 30.0–35.4).

Conclusions: The prevalence of obesity and AO in the Spanish population is high; it is higher in men, increases with age, and is inversely related to socioeconomic status. A lifestyle pattern combining a higher level of physical activity, moderate sedentariness and a Mediterranean dietary pattern is associated with a lower probability of obesity, AO, and CVRF.

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Prevalencia de obesidad y factores de riesgo cardiovascular asociados en la población general española: estudio ENPE

RESUMEN

Introducción y objetivos: La obesidad es un importante problema de salud pública y se asocia con mayor riesgo de adquirir factores de riesgo cardiovascular (FRCV). En este estudio se estima la prevalencia de sobrecarga ponderal y obesidad abdominal (OA) en población española de edad ≥ 3 años y se analiza la influencia de factores sociodemográficos y estilos de vida y la relación con los FRCV.

Métodos: La muestra procede del estudio ENPE (n = 6.800). El protocolo incluía mediciones antropométricas individuales, factores sociodemográficos, consumo alimentario (cuestionario sobre frecuencia de consumo), actividad física, estilos de vida y problemas de salud.

Resultados: La prevalencia total estimada de obesidad (22,0%; IC95%, 21,0%-23,0%) y OA (64,7%; IC95%, 63,5%-65,8%) es mayor en varones, con edad ≥ 65 años y menor nivel socioeconómico y de la región sur. El perfil de estilos de vida se asocia significativamente con obesidad y OA (p = 0,011), con menor probabilidad de obesidad en el perfil más activo (p < 0,0001). La obesidad (OR = 1,85; IC95%, 1,24-2,78) y la OA (OR = 2,16; IC95%, 1,1-4,24) se asocian positivamente con FRCV. La coexistencia de FRCV con OA es mayor entre las mujeres (12,6%; IC95%, 11,4%-13,9%) y aquellos con edad ≥ 65 años (32,7%; IC95%, 30,0%-35,4%).

Conclusiones: La prevalencia de obesidad y OA en población española es alta, mayor en varones, aumenta con la edad y presenta relación inversa con el nivel socioeconómico. El perfil de estilos de vida con mayor

Palabras clave:

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* Corresponding author: Sociedad Española de Nutrición Comunitaria (SENC), Euskalduna 5, escalera interior, entresuelo izquierda, 48008 Bilbao, Vizcaya, Spain.
E-mail address: javieraranceta@gmail.com (J. Aranceta-Bartrina).

nivel de actividad física, sedentarismo moderado y patrón alimentario mediterráneo se asocia con menor probabilidad de obesidad, OA y FRCV.

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Abbreviations

AO: abdominal obesity
 BMI: body mass index
 CVRF: cardiovascular risk factor

INTRODUCTION

Obesity is a worldwide health problem associated with an increased risk of cardiovascular disease, type 2 diabetes mellitus, chronic kidney disease, several types of cancer, musculoskeletal disorders, and body image issues.¹ Since the 1980s, there has been an overall increase in the prevalence of high body mass index values (BMI = weight in kilograms divided by height in meters squared). The increase among children and adolescents is of particular concern.² It has been estimated that 41% of deaths and 34% of disability-adjusted life years related to BMI are due to cardiovascular disease in obese individuals. Furthermore, it has been shown that obesity in childhood increases associated cardiovascular risk factors (CVRFs) in adults, and thus there is a need for adequate surveillance systems to allow early diagnosis, monitor trends, and assess the efficacy of preventive interventions.^{3,4}

BMI has long been accepted as an indicator for estimating body weight classification for screening, and epidemiological analysis, although it has limitations and has led to some controversy.⁵ In the infant and juvenile population, several age- and sex-specific cutoff points have been proposed according to reference growth standards.⁶ In older adults, BMI values of less than 23 have been associated with an increased risk of mortality.⁷

Obesity has a negative effect on CVRFs, hypertension, dyslipidemia, insulin resistance, and type 2 diabetes mellitus.^{1,2,8} Regardless of body fat, excess visceral abdominal adipose tissue is a reliable predictor of acquiring CVRFs.⁹

Obesity, abdominal obesity (AO), dyslipidemia, diabetes, and hypertension are recognized as biological risk factors for cardiovascular disease. These factors often cluster and lead to increased risk.⁹ Associations have been found between inadequate diet, a lack of physical activity, and sedentary lifestyles and an increased risk of obesity, cardiovascular disease, and the premature onset of other chronic conditions.¹⁰

This aim of this study was to provide a general estimate of the prevalence of overweight and AO in a random sample of the Spanish population older than 3 years and to analyze the influence of sociodemographic and lifestyle factors and their association with CVRFs. Previous studies have described the distribution of anthropometric indicators and prevalence by age bracket and sex.^{11,12}

METHODS

This analysis formed part of the ENPE study (*Estudio Nutricional de la Población Española*).^{11,12} The ENPE study was an observational cross-sectional study conducted in a representative population-based probabilistic sample (scope: persons more than 3 years of age residing in primary residences in Spain), which was selected

using a random multistep procedure, with stratification of the units from the first step (census sections) according to autonomous community ($k = 17$) with 400 individuals per stratum ($n = 6800$). Second level: primary residences in each census unit. Residences were selected by random route sampling, 1 individual per household, with quotas controlled by age bracket (3–8, 9–18, 19–64, and ≥ 65 years), sex, and municipality size according to the population census (Spanish National Institute of Statistics, January 2014). Sampling error, 1.62%. The sample was weighted according to the Spanish population distribution by age bracket, sex, and municipality size. Variance was estimated by applying bootstrap techniques without correction for finite populations.

Information was collected by personal interview at the participant's home (May 2014–May 2015). The sample and the fieldwork logistics were designed and coordinated by a population studies company (SIGMA DOS).

The exclusion criteria for the anthropometric measurements were as follows: being pregnant, not being able to stand upright, or having limbs immobilized with nonremovable plaster casts. In total, 6800 individuals were included, of whom 3514 were women (51.7%).

Anthropometric measurements

Individual anthropometric measurements were taken by highly trained professional surveyors who had received specific face-to-face training from the study authors. We followed standardized international protocols¹³ that had been previously tested in a pilot study. Measurements were performed with the participants standing upright, barefoot, and lightly clothed. The following instruments and procedures were used: height was measured using a Seca 213 portable height gauge (Seca, Germany: range, 0–200 cm; accuracy, 0.1 cm); body weight was measured using a calibrated Seca 803 digital scale (range: 0.1–150 kg; accuracy, 0.1 kg); waist circumference was measured in triplicate at the midpoint between lowest costal margin and iliac crest using a Seca 201 retractable tape measure (range, 0–150 cm; accuracy, 0.1 cm). We calculated the BMI and waist-to-height ratio, which was defined as the waist circumference (cm) divided by height (cm).

Quality controls showed that intraobserver- and interobserver-related measurement errors were less than 1% for all anthropometric parameters reported: these values were lower than those considered acceptable.¹³

Overweight (preobesity) and obesity were classified by BMI values of at least 25 and at least 30, respectively. In children younger than 18 years, age- and sex-specific BMI z-scores and cutoff points were used according to World Health Organization criteria.⁶ AO was defined as a waist-to-height ratio of more than 0.5.¹⁴

Sociodemographic factors

We included the following sociodemographic factors: sex, age bracket (3–8, 9–18, 19–64, and ≥ 65 years), family socioeconomic status according to educational level and occupation (high/middle-high, middle-middle, middle-low, and low), geographic region (North-West: Galicia and Principality of Asturias; North-East: Cantabria and Basque Country; Center: Castile and León, Community

of Madrid, Extremadura, and Castile-La Mancha; Center-East: Chartered Community of Navarre, La Rioja, and Aragon; East: Catalonia, Balearic Islands, and Valencian Community; South: Canary Islands, Andalusia, and Region of Murcia), and size of locality of residence (from < 5000 - > 200 000 population).

Lifestyle

We included the following lifestyle factors: dietary habits, physical activity, sedentary lifestyle, hours of sleep, and smoking habits (smoker, exsmoker, nonsmoker). The habitual consumption of food and beverages was estimated using a semiquantitative food consumption frequency questionnaire that was completed by interview. Information on physical activity levels and sedentary lifestyles was collected using the International Physical Activity Questionnaire (IPAQ)¹⁵ adapted to children younger than 16 years.¹⁶

Health problems

Health problems were assessed according to the participants' response to the following question: "Do you have any of the following chronic health problems: high cholesterol (dyslipidemia), high blood pressure, or diabetes?" (response format: yes/no).

Data analysis

We analyzed participants older than 3 years with full information available on the variables of interest (BMI: n = 6422 [94.4%]; waist circumference and height: n = 6454 [94.9%]). We calculated the prevalence of obesity and AO and their 95% confidence intervals (95%CI) by age and sex bracket. The sample was weighted according to the distribution of the Spanish population. The estimated prevalence rates were calculated for each autonomous community using a direct method according to the Spanish population distribution. The chi-square and z-test were used to compare prevalence rates according to age and sex. Logistic regression models were used to analyze associations between sociodemographic and lifestyle factors and the prevalence of obesity and AO.

After transformation of habitual daily food consumption (g/d) into z-scores, 4 dietary patterns were identified using principal components factor analysis with varimax rotation (Kaiser-Meyer-Olkin test: 0.82). To identify lifestyle profiles in the group older than 18 years, a 2-stage cluster analysis was performed including factor scores, the usual number of daily meals, physical activity (low, moderate, high), mean sedentary time (quartiles), and usual hours of daily sleep. These profiles as well as obesity and AO adjusted for sociodemographic factors were entered into logistic regression models as independent and dependent variables, respectively.

In persons older than 18 years, logistic regression models were used to analyze the association between weight classification and AO, smoking and lifestyle profiles (independent variables) and dyslipidemia, hypertension, and diabetes (dependent variables) adjusted for sociodemographic factors. We also analyzed the association between sociodemographic factors and lifestyles (independent variables) and the clustering of 3 or more CVRFs (obesity, AO, dyslipidemia, hypertension, and diabetes) (n = 4340 individuals with valid full data). A P value of < .05% was used as a cutoff for statistical significance. The analysis took the complex design of the sample into consideration and was performed using IBM SPSS v. 24.0.

Ethical considerations

All participants were informed of the study objectives and procedures and gave written consent to participate. The study protocol was approved by the Euskadi Clinical Research Ethics Committee (PI2015147) and performed in accordance with the World Medical Association's Declaration of Helsinki for research involving human participants. It was conducted in compliance with Organic Law 15/1999 of 13 December on the protection of personal data in all processes.

RESULTS

The overall prevalence of obesity was 22.0% (95%CI, 21.0%-23.0%) (table 1) and that of overweight was 36.1% (95%CI, 34.9%-37.3%), which was significantly higher in males (41.8%; 95%CI, 40.1%-43.5%). Overweight and obesity increased with age after the age of 19 years, with higher prevalence in the age bracket of 65 years and older. In total 15.9% (95%CI, 12.6%-19.6%) of individuals in the 3 to 8 years age bracket were obese and 11.6% (95%CI, 9.3%-14.2%) of individuals in the 9 to 18 years age bracket were obese.

The estimated prevalence of AO (64.7%; 95%CI, 63.5%-65.8%) was higher in males (68.3%; 95%CI, 66.7%-69.9%), increased with age from the age of 19 years, and reached the highest rate in the age bracket of 65 years and older (91.6%; 95%CI, 90.0%-93.1%).

Factors associated with overweight and abdominal obesity

Sociodemographic factors

Table 1 shows the prevalence of each BMI category according to socioeconomic level, local population size, and autonomous community (adjusted for age). Table 2 shows the odds ratios (OR) of the prevalence of obesity and AO and their corresponding 95%CIs according to sociodemographic factors. A significant association was found between the prevalence of obesity and socioeconomic status, local population size, and geographic region. There was a lower risk of obesity in the 9 to 34 year age bracket than in the 3 to 8 year age bracket, but there was a significant increase in its risk after the age of 55 years. An inverse association was found between socioeconomic level and a lower risk of obesity in the North-Eastern, Central, and Eastern regions compared with the South.

An association was found between AO and sex, age, socioeconomic level, local population size, and geographic region (table 1). The risk of AO was higher in males than in females and progressively increased with age, especially after 55 years of age. An inverse association was found between AO and socioeconomic level.

Lifestyle

Four dietary patterns were identified: "meat-protein-pasta" (MPP), "sweets-cakes-dairy foods" (SCM), "Mediterranean diet" (MD) with more fish, legumes, yogurt, olive oil, fruit, and vegetables, and "salty snacks-dairy desserts-sweetened beverages" (SSDDSB). In persons older than 18 years, 4 lifestyle profiles were identified, which were mainly defined by the level of physical activity and sedentary time: a) not active-moderately sedentary/ MD + pattern, moving away from the SSDDSB pattern; b) very active-moderately sedentary/higher scores on the MD + +, SCM +, and SSDDSB + patterns; c) not active-very sedentary/neutral diet; and d) not active-very sedentary/higher MPP + pattern score and lower SCM-pattern score.

Table 1

Prevalence of weight classifications according to body mass index values and abdominal obesity (waist/height index) in the total sample by sex, age bracket, autonomous community, socioeconomic level, and size of locality of residence

	Normal weight		Overweight		Obese		Abdominal obesity	
	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)
<i>Total</i>	2753	41.9 (40.7–43.1)	2306	36.1 (34.9–37.3)	1363	22.0 (21.0–23.0)	4014	64.7 (63.5–65.8)
<i>Sex</i>								
Male	1157	36.2 (34.6–37.9)	1284	41.8 (40.1–43.5) ^b	682	22.0 (20.6–23.5)	2063	68.3 (66.7–69.9) ^b
Female	1596	47.4 (45.7–49.2)	1022	30.6 (29.0–32.2)	681	22.0 (20.6–23.5)	1951	61.2 (59.5–62.8)
<i>Age bracket</i>								
3–8 y	238	60.2 (55.5–64.8)	84	24.0 (20.1–28.2) ^b	68	15.9 (12.6–19.6) ^b	123	33.6 (29.1–38.3) ^b
9–18 y	405	66.0 (62.4–69.7)	159	22.3 (19.2–25.6)	69	11.6 (9.3–14.2)	144	25.5 (22.3–29.0)
19–64 y	1880	42.3 (40.8–43.8)	1553	37.6 (36.1–39.1)	820	20.1 (18.9–21.3)	2709	66.1 (64.7–67.5)
≥ 65 y	230	20.3 (18.0–22.6)	510	42.8 (40.0–45.7)	406	36.9 (34.1–39.7)	1038	91.6 (90.0–93.1)
<i>Autonomous community^a</i>								
Andalusia	137	36.0 (24.0–50.0)	139	37.3 (24.2–52.6)	93	26.7 (15.5–40.8)	255	68.7 (57.6–78.4)
Aragon	148	39.5 (27.1–53.2)	135	35.9 (23.4–50.5)	97	24.4 (14.4–37.9)	251	65.2 (53.1–75.8)
Principality of Asturias	122	36.4 (23.5–50.9)	133	37.4 (24.2–53.0)	92	26.2 (15.1–40.2)	215	59.4 (45.9–72.4)
Balearic Islands	225	56.3 (42.4–69.7)	123	31.8 (20.0–46.5)	40	11.7 (5.1–22.8)	147	39.6 (27.7–52.0)
Canary Islands	157	41.7 (28.6–56.0)	121	35.1 (22.3–50.2)	78	23.1 (12.8–37.3)	211	60.4 (48.0–71.5)
Cantabria	168	44.0 (30.7–57.6)	143	37.6 (24.9–52.3)	69	18.4 (9.5–31.6)	204	52.5 (39.8–65.0)
Castile-La Mancha	162	39.1 (26.8–53.0)	147	38.9 (25.9–53.4)	79	22.0 (12.1–35.6)	247	66.0 (54.8–76.0)
Castile and León	160	41.9 (29.2–55.8)	144	36.5 (23.6–51.1)	81	21.5 (12.0–35.0)	263	66.5 (54.1–77.6)
Catalonia	176	49.1 (35.2–62.5)	131	34.7 (22.3–49.6)	67	16.1 (8.3–28.2)	245	62.6 (49.3–74.4)
Extremadura	165	43.2 (30.1–56.9)	142	36.6 (23.7–51.6)	78	20.2 (11.2–33.2)	277	70.9 (60.0–79.9)
Galicia	136	35.5 (24.2–48.4)	146	37.7 (25.4–52.0)	105	26.7 (16.5–39.9)	255	65.3 (53.4–75.6)
Community of Madrid	157	39.7 (26.5–54.3)	133	34.9 (22.4–49.8)	92	25.2 (14.5–39.2)	250	69.9 (56.5–80.4)
Chartered Community of Navarre	174	45.1 (31.5–59.6)	123	34.0 (21.2–49.0)	76	20.8 (11.5–33.4)	221	61.1 (48.1–72.4)
Basque Country	190	48.0 (34.2–62.3)	137	35.1 (22.5–50.0)	62	16.5 (8.0–29.8)	206	52.5 (39.2–65.6)
Region of Murcia	144	35.5 (24.2–49.2)	146	38.6 (25.5–53.2)	93	25.7 (15.2–39.4)	251	66.4 (53.9–76.7)
La Rioja	158	42.8 (29.1–57.3)	138	36.9 (24.0–51.8)	75	20.1 (10.4–33.7)	250	65.5 (52.0–77.4)
Valencian Community	174	42.7 (30.1–56.3)	125	34.3 (21.9–48.7)	86	22.7 (12.7–36.3)	266	70.1 (59.1–79.4)
<i>Socioeconomic level</i>								
High-medium high	465	57.2 (53.7–60.6)	258	31.2 (28.1–34.4)	98	11.6 (9.6–14.0) b	414	51.9 (48.4–55.3) ^b
Medium-medium	672	43.9 (41.2–46.5)	541	37.2 (34.7–39.8)	267	19.0 (17.0–21.1)	860	63.0 (60.4–65.5)
Low-medium	932	36.0 (34.1–37.9)	938	39.6 (37.7–41.5)	586	24.5 (22.8–26.2)	1.661	69.5 (67.6–71.2)
Low	527	37.5 (35.0–40.0)	507	34.3 (31.9–36.8)	370	28.2 (25.9–30.6)	970	69.7 (67.3–72.0)
<i>Population size</i>								
< 5000 pop	451	40.7 (37.7–43.6)	410	37.0 (34.1–39.9)	256	22.3 (19.9–24.9)	763	67.6 (64.8–70.4)
5000–15 000 pop	530	41.9 (39.1–44.8)	426	36.0 (33.3–38.8)	248	22.1 (19.8–24.6)	748	65.1 (62.3–67.7)
15 000–50 000 pop	565	44.2 (41.5–47.0)	460	35.5 (32.9–38.2)	252	20.3 (18.1–22.6)	747	63.2 (60.5–65.9)
50 000–200 000 pop	599	43.6 (40.9–46.2)	496	36.4 (33.9–39.0)	261	20.0 (17.9–22.2)	834	64.2 (61.6–66.8)
> 200 000 pop	608	39.7 (37.4–42.1)	514	35.8 (33.5–38.1)	346	24.5 (22.5–26.7)	922	64.0 (61.6–66.2)

95%CI, 95% confidence interval; pop, population.

^a Adjusted for age by the direct method according to the Spanish population.

^b $P < .001$.

The prevalence of obesity was significantly lower ($P < .0001$) in the active profile (17.7%) than in the other 3 profiles (24.5%, 22.7%, and 22.2%). The prevalence of AO was also significantly lower ($P < .0001$) in the active profile (62.7%) than in the other 3 profiles (72.0%, 69.8%, and 72.6%). Figure 1 shows the ORs of the prevalence of obesity and AO in models adjusted for age, sex, and socioeconomic status for the lifestyle and smoking profiles of persons older than 18 years. We estimated the ORs for obesity (OR = 0.82; 95%CI, 0.66–1.03) (figure 1A) and AO (OR = 0.85; 95%CI, 0.69–1.04) (figure 1B) of the very active-moderately sedentary profile and the not active-moderately sedentary profile. The ORs for obesity (OR = 0.72; 95%CI, 0.61–0.87) and AO (OR = 0.83; 95%CI, 0.71–0.97) were significantly lower in smokers than in nonsmokers.

Obesity, abdominal obesity, and cardiovascular risk factors

Figure 2A–C shows the ORs of the prevalence of obesity and AO in relation to the self-reported presence of dyslipidemia (hypercholesterolemia), hypertension, and diabetes in persons 18 years and older. In models adjusted for age, sex, socioeconomic status, smoking, and lifestyle profile, a positive association was found between overweight, obesity and AO and dyslipidemia (figure 2A) and hypertension (figure 2B). The risk of hypertension was lower in persons with a very active-low sedentary profile than persons with a not active-moderately sedentary profile. An association was found between obesity and AO and a higher risk of diabetes mellitus (figure 2C). The risk was lower in persons in the very active-moderately sedentary profile.

Table 2
Sociodemographic factors associated with the prevalence of obesity and abdominal obesity

	Obesity		Abdominal obesity	
	OR (95%CI)	P	OR (95%CI)	P
<i>Female</i>	1		1	
<i>Male</i>	1.13 (1.00-1.28)	.057	1.71 (1.52-1.93)	< .001
<i>Age bracket</i>		< .001		< .001
3-8 y	1		1	
9-18 y	0.53 (0.36-0.78)	.001	0.60 (0.44-0.81)	.001
19-24 y	0.42 (0.27-0.64)	< .001	1.04 (0.77-1.40)	.814
25-34 y	0.62 (0.43-0.90)	.011	1.98 (1.50-2.63)	< .001
35-44 y	1.11 (0.80-1.55)	.518	3.80 (2.89-4.99)	< .001
45-54 y	1.14 (0.83-1.58)	.419	5.82 (4.42-7.67)	< .001
55-64 y	2.22 (1.61-3.08)	< .001	15.08 (10.94-20.79)	< .001
65-74 y	2.41 (1.73-3.34)	< .001	19.04 (13.55-26.76)	< .001
≥ 75 y	2.32 (1.63-3.28)	< .001	17.99 (12.19-26.53)	< .001
<i>Socioeconomic level</i>		< .001		< .001
High-medium high	1		1	
Medium-medium	1.68 (1.30-2.17)	< .001	1.56 (1.28-1.89)	< .001
Low-medium	1.97 (1.55-2.49)	< .001	1.64 (1.36-1.96)	< .001
Low	2.13 (1.66-2.74)	< .001	1.76 (1.43-2.16)	< .001
<i>Population size</i>		.038		< .001
< 5000 pop	1		1	
5000-15 000 pop	0.83 (0.67-1.03)	.090	0.81 (0.64-1.02)	.072
15 000-50 000 pop	0.85 (0.69-1.05)	.137	0.52 (0.41-0.64)	.000
50 000-200 000 pop	0.82 (0.67-1.01)	.058	1.11 (0.92-1.35)	.283
> 200 000 pop	1.04 (0.86-1.27)	.670	0.90 (0.74-1.10)	.314
<i>Region</i>		< .001		< .001
South	1		1	
North-West	1.03 (0.82-1.29)	.801	0.64 (0.52-0.78)	< .001
North-East	0.63 (0.49-0.81)	< .001	0.66 (0.54-0.81)	< .001
Central	0.81 (0.66-0.99)	.037	0.65 (0.53-0.80)	< .001
East Central	0.83 (0.67-1.02)	.080	0.67 (0.55-0.82)	< .001
East	0.61 (0.49-0.76)	< .001	0.72 (0.59-0.87)	.001

95%CI, 95% confidence interval; OR, odds ratio of prevalence; pop, population.

The clustering of self-reported dyslipidemia, hypertension, and diabetes and obesity or AO was significantly higher in women and in persons of 65 years of age and older (table 3). An inverse association was found between the OR for the prevalence of CVRFs and socioeconomic level; in the North-East region vs the South region, OR = 0.32 (95%CI, 0.20-0.53); in smokers vs nonsmokers, OR = 0.60 (95%CI, 0.44-0.80); and in exsmokers, OR = 2.06 (95%CI, 1.48-2.86). The risk of clustering of CVRFs was lower in the very active-moderately sedentary profile/ MD + + pattern than in the nonactive-moderately sedentary profile/MD + pattern.

DISCUSSION

In the ENPE study sample, the estimated prevalence of overweight was 58.1% (95%CI, 56.9%-59.3%) and that of obesity was 22.0% (95%CI, 21.0%-23.0%). Overweight was higher in males and overweight and obesity increased with age after 19 years of age. The estimated prevalence of AO was 64.7% (95%CI, 63.5%-65.8%), higher in males, and increased with age after 19 years of age. These figures are similar to those reported in Ontario and Quebec (Canada) (6-79 years),¹⁷ and in Portugal (3 months-84

years).¹⁸ A study conducted in the United States (2015-2016) reported obesity prevalences of 39.6% in persons of at least 20 years.¹⁹ In the geographical area of the Organization for Economic Cooperation and Development (OECD), the estimated average of overweight was 60% and that of obesity was 25% (18.7% of persons younger than 20 years were overweight and 9.9% were obese), with obesity figures fluctuating between 3.6% (India) and 39.6% (United States).²⁰

Recent analyses have projected a 16% increase in excess weight in Spain by 2030, with a 58% increase in direct health care costs.²¹

The Spanish National Health Surveys provide relevant public health information on weight, height, and health problems reported by participants. These data have been used to analyze the prevalence of obesity and associated factors in Spain²² and are of undoubted interest. However, these analyses underestimate the prevalence of obesity, with an error that has been calculated to be between 2.0 and 2.7 percentage points in men and 4.7 and 5.9 percentage points in women²³ vs estimates based on measurements. The magnitude of obesity and its health, economic, and social impact necessitate a measurement-based quality surveillance system, which also includes quality information on related factors. Failing this, valuable information would be provided by

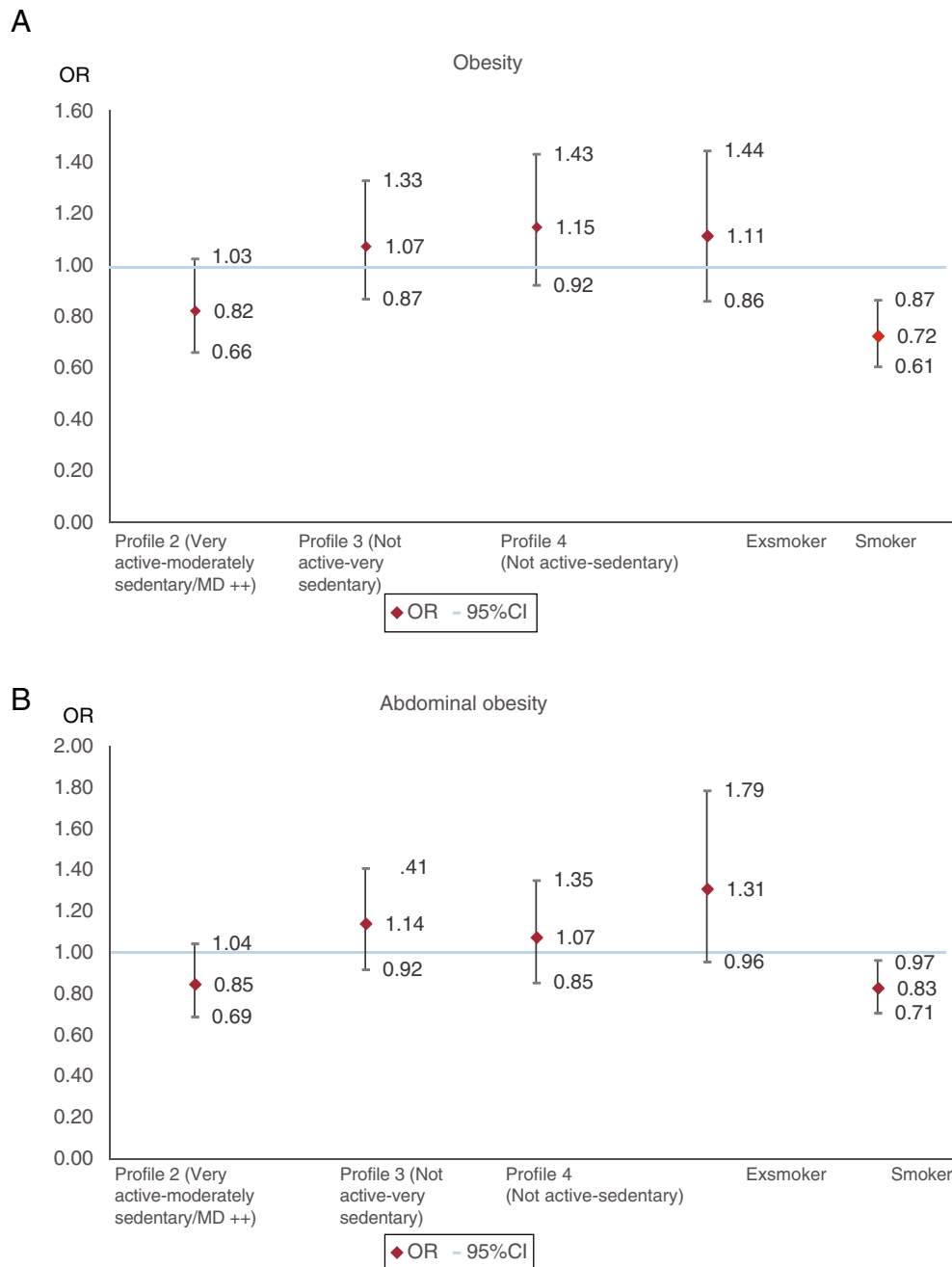


Figure 1. Odds ratios of the prevalence of obesity (A) and abdominal obesity (B) according to lifestyle profile and smoking. Odds ratios of prevalence adjusted for sociodemographic factors in persons older than 18 years. 95%CI, 95% confidence interval; MD, Mediterranean diet; OR, odds ratio.

well-designed population-based cross-sectional studies using well-designed protocols and individual anthropometric measurements.

The results of the present study are in line with those of previous studies, which found unequal distributions of obesity: its prevalence was higher in persons in lower socioeconomic brackets.^{22,24,25} Likewise, previous studies have found socioeconomic inequalities in the distribution of risk behaviors, such as poor dietary habits, low levels of physical activity, and tobacco consumption.^{24,25} Other studies have also found differences in the distribution of eating habits and physical activity according to autonomous community, which was mediated by the unequal distribution of educational and socioeconomic levels.^{26,27}

A significant association was observed between the risk of obesity and AO and the size of the locality of residence. Other studies have found higher prevalences of obesity and AO in rural areas²⁸ and have suggested social selection mechanisms as an explanation. It is important to pay attention to the urban environment in smaller localities and especially to the resources and health promotion initiatives available to reinforce nutritional literacy strategies and promote exercise together with initiatives that favor a less sedentary lifestyle in all age brackets.

Eating habits, physical activity, sedentary lifestyle, and hours of sleep have been associated with obesity.^{10,29} Some studies have analyzed the tendency of lifestyles to cluster^{30,31} and their

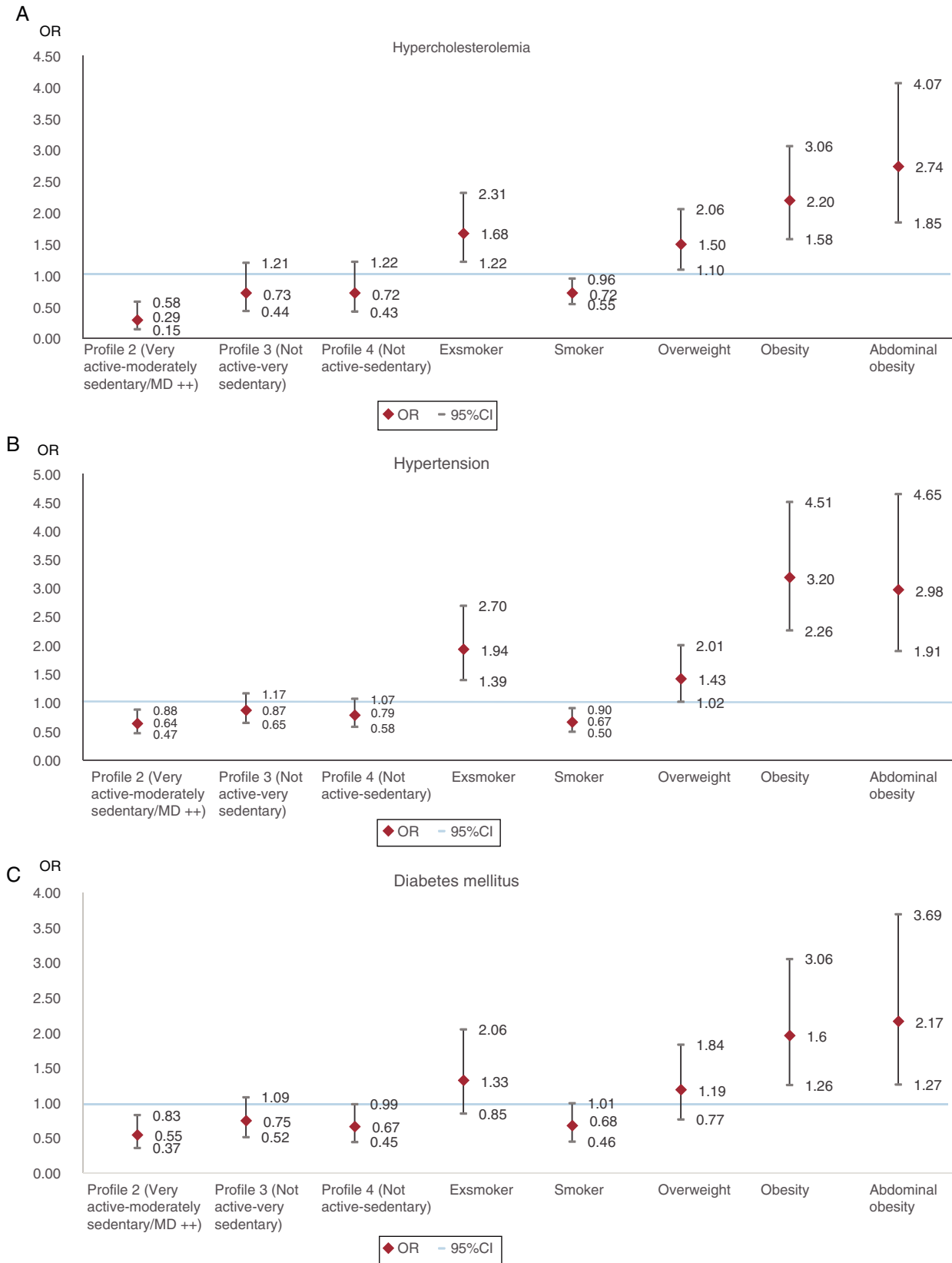


Figure 2. Odds ratios of the prevalence of hypercholesterolemia (A), hypertension (B), and diabetes mellitus (C) according to lifestyle profile, smoking habit, weight classification, and abdominal obesity. Odds ratios of prevalence adjusted for age, sex, socioeconomic level, smoking habit, and lifestyle profile in persons older than 18 years. 95%CI, 95% confidence interval; MD, Mediterranean diet; OR, odds ratio.

Table 3

Prevalence of the clustering of 3 or more biological cardiovascular risk factors and the odds ratio of prevalence according to sociodemographic factors and lifestyles in the population older than 18 years

	n	Prevalence % (95%CI)	Odds ratio OR (95%CI)	P
Sex				.035
Female	342	12.6 (11.4-13.9)	1	
Male	243	9.6 (8.5-10.7)	0.89 (0.72-1.11)	
Age bracket				< .001
19-64 y	210	5.1 (4.5-5.8)	1	
≥ 65 y	375	32.7 (30.0-35.4)	6.76 (5.38-8.48)	
Socioeconomic level				< .001
High-medium high	37	5.4 (3.9-7.4)	0.44 (0.29-0.68)	
Medium-medium	64	5.7 (4.4-7.1)	0.48 (0.34-0.68)	
Low-medium	258	11.9 (10.6-13.4)	0.87 (0.68-1.11)	
Low	222	19.3 (17.1-21.7)	1	
Region				< .001
South	143	10.9 (9.3-12.7)	1	
North-West	66	15.1 (11.9-18.6)	0.98 (0.67-1.43)	
North-East	20	6.2 (3.8-9.0)	0.32 (0.20-0.53)	
Central	155	11.3 (9.7-13.1)	1.01 (0.72-1.42)	
Central-East	33	13.1 (9.2-17.5)	0.89 (0.62-1.28)	
East	167	10.8 (9.3-12.4)	0.91 (0.63-1.32)	
Population size				.094
< 5000 pop	97	11.5 (9.5-13.9)	1	
5000-15 000 pop	119	12.2 (10.3-14.4)	0.87 (0.61-1.25)	
15 000-50 000 pop	100	10.1 (8.4-12.1)	0.93 (0.65-1.33)	
50 000-200 000 pop	113	10.2 (8.5-12.1)	0.80 (0.57-1.14)	
> 200 000 pop	156	11.6 (10.0-13.4)	1.26 (0.91-1.75)	
Smoking habit				< .001
No	403	13.1 (11.9-14.3)	1	
Exsmoker	78	22.3 (18.2-26.9)	2.06 (1.48-2.86)	
Yes	90	5.4 (4.4-6.5)	0.60 (0.44-0.80)	
Lifestyle profile				< .001
1 Non-active-moderate sedentary/Mediterranean diet +/sweetened beverages -	133	16.0 (13.6-18.6)	1	
2 Very active-moderately sedentary/Mediterranean diet++/ dairy foods-cakes+/sweetened drinks +	88	5.8 (4.7-7.0)	0.61 (0.44-0.84)	
3 Not active-very sedentary/neutral diet	180	13.3 (11.6-15.2)	0.99 (0.74-1.32)	
4 Not active-highly sedentary/protein-pasta++/dairy foods-cakes -	112	12.8 (10.6-15.1)	0.79 (0.58-1.08)	

95%CI, 95% confidence interval; OR, odds ratio for prevalence; pop, population.

relationship with obesity. The ENPE study identified 4 dietary patterns and 4 lifestyle profiles. Similar lifestyle patterns have been identified in studies on adults^{27,30} and children and adolescents.³¹ This type of analysis, which analyzes both lifestyle and dietary pattern, is of particular interest because it can be used to design intervention strategies that are adjusted to the characteristics of the group under study. Risk behaviors tend to cluster, whereas higher levels of physical activity tend to cluster with better dietary profiles, although they may differ according to sociodemographic characteristics.^{30,31} The present study found an association between the more active-moderately sedentary profile/MD + + pattern and a lower risk of obesity, dyslipidemia, hypertension, and diabetes.

Spanish studies have used objective indicators to analyze the clustering of CVRFs (obesity, AO, dyslipidemia, hypertension, diabetes).^{27,32,33} Our study found that there was a higher risk of clusters of 3 or more CVRFs in exsmokers than in smokers and persons with a more active-moderately sedentary lifestyle. Other

studies have also found a higher prevalence of CVRF clusters in nonsmokers and former smokers.^{32,34} Being at increased cardiovascular risk could favor smoking cessation in smokers (exsmokers) after receiving medical advice (reverse causality). It is also known that smoking cessation is associated with weight gain, risk of obesity,³⁴ and diabetes.³⁵ Patients with concurrent obesity, dyslipidemia, hypertension, and a smoking habit could have refused to participate or even died and thus would not have been included in the prevalent cases.

Positive associations have been found between smoking and obesity, and even between obesity and the number of cigarettes consumed, especially in adolescents and young adults.³⁴ It would be desirable to reinforce smoking prevention strategies and promote healthy lifestyles in adolescents and young adults. Furthermore, smoking cessation interventions should also include measures aimed at adjusting energy intake and promoting the practice of physical activity to avoid or limit weight gain.

Strengths and limitations

The ENPE study had several strengths. It included a random sample that was representative of the Spanish population that ensured 400 interviews in each autonomous community. Anthropometric data were collected by individual measurement following a well-designed protocol, and by the careful selection and calibration of the measuring devices and thorough training of the interviewers. Quality controls were applied throughout the process. Valid measurements were obtained in more than 94% of the sample.

Among the limitations, the cross-sectional design of the study does not allow us to establish causal associations with other factors. The presence of risk factors such as dyslipidemia, hypertension, and diabetes was based on self-reports, which may lead to response bias. The target sample size was reached, although some authors of other studies have reported difficulties in the selection and participation of persons at the extremes of the socioeconomic distribution. No information is available on persons who refused participation, and so it is not possible to assess selection bias.

A previous study that provided a mathematical model of adulthood obesity as an epidemic in Spain suggested that it would only be mitigated by the implementation of prevention strategies aimed at controlling the progression from normal weight to overweight to obesity.³⁶

CONCLUSIONS

In the Spanish population, the prevalence of obesity and AO is high, the prevalence of AO is higher in men, both conditions increase with age, and both are inversely associated with socioeconomic level. Lifestyle profiles combining a higher level of physical activity, a moderately sedentary lifestyle, and a Mediterranean dietary pattern are associated with a lower risk of obesity, AO, and CVRFs. Early intervention strategies that promote better eating habits, increased physical activity, and reducing sedentariness are key to the prevention of these problems. The prescription of dietary advice and physical exercise is also essential in the treatment of affected individuals.

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CONFLICTS OF INTEREST

None declared.

WHAT IS KNOWN ABOUT THE TOPIC?

- The prevalence of obesity in Spain is high, contributes to the onset of cardiovascular and other chronic diseases, and is associated with impaired quality of life and premature mortality. This relationship may be affected by the distribution of body fat.

WHAT DOES THIS STUDY ADD?

- This study provides recent data on the prevalence of obesity and AO in the general Spanish population, in a nationwide sample, based on individual anthropometric measurements. We analyzed the influence of socio-demographic factors, lifestyle patterns and their association with CVRFs. The study provides estimates that are comparable with those of other studies conducted in Spain and other countries.

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