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Original Article

Prevalence and Related Risk Factors of Overweight and Obesity among the Adult Population in the Balearic Islands, a Mediterranean Region

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Key Words
Overweight · Obesity · Abdominal obesity · Adults · Balearic Islands

Abstract
Objective: To assess the prevalence and risk factors of overweight (OW) and obesity (OB) by BMI and abdominal obesity (AO) by waist-to-height ratio, (WHtR) among the Balearic Islands' adult population. ***Methods:*** Cross-sectional nutritional survey carried out in the Balearic Islands (2009–2010). A random sample (n = 1,081) of young (18–35 years) and middle-aged adults (36–55 years) were interviewed and anthropometrically measured. OW (BMI 25.0–29.9 kg/m^2) and OB (BMI ≥ 30 kg/m^2) were defined according to WHO criteria. AO was defined as WHtR ≥ 0.5. Socio-economic and lifestyle determinants were considered. ***Results:*** The overall prevalence of OW/OB and AO was 29.4% (95% confidence interval (95% CI) 26.9–32.3%), 11.2% (95% CI 9.5–13.2%) and 33.1% (95% CI 30.4–36.0%), respectively. Men showed higher prevalence of OW (35.9%, 95% CI 31.6–40.5%) and AO (37.9%, 95% CI 33.6–42.5%) than women (OW 24.9%, 95% CI 21.7–28.4%; AO 29.7%, 95%CI 26.2–33.4%). Overall prevalence of OB was 11.8% (95% CI 9.1–15.1%) in men and 10.8% (95% CI 8.6–13.5%) in women. Age and no leisure-time physical activity (LTPA) were main risk factors associated with OW/OB and AO. Living with at least one child at home and to be married in men as well as to be unemployed, to be born in South America, and a low level of education in women were associated with AO. ***Conclusions***: Men showed higher prevalence of OW and AO than women. In both sexes, age is the main risk factor associated with OW/OB and AO; in men also the absence of LTPA plays a significant role.

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Introduction

Overweight and obesity are one of the most serious public health challenges of the 21st century that pose a major risk for serious diet-related chronic diseases (i.e., cardiovascular disease, type 2 diabetes, hypertension and stroke, and certain forms of cancer), physical disabilities, musculoskeletal disorders, asthma, predisposition to some infections, and economic consequences [1–4]. Its prevalence has tripled in many countries in the World Health Organization (WHO) European Region since the 1980s, and the number of those affected continues to rise at an alarming rate [5]. It has been pointed out that obesity in men shifted into a higher category in eight of the nine countries with available self-reported weight and height from 1981 to 2010 (i.e., the Czech Republic, Estonia, Finland, France, Italy, Lithuania, Latvia, Spain, and Switzerland), and in six of the nine countries in women [6]. In Spain, according to the nationally representative survey carried out in 2011–2012 among individuals aged 18 years or above, the prevalence of overweight/obesity and obesity was 53.7% and 17.0%, respectively (based on self-reported weight and height), which makes it one of the European countries with the highest frequency of overweight and obesity [5]. In the Balearic Islands, the overall prevalence of overweight and obesity estimated for the adult population in 1999–2000 was 27.8% and 13.1%, respectively [7].

Although there are both genetic and environmental causes of overweight, the increase in its prevalence worldwide is likely to be closely associated with changes in environmental factors. In 1999–2000, the predictors of overweight and obesity in the Balearic Islands were to be over 40 years old, to be married, to be on the lowest educational levels, and to have a sedentary lifestyle [7]. Nevertheless, the first decade of the 21st century has witnessed remarkable demographic and socio-cultural changes (i.e., education, family structures, immigration patterns, etc.) in Europe and also in Spain. In the Balearic Islands, an archipelago off the eastern coast of Spain, diet and current food patterns have currently been affected by the development of tourism, a high population growth after the arrival of people from abroad, and then the introduction of new socio-cultural habits [8]. Therefore, the aim of this study was to assess the current prevalence of overweight, obesity, abdominal obesity, and related risk factors in adults of the Balearic Islands, a Mediterranean region. So, the first objective of this study was to assess the prevalence of overweight and obesity as well as of abdominal obesity among the adult population in the Balearic Islands. Secondly, the relationship between socio-demographic and lifestyle habits and overweight and abdominal obesity were also assessed. Finally, energy and nutrient intakes among overweight and abdominally obese subjects were also compared with those of their leaner counterparts.

Participants and Methods

Study Design

The study is a population-based cross-sectional nutritional survey carried out in 2009–2010 in the Balearic Islands, Spain.

Study Population, Recruitment, and Approval

This study is part of the Obesity and Oxidative Stress (OBEX) survey (2009–2010). The target population consisted of all inhabitants aged 16–65 years living in the Balearic Islands; the sample population was derived from 16- to 65-year-old residents registered in the official population census of the Balearic Islands

[9]. The theoretical sample size was set at 1,500 individuals to provide a specific relative precision of 5% (type I error, 0.05; type II error, 0.10) and taking into account an anticipated 70% participation rate. The sampling technique included stratification according to geographical area and municipality size, age (3 strata), and sex of inhabitants that were randomized into subgroups, with Balearic Islands municipalities being the primary sampling units and individuals within these municipalities comprising the final sample units [9]. Pregnant women were not considered in this study. The final sample was 1,388 (93% participation).

Sample Selection

This analysis was limited to adult participants aged 18–55 years, with no missing data to calculate their BMI (n = 1,081). Participants were classified into two groups according to their age: young adults (18–35 years) and middle-aged adults (36–55 years). This sample size was considered sufficient to detect risk factors with 95% confidence and a precision rate of 3.0%. This sample size also calculated a prevalence with 95% confidence, and a precision rate of 3.7% and 5.0% in young (18–35 years, n = 704) and middle-aged (36–55 years, n = 377) participants, respectively. Moreover, this sample size was considered representative and sufficient to detect obesity and related risk factors with a precision rate of 4.5% in men (young adults: 5.3%; middle-aged adults: 8.5%) and 3.8% in women (young adults: 4.9%; middle-aged adults: 6.0%). Pregnant women were not considered in this study.

Ethics

The study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures were approved by the Balearic Islands Ethics Committee. Written informed consent was obtained from all subjects.

Anthropometric Measurements

Anthropometric measurements were performed by well-trained observers in order to minimize the inter-observer coefficients of variation. Height was determined using a mobile anthropometer (Kawe 44444; Kirchner & Wilhelm GmbH + Co. KG, Asperg, Germany) to the nearest millimeter, with the subject's head in the Frankfurt plane. Body weight was determined to the nearest 100 g using a digital scale (Tefal sc9210; Tefal, Rumilly, France). The subjects were weighed in bare feet and light clothes, noting and subtracting the weight of the clothes. Waist circumference (WC) was measured as the smallest horizontal girth between the costal margins and the iliac crests at minimal respiration using a flexible, non-extensible plastic tape with 0.1 cm precision (Kawe 43972; Kirchner & Wilhelm GmbH + Co. KG). Weight and height measures were used to calculate BMI (in kg/m^2). Overweight and obesity were defined as BMI 25.0–29.9 kg/m^2 and ≥30 kg/m^2, respectively [1]. WC and height measures were used to calculate waist-to-height ratio (WHtR). Abdominal obesity was defined as a WHtR ≥ 0.5 [10].

Socio-Economic and Lifestyle Determinants

Participants were interviewed using a questionnaire that includes the following questions: age (grouped into two categories: young adults (18–35 years) and middle-aged adults (36–55 years)); place of birth (defined as being born in the Balearic Islands; other regions of Spain; South America; other countries); marital status (single; married or coupled (including unmarried, divorced or widowed living actually with a partner); divorced or widowed); living with children (none; at least one child at home); educational level (grouped according to years and type of education: <6 years at school = low; 6–12 years of education = medium; >12 years of education = high); and professional profile (student; unemployed (including homemaker, incapacity, retired); employed). Information about smoking habits (yes; occasionally; no) and leisure time physical activity (LTPA: yes; no) was also collected.

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Energy and Nutrient Intakes

For energy intake (EI), two non-consecutive 24-hour diet recalls were obtained from the participants. Well trained dieticians administered the recalls and verified and quantified the food records. Volumes and portion sizes were reported in natural units, household measures, or with the aid of a book of photographs [11]. To account for day-to-day intake variability, the questionnaires were conducted every other day of the week from Monday to Sunday, and the means of total EI (expressed as MJ and kJ/kg/day) and % of EI from selected nutrient intakes (i.e., proteins, carbohydrates, total fats, saturated fatty acids (SFA), and alcohol) were used. Conversion of food into nutrients was made using a computer program (ALIMENTA®; NUCOX, Palma, Spain) based on Spanish [12, 13] and European [14] food composition tables, and complemented with food composition data available for Majorcan food items [15]. Identification of under-reporters of food intake was made using the Goldberg cut-off (EI / basal metabolic rate < 1.14 classified the individual as an under-reporter) [16]. Under-reporters (n = 330) were not considered in the energy and nutrient analysis.

Statistics

Analyses were performed with the SPSS statistical software package version 21.0 (SPSS Inc., Chicago, IL, USA). Analyses were stratified by gender. Significant differences in prevalence were calculated by means of chi-square testing. Differences in anthropometric and dietary intake data were tested by an unpaired Student's t-test. Differences in dietary intake means were also compared using an analysis of covariance (ANCOVA) after adjustment for potential confounding factors (i.e., age, educational profile, and professional profile). Logistic regression models with the calculations of corresponding odds ratio (OR) and 95% confidence intervals (CI) were used to examine the possible association between socio-demographic or lifestyle characteristics (independent variables) and overweight/obesity or abdominal obesity (dependent variables). Univariate analysis was first carried out for all socio-demographic and lifestyle variables that could be associated with the frequency of overweight/obesity or abdominal obesity. Multivariate analyses (multiple logistic regressions considering the simultaneous effect of all explanatory variables) were also used to examine the effect of the different socio-demographic and lifestyle variables on the prevalence of overweight/obesity or abdominal obesity. The study of possible differences in food patterns between overweight/obese and non-overweight/non-obese subjects, and also for those who were and were not abdominally obese, were adjusted by confounding factors (i.e., age, educational level, and professional profile). Level of significance for acceptance was $p < 0.05$.

Results

The anthropometrical characteristics of participants as well as overweight, obesity and abdominal obesity prevalence are described in table 1. The mean age (± standard deviation (SD)) of the participants was 31.9 ± 10.8 years. Men showed higher values than women in weight, height, BMI, WC and WHtR. The overall prevalence of overweight, obesity and abdominal obesity was 29.4% (95% CI 26.9–32.3%), 11.2% (95% CI 9.5–13.2%) and 33.1% (95% CI 30.4–36.0%), respectively. While no differences between genders were established for the frequency of obesity, men presented higher prevalences of overweight (35.9%; 95% CI 31.6–40.5%) and abdominal obesity (37.9%; 95% CI 33.6–42.5%) than women (24.9% (95% CI 21.7–28.4%) and 29.7% (95% CI 26.2–33.4%)). Moreover, in middle-aged adults higher values for the anthropometrical measurements as well as for overweight, obesity and abdominal obesity prevalence were found than in young adults.

In both sexes, the univariate analysis with socio-demographic and lifestyle variables (tables 2 and 3) showed that the risk of overweight/obesity and abdominal obesity was higher in middle-aged adults than in young adults. In men, the risk of overweight/obesity and abdominal obesity was more than twice as high in the married or partnered group than in the student group, and subjects living with at least one child at home were also more likely to be

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Table 1. Anthropometric characteristics, overweight, obesity and abdominal-obesity prevalence among Balearic Islands' adult population

	Men (n = 451)	Women (n = 630)	p value
Weight, kg†	78.5 ± 13.8	64.1 ± 12.9	<0.001
18–35 years old	77.0 ± 13.4	62.4 ± 12.4	<0.001
36–55 years old	82.7 ± 14.1	66.9 ± 13.3	<0.001
p value	<0.001	<0.001	
Height, cm†	175.6 ± 6.7	161.6 ± 6.4	<0.001
18–35 years old	176.0 ± 6.5	162.1 ± 6.4	<0.001
36–55 years old	174.4 ± 7.0	160.9 ± 6.4	<0.001
p value	0.029	0.017	
BMI, kg/m^2†	25.5 ± 4.1	24.6 ± 4.9	0.001
18–35 years old	24.9 ± 4.0	23.7 ± 4.4	<0.001
36–55 years old	27.1 ± 4.0	25.9 ± 5.1	0.017
p value	<0.001	<0.001	
Prevalence of overweight, %‡	35.9 (31.6–40.5)	24.9 (21.7–28.4)	<0.001
18–35 years old	31.0 (26.2–36.2)	20.9 (17.1–25.3)	0.002
36–55 years old	48.8 (40.2–57.5)	31.0 (25.6–36.9)	0.001
p value	0.001	0.007	
Prevalence of obesity, %‡	11.8 (9.1–15.1)	10.8 (8.6–13.5)	0.622
18–35 years old	8.9 (6.3–12.5)	7.7 (5.4–10.8)	0.556
36–55 years old	19.2 (13.3–27.0)	15.5 (11.5–20.5)	0.362
p value	0.009	0.003	
Waist circumference, cm†	86.5 ± 12.8	76.9 ± 11.2	<0.001
18–35 years old	83.9 ± 11.6	73.9 ± 9.6	<0.001
36–55 years old	93.5 ± 13.0	81.2 ± 12.0	<0.001
p value	<0.001	<0.001	
WHtR†	0.49 ± 0.07	0.48 ± 0.07	<0.001
18–35 years old	0.48 ± 0.07	0.46 ± 0.06	<0.001
36–55 years old	0.54 ± 0.07	0.51 ± 0.08	<0.001
p value	<0.001	<0.001	
Prevalence of abdominal obesity, %‡	37.9 (33.6–42.5)	29.7 (26.2–33.4)	0.005
18–35 years old	26.2 (21.7–31.3)	19.9 (16.2–24.3)	0.047
36–55 years old	68.5 (59.9–76.1)	44.2 (38.2–50.4)	<0.001
p value	<0.001	<0.001	

†Mean ± SD; differences tested by unpaired Student's t-test.
‡% (95% CI); differences tested by chi-square test.

overweight/obese than those with no child at home. Employed and unemployed subjects were more likely to be overweight/obese and abdominally obese than the student group. Contrary to these results, men with a medium level of education showed a 54% lower risk of abdominal obesity. Finally, LTPA decreases ~40% the risk of overweight/obesity and abdominal obesity. In women, marital status and living with at least one child at home were also directly associated with a high risk of overweight/obesity and abdominal obesity. Women who were born in South America showed a 1.8 higher risk of abdominal obesity than those who were born in the Balearic Islands. A 56% lower risk of overweight/obesity was observed in women with a high level of education. In women, educational level was also inversely asso-

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Table 2. Socio-demographic and lifestyle characteristics among Balearic Islands' men classified as overweight/obesity (BMI ≥ 25 kg/m^2) and showing abdominal obesity (WHtR ≥ 0.5)

	Overweight/obesity				Abdominal obesity			
	BMI < 25 kg/m^2 N (%)	BMI ≥ 25 kg/m^2 N (%)	crude OR[a] (95% CI)	adjusted OR[b] (95% CI)	WHtR < 0.5 N (%)	WHtR ≥ 0.5 N (%)	crude OR[a] (95% CI)	adjusted OR[b] (95% CI)
Age group								
18–35 years old	196 (60.1)	130 (39.9)	1.00	1.00	241 (73.8)	85 (26.2)	1.00	1.00
36–55 years old	40 (32.0)	85 (68.0)	3.20 (2.07, 4.96)***	2.95 (1.63, 5.33)***	39 (31.5)	86 (68.5)	6.13 (3.90, 9.64)***	5.83 (3.09, 1.99)***
Place of birth								
Balearic Islands	159 (51.2)	181 (48.8)	1.00	1.00	189 (60.9)	121 (39.1)	1.00	1.00
Other regions from Spain	51 (52.8)	45(47.2)	0.94 (0.58, 1.50)	0.87 (0.51, 1.51)	61 (63.6)	35 (36.4)	0.89 (0.55, 1.46)	0.70 (0.38, 1.29)
South America	17 (63.0)	10 (37.0)	0.62 (0.27, 1.39)	0.97 (0.41, 2.31)	18 (66.7)	9 (33.3)	0.78 (0.34, 1.79)	1.61 (0.64, 4.04)
Other countries	9 (50.0)	9 (50.0)	1.04 (0.41, 2.71)	0.97 (0.34, 2.75)	12 (64.7)	6 (35.3)	0.85 (0.31, 2.36)	0.73 (0.21, 2.53)
Marital status								
Single	158 (61.2)	100 (38.8)	1.00	1.00	186 (71.9)	72 (28.1)	1.00	1.00
Married or coupled	72 (39.8)	109 (60.2)	2.39 (1.62, 3.53)***	1.16 (0.64, 2.10)	87 (47.8)	94 (52.2)	2.79 (1.87, 1.47)***	0.78 (0.41, 1.50)
Divorced or widowed	6 (50.0)	6 (50.0)	1.58 (0.50, 5.04)	0.72 (0.19, 2.65)	8 (66.7)	4 (33.3)	1.28 (0.37, 4.38)	0.30 (0.07, 1.27)
Living with children								
None	204 (57.8)	149 (42.2)	1.00	1.00	248 (70.3)	105 (29.7)	1.00	1.00
At least one child at home	32 (32.7)	66 (67.3)	2.82 (1.76, 1.53)***	1.28 (0.66, 2.49)	32 (32.7)	66 (67.3)	4.88 (3.02, 7.89)***	2.06 (1.02, 4.17)*
Educational level								
Low	11 (37.9)	19(62.1)	1.00	1.00	14 (48.3)	16 (51.7)	1.00	1.00
Medium	146 (57.1)	110 (42.9)	0.46 (0.21, 1.01)	0.66 (0.26, 1.67)	172 (67.1)	84 (32.9)	0.46 (0.21, 0.99)*	0.88 (0.33, 2.34)
High	78 (47.0)	87 (53.0)	0.69 (0.31, 1.55)	0.87 (0.33, 2.26)	92 (55.8)	73 (44.2)	0.74 (0.34, 1.63)	1.17 (0.43, 3.22)
Professional profile								
Student	77 (62.0)	47 (38.0)	1.00	1.00	96 (77.7)	28 (22.3)	1.00	1.00
Unemployed	10 (38.5)	16 (61.5)	2.61 (1.09, 6.23)*	1.50 (0.59, 3.83)	13 (50.0)	13 (50.0)	3.48 (1.44, 8.39)**	2.04 (0.76, 5.48)
Employed	147 (49.0)	153 (51.0)	1.70 (1.10, 2.62)*	0.93 (0.52, 1.66)	169 (56.3)	131 (43.7)	2.70 (1.66, 4.39)***	1.58 (0.82, 3.07)
Current smoking habit								
No	53 (53.3)	47 (46.7)	1.00	1.00	64 (63.9)	36 (36.1)	1.00	1.00
Occasionally	12 (44.4)	15 (55.6)	1.14 (0.72, 1.80)	1.20 (0.71, 2.02)	17 (63.0)	10 (37.0)	1.43 (0.91, 2.29)	1.70 (0.97, 2.99)
Yes	162 (50.0)	162 (50.0)	1.43 (0.65, 3.14)	1.79 (0.75, 4.28)	179(55.2)	145 (44.8)	1.04 (0.46, 2.35)	1.62 (0.63, 4.19)
LTPA								
No	59 (43.8)	75 (56.2)	1.00	1.00	70 (52.3)	64 (47.7)	1.00	1.00
Yes	176 (55.6)	141 (44.4)	0.62 (0.41, 0.94)*	0.50 (0.31, 0.81)**	207 (65.2)	110 (34.8)	0.59 (0.39, 0.89)*	0.40 (0.24, 0.68)**

[a] Univariate analysis (logistic regression analysis considering the effect of one explanatory variable). *p < 0.05, **p < 0.01, ***p < 0.001.
[b] Multivariate analyses (multiple logistic regressions considering the simultaneous effect of all the explanatory variables). *p < 0.05, **p < 0.01, ***p < 0.001.

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Table 3. Socio-demographic and lifestyle characteristics among Balearic Islands' women classified as overweight/obese (BMI ≥ 25 kg/m^2) and showing abdominally obese (WHtR ≥ 0.5)

	Overweight/obesity				Abdominal obesity			
	BMI < 25 kg/m^2 N (%)	BMI ≥ 25 kg/m^2 N (%)	crude OR[a] (95% CI)	adjusted OR[b] (95% CI)	WHtR < 0.5 N (%)	WHtR ≥ 0.5 N (%)	crude OR[a] (95% CI)	adjusted OR[b] (95% CI)
Age group								
18–35 years old	270 (71.4)	108 (28.6)	1.00	1.00	303 (80.1)	75 (19.9)	1.00	1.00
36–55 years old	136 (53.8)	116 (46.2)	2.15 (1.54, 3.00)***	1.85 (1.18, 2.90)**	141 (55.8)	111 (44.2)	3.19 (2.24, 4.56)***	2.41 (1.48, 3.93)***
Place of birth								
Balearic Islands	259 (65.5)	136 (34.5)	1.00	1.00	282 (71.5)	113 (28.5)	1.00	1.00
Other regions from Spain	97 (68.5)	44 (31.5)	0.87 (0.57, 1.34)	0.84 (0.53, 1.33)	102 (72.3)	39 (27.7)	0.96 (0.62, 1.50)	0.88 (0.53, 1.47)
South America	38 (53.7)	32 (46.3)	1.63 (0.97, 2.76)	1.63 (0.91, 2.92)	41 (58.2)	29 (41.8)	1.80 (1.06, 3.07)*	2.07 (1.10, 3.89)*
Other countries	11 (47.8)	13 (52.2)	2.06 (0.89, 4.81)	1.76 (0.68, 4.55)	14 (56.5)	10 (43.5)	1.93 (0.82, 4.53)	1.49 (0.54, 4.13)
Marital status								
Single	196 (72.8)	73 (27.2)	1.00	1.00	221 (82.3)	48 (17.7)	1.00	1.00
Married or coupled	195 (59.1)	135 (40.9)	1.85 (1.30, 2.61)**	1.41 (0.86, 2.29)	206 (62.5)	124 (37.5)	2.79 (1.89, 4.11)***	1.83 (1.05, 3.17)*
Divorced or widowed	14 (45.2)	17 (54.8)	3.24 (1.52, 6.91)**	2.19 (0.90, 5.29)	15 (48.4)	16 (51.6)	4.95 (2.29, 10.70)***	2.59 (1.02, 6.55)*
Living with children								
None	279 (69.7)	121 (30.3)	1.00	1.00	312 (78.0)	88 (22.0)	1.00	1.00
At least one child at home	125 (54.4)	105 (45.6)	1.93 (1.37, 2.70)***	0.96 (0.59, 1.56)	129 (56.0)	101 (44.0)	2.79 (1.95, 3.98)***	1.23 (0.73, 2.06)
Educational level								
Low	26 (52.1)	23 (47.9)	1.00	1.00	24 (48.9)	25 (51.1)	1.00	1.00
Medium	191 (60.6)	125 (39.4)	0.71 (0.38, 1.30)	1.00 (0.51, 1.96)	208 (65.9)	108 (34.1)	0.49 (0.26, 0.92)*	0.91 (0.45, 1.84)
High	189 (71.2)	76 (28.8)	0.44 (0.24, 0.83)**	0.61 (0.30, 1.24)	213 (80.2)	52 (19.8)	0.24 (0.12, 0.45)***	0.44 (0.21, 0.93)*
Professional profile								
Student	89 (69.7)	38 (30.3)	1.00	1.00	101 (79.5)	26 (20.5)	1.00	1.00
Unemployed	25 (44.6)	31 (55.4)	2.85 (1.48, 5.47)**	1.87 (0.87, 4.00)	23 (41.8)	33 (58.2)	5.40 (2.70, 10.80)***	2.59 (1.13, 5.96)*
Employed	291 (65.2)	156 (34.8)	1.23 (0.79, 1.89)	1.05 (0.61, 1.81)			1.57 (0.97, 2.56)	1.18 (0.64, 2.21)
Current smoking habit								
No	272 (64.4)	150 (35.6)	1.00	1.00	298 (70.7)	124 (29.3)	1.00	1.00
Occasionally	20 (62.5)	12 (37.5)	1.04 (0.72, 1.50)	1.07 (0.70, 1.63)	24 (75.0)	8 (25.0)	1.17 (0.80, 1.72)	1.17 (0.74, 1.85)
Yes	112 (63.6)	64 (36.4)	1.09 (0.52, 2.29)	1.24 (0.55, 2.79)	118 (67.2)	58 (32.8)	0.80 (0.35, 1.84)	0.81 (0.32, 2.07)
LTPA								
No	188 (60.8)	121 (39.2)	1.00	1.00	200 (64.6)	109 (35.4)	1.00	1.00
Yes	217 (67.6)	104 (32.4)	0.74 (0.54, 1.03)	0.84 (0.58, 1.22)	243 (75.6)	78 (24.4)	0.59 (0.41, 0.83)**	0.66 (0.44, 0.99)*

[a] Univariate analysis (logistic regression analysis considering the effect of one explanatory variable). *p < 0.05, **p < 0.01, ***p < 0.001.
[b] Multivariate analyses (multiple logistic regressions considering the simultaneous effect of all the explanatory variables). *p < 0.05, **p < 0.01, ***p < 0.001.

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Table 4. Comparison of energy and nutrient intake (mean ± SD) of subjects being overweight/obese versus those being non-overweight/non-obese and of those being abdominally obese versus those being not abdominally obese

	Overweight/obesity				Abdominal obesity			
	BMI < 25 kg/m^2	BMI ≥ 25 kg/m^2	crude analysis[a]	adjusted analysis[b]	WHtR < 0.5	WHtR ≥ 0.5	crude analysis[a]	adjusted analysis[b]
Men (n)	159	110			185	83		
EI, MJ	10.9 ± 2.8	11.2 ± 2.5	0.376	0.070	10.9 ± 2.6	11.0 ± 2.7	0.803	0.054
EI, kJ/kg/day	158.4 ± 45.6	132.5 ± 29.0	<0.001	<0.001	154.2 ± 42.9	131.1 ± 29.5	<0.001	0.043
Energy from proteins, %	17.0 ± 4.7	16.5 ± 4.3	0.421	0.628	17.2 ± 4.5	15.9 ± 4.4	0.037	0.049
Energy from carbohydrates, %	43.7 ± 8.1	44.5 ± 8.4	0.460	0.105	44.0 ± 8.3	44.0 ± 8.1	0.997	0.136
Energy from total fat, %	37.4 ± 7.4	36.6 ± 8.1	0.435	0.271	37.1 ± 7.4	37.0 ± 8.4	0.916	0.442
Energy from SFA, %	5.7 ± 1.7	5.2 ± 1.5	0.011	0.159	5.7 ± 1.7	5.0 ± 1.5	0.002	0.131
Energy from alcohol, %	1.0 ± 2.6	1.3 ± 2.9	0.436	0.605	0.8 ± 2.4	1.7 ± 3.3	0.014	0.404
Women (n)	344	139			372	112		
EI, MJ	8.9 ± 2.1	8.7 ± 1.8	0.583	0.984	8.9 ± 2.1	8.6 ± 1.8	0.262	0.777
EI, kJ/kg/day	157.3 ± 44.4	120.5 ± 25.5	<0.001	<0.001	154.7 ± 44.1	120.7 ± 28.1	<0.001	<0.001
Energy from proteins, %	16.8 ± 5.0	17.6 ± 5.3	0.121	0.145	16.8 ± 5.0	17.6 ± 5.5	0.148	0.248
Energy from carbohydrates, %	43.5 ± 8.1	41.5 ± 10.2	0.021	0.050	43.1 ± 8.3	42.3 ± 10.3	0.374	0.573
Energy from total fat, %	39.9 ± 7.9	40.0 ± 9.2	0.183	0.250	39.3 ± 8.0	38.9 ± 9.3	0.652	0.611
Energy from SFA, %	5.7 ± 1.7	5.9 ± 1.9	0.267	0.134	5.8 ± 1.8	5.7 ± 1.9	0.686	0.759
Energy from alcohol, %	0.5 ± 1.3	0.5 ± 1.4	0.747	0.652	0.4 ± 1.2	0.6 ± 1.5	0.142	0.580

[a] Differences between group means were tested by an unpaired Student's t-test.

[b] Differences between group means adjusted by confounding data (age, educational profile and professional profile) were tested by ANCOVA.

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ciated with abdominal obesity. Moreover, unemployed women were more likely to be overweight/obese and abdominally obese than students. Women who reported LTPA were also 41% less likely to have abdominal obesity. In our study, current smoking habits were not associated with overweight/obesity or abdominal obesity.

The multivariate analysis, considering the simultaneous effect of all the studied variables, showed that in men the risk of overweight/obesity and abdominal obesity was higher in middle-aged than in young adults and it was also lower in subjects who reported LTPA. Moreover, their risk of abdominal obesity was twice as great if they were living with at least one child. The other variables (i.e., marital status, educational level, and professional profile) lost their statistical significance after being adjusted for all studied variables. As has been described in men, in women the risk of overweight/obesity and abdominal obesity was also higher in middle-aged than in young adults. A higher risk of abdominal obesity was shown in women who were born in South America, were married or partnered (unmarried, separated or divorced) and were unemployed. Moreover, LTPA and a high level of education were significantly associated with a lower risk of abdominal obesity. In women, the living with children variable lost its statistical significance after being adjusted for all studied variables.

Table 4 shows the energy and nutrient intake (mean ± SD) of men and women with no overweight/obesity versus overweight/obesity and no abdominal obesity versus abdominal obesity, after excluding under-reporters. In both sexes, overweight/obese or abdominally obese subjects presented a higher percentage of under-reporters (data not shown). Overweight/obese and abdominally obese men showed lower EI (kJ/kg/day) and %EI from SFA than their leaner counterparts. Furthermore, men with abdominal obesity presented lower %EI from proteins and higher %EI from alcohol. Differences in EI (kJ/kg/day) and %EI from proteins between groups remained stable after controlling for age as well as educational and professional profiles. On the other hand, the significant differences shown for %EI from SFA and %EI from alcohol disappeared after considering the simultaneous effect of all previous variables. Overweight/obese and abdominally obese women showed lower EI (kJ/kg/day) and overweight/obese women lower %EI from carbohydrates than their lean counterparts. These differences remained stable after controlling for age as well as educational and professional profiles.

Discussion

Overweight, Obesity and Abdominal Obesity Prevalence

Firstly, the results of this study revealed an overall overweight and obesity prevalence of 29.4% (95% CI 26.9–32.3%) and 11.2% (95% CI 9.5–13.2%), respectively. In Europe, overweight and obesity affect 30–80% of the adult population (≥20 years old) [17]. In the intercountry comparable overweight and obesity estimates from 2008, more than 50% of adults (≥20 years old; both genders) were overweight in 46 out of the 51 countries, and more than 20% were obese in 40 countries [18]. Despite the differences in the ages studied which hampered direct comparisons, our results showed lower rates of overweight and obesity than those estimated by the WHO for the Spanish adult (≥20 years old) population (45.1% and 26.6%, respectively) [19] and also by a national survey (based on self-reported weight and height) carried out in 2011–2012 (53.7% and 17.0%, respectively) [5]. Secondly, our results also revealed that more than one third of the population showed abdominal obesity, which was also lower than in other previous studies conducted in Spain [20] and also Puerto Rico [21].

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Socio-Demographic and Lifestyle Factors

Gender and Age

BMI and WHtR increase with age, and older subjects show a higher frequency of overweight, obesity and abdominal obesity than younger ones [6]. Independently of age and in accordance with the DARIOS study (Dyslipidemia, Atherosclerotic Risk, Increased high-sensitivity C-reactive protein, and inflammatory and Oxidative status in Spanish population) – a population-based study conducted in 10 geographical areas of Spain since 2000 –, the prevalence of overweight in Spain was higher in men than in women (35.9% and 24.9%, respectively), while the proportion of obese adults did not differ between men and women (around 11% for both genders) [22]. Nevertheless, the DARIOS study reported a higher prevalence of overweight and obesity for both men (50.7% and 28.0%, respectively) and women (35.6% and 28.3%, respectively) [22]. In comparison to data from other countries, the incidence of overweight and obesity in the Balearic Islands' men was also lower than that reported in American and Oceanic countries (e.g., USA, Canada, Mexico, Chile, and Australia) but higher than in Asian countries (e.g., India, China, and Japan) and European countries e.g., Belgium, Denmark and Italy) [23]. In contrast, Balearic Islands' women showed lower overweight and obesity prevalence whatever the European country they were compared to [23]. Finally, in agreement with the literature, gender differences in abdominal obesity were also found, with higher prevalence in men than in women (37.9% vs. 29.7%) [21]. This could be associated to the sedentary lifestyle, which is more common in Spanish women than in men [24]. Differences in gender fat distribution [25] and in eating behavior [26] may also play a key role in the fat distribution.

Place of Birth

Spain, not so long ago a source of emigration, experienced a significant increase in immigration rates in the first decade of the 21st century [27]. Specifically, the Balearic Islands experienced a high population growth (+26.7%), and the foreign population increased by 228.7% (i.e., it has increased 3.2-fold) [28]. In this study, women who were born in South America showed twice the risk of abdominal obesity than those born in the Balearic Islands. Higher obesity rates in Latin American immigrant communities than in natives have been reported previously [29]. Differences in ways of cooking, time for shopping for food and preparing it, the diversity of foods in the receiver country, the kinds of foods available, lower physical activity, stress levels, and, particularly, the price of food and less social support may be associated with a change in dietetic habits [30]. However, differences in the population sampled, and especially the ages of the women, could have also contributed to these observed differences in obesity.

Family and Marital Status

These results agree with previous studies which linked being single with lower frequency of overweight/obesity [31, 32] and abdominal obesity [33] in women. On the other hand, living with at least one child at home was positively associated with abdominal obesity in men. It has been suggested that, after getting married, subjects are less physically active, change their dietary pattern, may be less focused on being attractive, have more social support, or may be exposed to other environmental factors [31]; and this could also happen to men after having a child.

Educational and Professional Profiles and LTPA

Educational level is considered to influence obesity-linked health behavior, such as specific dietary habits and physical exercise [34, 35]. According to previous studies [35–37], an inverse association between educational level and the prevalence of overweight/obesity

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and abdominal obesity in women was found. Furthermore, a high risk of abdominal obesity among unemployed women was also demonstrated, which has also been described previously in industrialized countries [38, 39]. The absence of an association between occupation and overweight/obesity in men could be partly explained by differences in physical demands: low-status jobs may also protect against overweight/obesity and could hide the association between occupation and risk of becoming overweight [35].

Energy and Nutrient Intake

In agreement with previous studies [40], subjects with overweight/obesity and abdominal obesity reported lower EI (expressed as kJ/kg/day) than their lean counterparts. Obese people tend to under-report high-fat and high-carbohydrate foods as well as socially undesirable food (pastries, etc.) and to report higher intakes of healthy food, such as fruit and vegetables [41–43]. In this study, lower %EI from proteins was observed in abdominally obese men compared to their lean counterparts. Physiological evidence shows that high protein intake may increase the thermogenic response and reduce the caloric intake by satiety [43, 44]. Specifically, dairy protein might be the component responsible for beneficial effects on body composition [45]. Nevertheless, while some studies linked high-protein diets to fat loss, weight loss and preventing weight gain [43, 46], other studies have associated protein intake with increased adiposity [47, 48]. Our results also showed lower %EI from carbohydrates in women with excess weight, but there has been some controversy between carbohydrate intake and BMI [40, 49].

Limitations and Strengths

This study has several limitations. The present cross-sectional design gives limited ability to elucidate causal relationship between risk factors and overweight/obesity. Because of the cross-sectional study design, we are not able to make any statements if our age groups contribute to the occurrence or diagnoses of overweight/obesity. Moreover, questionnaires have inherent limitations, mainly because they are subjective in nature. So, our results are limited by the validity of the instruments to measure energy and nutrient intakes in our population. Other studies proposed to not exclude the implausible reporters but, rather, to adjust for them so that the relation between dietary intake and BMI after the stratifying by reporting group was similar to the observed for the plausible subjects [41]. Biomarkers are an alternative to assessing dietary intakes avoiding the bias of self-reported dietary intake [50]. Nevertheless, biomarkers have some limitations, e.g., cost, invasive technique, genetic variability, lifestyle-physiologic factors, dietary factors, biological sample and analytical methodology [51, 52].

On the other hand, this study also has several strengths. This study is representative of the Balearic Islands' population of 18- to 55-year-old adults and provides new data about the current association between body weight or abdominal obesity and socioeconomic or lifestyle determinants. Furthermore, anthropometric data were objectively measured and several statistically known potential confounding factors were controlled in the analysis.

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Conclusion

To sum up, the overall prevalence of overweight, obesity and abdominal obesity in the Balearic Islands' adult population was 29.4%, 11.2% and 33.1%, respectively, and thus lower than the reported data for the Spanish population as a whole. Men presented higher values of overweight and abdominal obesity prevalence than women. In both sexes, the main risk factor associated with overweight/obesity in adults is the age group and in men also the absence of LTPA. In both sexes the main risk factors associated with abdominal obesity are also the age group and the absence of LTPA. In addition in men being married and having at least one child represents a further risk factor as is unemployment, origin from South America, and low level of education in women. A program of action mainly focusing on increasing levels of education, LTPA, and healthy eating habits is needed.

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Disclosure Statement

The authors state that there are not conflicts of interest.

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