Prevalence of overweight and obesity in non-institutionalized people aged 65 or over from Spain: The Elderly EXERNET Multi-center Study

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Abstract

Introduction: coupled with the growth of the older population, an increase in the prevalence of overweight and obesity in this age group has occurred in the last decades. **Aims:** 1) to provide an updated prevalence of overweight and obesity in a representative sample of the Spanish elderly population; 2) to calculate the prevalence of sarcopenic obesity (SO); and 3) to analyze the relationships between adiposity measurements and lifestyle. **Methods:** a cross-sectional study was carried out in a sample of 3136 persons representative of the non-institutionalized population ≥65 years of age. Anthropometric measurements were obtained using standardized techniques and equipment. **Results:** overall, 84% of the population can be categorized as overweight and/or obese. The present study indicates that 67% of the Spanish elderly population has an increased percentage of fat mass and more than 56% suffer from central obesity. Moreover, SO is present in 15% of the Spanish elderly population. Finally, a strong relationship between both physically active and sedentary lifestyles and the level of adiposity was found. **Conclusion:** prevalence of overweight and obesity among elderly people in Spain is very high and is still increasing. Lifestyle seems to be a determinant factor in the development of obesity among elderly people.

Key words: adiposity, aging, sarcopenic obesity, lifestyle, education

Introduction

One of the major changes occurring in Western societies is a significant ageing of the population. Nowadays, due to an enhanced life expectancy, 17% of the Spanish population is composed of people over 65 and the number is expected to rise to 33% in 2050 (1). Coupled with the increased number of elderly people, an increase in the prevalence of overweight and obesity in this age group has occurred, probably due to changes in nutritional habits and lifestyles (2). Although it is widely known that obesity has a profound impact on health and mortality (3-7), not many studies have estimated the overweight and obesity prevalence in representative samples of elderly people in developed countries.

To our knowledge, there is only one previous study in Spain that includes a representative sample of the elderly population and their corresponding overweight and obesity prevalence (8). Gutiérrez-Fisac et al (2004) showed that 81% of men and women aged 60 and more were either overweight or obese in Spain. Nevertheless, because of the large increase in both aging and overweight-obesity prevalence, it is necessary to update these data in this age-group.

The body mass index (BMI) is the most widely used measurement for overweight and obesity in all age-groups and its advantages are widely exploited across disciplines ranging from international surveillance to individual patient assessment (9). However, the fact that aging is accompanied by a reduction in stature (10) and muscle mass (11), and by an increase in and redistribution of body fat (12), could lead to masked-age-related muscle loss and excess of fat (13) in older people with weight and BMI stability. Therefore, it is necessary to use other techniques in order to identify individuals with high adiposity and low muscle mass in this specific population. Waist circumference (WC), and percentage of fat mass (%BF), as well as the combination of low fat-free mass and high fat mass (defined as sarcopenic obesity -SO)(14), will increase accuracy in order to better identify older people with health risks.

It is known that obesity is a multifactorial disorder and, thus, much research has been carried out in order to identify some of the main factors that are important in the development of this health problem (15-20). Education level and lifestyle (sedentary

and physical activity patterns) have been shown to be strongly associated with obesity in both younger populations (21-23) and the elderly (24-26).

Thus, the main aims of the present study were: 1) to provide an updated prevalence of overweight and obesity in a representative sample of the non-institutionalized Spanish elderly population; 2) to calculate for the first time the prevalence of sarcopenic obesity in Spanish elderly; and 3) to analyze the relationships between different adiposity measurements and educational levels, sedentary behaviours and physical activity levels in this population.

Material and methods

The study was carried out within the framework of the elderly EXERNET multi-center study. Briefly, this study was performed on a representative sample of non-institutionalized Spanish seniors aged 65-92 years. The population was selected by means of a multi-step, simple random sampling, taking into account, first, the location (six different regions from Spain: Aragón, Castilla La Mancha, Castilla León, Madrid, Extremadura and Canarias) that ensure the geographic and cultural diversity of the sample, then 3 different cities of each region (the capital of the region and two other cities; one of 10000-40000 habitants and other of 40000-100000 habitants) and, finally, by random assignment of the civic and sports centers. For an estimated error of ± 1.5%, and a variability p=q=0.5 the established number of subjects was 3000 in order to guarantee a representative sample of the whole country. The total number of subjects was uniformly distributed in the six regions and in their corresponding cities. The exclusion criteria were: people under 65 years; those suffering from cancer and/or dementia; and those who were living in nursing homes and/or were not independent or able to take care of themselves. The information was collected through personal interviews using a structured questionnaire, followed by a physical examination to measure anthropometric characteristics. After finishing the field study, the subjects who did not fulfil the inclusion criteria were excluded. A total of 3136 subjects participated, and baseline data were collected between June 2008 and November 2009. The participation rate of the study was 81%. Written informed consent was obtained from all the subjects included. The protocol was approved by the Clinical Research Ethics Committee of Aragón (18/2008). The ethical guidelines for human research studies as stated in the Helsinki Declaration were followed throughout the study.

Anthropometric and body composition measurements

Training workshops were organized to harmonize the assessment of anthropometric measurements before starting the study. These anthropometric measurements were validated by the investigators in a random sample of 100 persons. Intraobserver reliability values were greater than 99% for height and waist circumference and interobserver reliability for both measurements were greater than 97 and 87%, height and waist circumference, respectively. A portable stadiometer with 2.10 m maximum

capacity and a 0.001 m error margin (SECA, Hamburg, Germany) was used to measure height. Subjects stood with their scapula, buttocks and heels resting against a wall; the neck was held in a natural non-stretched position, the heels were touching each other with the toe tips spread to form a 45° angle; and the head was held straight with the inferior orbital border in the same horizontal plane as the external auditory tube (Frankfort's plane)(27).

Weight, percentage of fat mass and muscle mass

A portable bioelectrical impedance analyzer TANITA BC 418-MA (Tanita Corp., Tokyo, Japan) with a 200 kg maximum capacity and a +/- 100 g error margin was used to measure the body mass, the %BF and the muscle mass. Individuals removed shoes, socks, and heavy clothes prior to weighing. In the current study, sex-specific percentage-of-body-fat quintiles were created. For women, the limits for percent of fat quintiles were: (1) ≤35.06; (2) 35.07–38.28; (3) 38.29–40.90; (4) 40.91–43.90; and (5) ≥43.91. The corresponding boundaries for men were: (1) ≤25.18; (2) 25.19–27.82; (3) 27.83–30.33; (4) 30.34–33.07; and (5) ≥33.08.

Full-body skeletal muscle mass was estimated with the predictive equation developed by Janssen et al (28). Skeletal mass (kg) = $[(Ht^2/R - 0.401) + (\text{sex} \times 3.825) + (\text{age in years} \times -0.071)] + 5.102$, where Ht = height in cm, R = resistance in ohms from bioelectrical impedance analysis, and sex = 0 for women and 1 for men. To account for differences in muscle mass as a function of height, relative muscle mass (RMM) was calculated as skeletal muscle (kg)/ height^2 (m^2). As with %BF, the RMM was divided into sex-specific quintiles to facilitate the interpretation of odds ratios. For women, the bounds for relative muscle mass quintiles were: (1) ≤5.80; (2) 5.81–6.19; (3) 6.20–6.56; (4) 6.57–7.00; and (5) ≥7.01. The corresponding bounds for men were: (1) ≤8.11; (2) 8.12–8.61; (3) 8.62–9.01; (4) 9.02–9.50; and (5) ≥9.51.

Body-mass index (BMI) was estimated by dividing weight (kg) by height^2 (m^2). The prevalence of overweight and obesity was calculated according to the WHO guidelines, considering the thresholds of overweight and obesity as a BMI of 25 kg/m^2 and 30 kg/m^2, respectively (29). Waist circumference (WC) was measured using a flexible non-elastic measuring tape. Individuals stood with feet together and arms resting by their sides. The WC was taken as the narrowest point between the inferior rib border and the

iliac crest. The WC was used to identify individuals with central obesity above threshold values of ≥ 88 cm for women and ≥ 102 cm for men (30, 31). The prevalence of overweight and obesity regarding % BF was estimated considering the cut-off points published by Gallagher et al (2000) (32). Values of ≥25% and ≥38%, men and women respectively, were considered as overweight and values of ≥31% and ≥43%, men and women respectively, were considered as obesity.

Calculations

Following previous published criteria for defining SO (33) (Table 1), four groups were created by cross-tabulating quintile scores for %BF and RMM. High body fat was defined as the upper two quintiles for %BF, and low muscle mass was defined as the lower two quintiles for RMM. Body fat in the lower three quintiles and muscle mass in the upper three quintiles were considered normal. Using these cutoffs, the four groups included were: 1) normal body fat and muscle mass; 2) high body fat only (and normal muscle mass); 3) low muscle mass only (and normal body fat); and 4) high body fat in combination with low muscle mass (SO). The anthropometric variables were measured in 97.8% (height, weight and WC) and 91.7% (fat and muscle masses) of the study participants.

The structured validated questionnaire included information on different aspects of health, physical activity and socio-demographic status (34). The variables considered in the present study were sex, age, educational level, walking and sedentary levels (hours sitting per day) for which information was obtained in 100%, 100%, 86.3%, 86.8% and 83.7% of those interviewed, respectively.

In accordance with previous published studies (8, 35) age was divided in different categories to guarantee a proportional distribution between groups: 65-69 years, 70-74 years and 75 or more years. The minimum age to participate in the study was 65 years, according to the Spanish retirement age. Educational levels were classified into one of the following groups: no education (no formal education); first level (primary studies); second level (secondary studies) and third level (university studies). Walking levels were defined as: first level (<1 hour/day); second level (1-2 hours/day); and third level (>2 hours/day). Finally, sedentary levels were classified into: first level (<2hours/day); second level (2-4 hours/day); and third level (>4 hours/day).

Statistical analysis

Mean of BMI, %BF and WC for men and women were calculated taking into account the differences of age, educational level, walking and sedentary levels (95% confidence interval [CI]). The prevalence of overweight, obesity, central obesity and SO were calculated by sex. Proportional test was used to analyze the differences of BMI, %BF and WC across the different categories. Percentile rank of BMI and %BF were calculated by sex and age. The presence or absence of linear trends of BMI, %BF and WC across the different categories was tested by multivariate regression analysis controlling for age, educational level, walking and sedentary levels as confounders. All analyses are performed separately by sex. All analyses were carried out with the Statistical Package for the Social Sciences (SPSS, Inc. Chicago, USA) Windows software, version 15.0. P-value was set at level < 0.05.

Results

Overall, 84.3% of the population could be categorized as overweight and/or obese (Table 2). Men were more frequently overweight than women (58.7% vs. 43.1%) ($P < 0.05$); nevertheless, the prevalence of obesity was much higher for women than for men (40.9% vs. 26.6%) ($P < 0.05$) (Table 2). The overall prevalence of central obesity, according to the WC cut-off points, was 55.9%, showing a large difference between sexes (34.1% vs. 62.5% for men and women respectively) ($P < 0.05$). Central obesity was higher in women aged more than 75 years than in those aged 65-69 years ($P < 0.05$).

Tables 3 and 4 show percentiles of BMI and %BF by age (65 to 69, 70 to 74 and 75 or more years) and sex. Table 5 shows the mean BMI, %BF and WC of men and women by age, education, and walking and sedentary levels. The mean BMI was 28.5 kg/m^2 in men and 29.3 kg/m^2 in women. For age, a significant linear trend was found in men (p for trend < 0.01) but not in women. Otherwise, both men and women showed a linear trend regarding their educational levels. The mean BMI varying from 28.8 and 30.7in those with no education to 27.4 and 26.9 in those with a third level education, men and women respectively (p for trend < 0.05).

Regarding the sedentary levels, men and women who spent more hours per day sitting had a higher BMI than those with a more active lifestyle (p for trend < 0.01). Additionally, women in the first walking level showed higher values of BMI than those in the third level (29.4vs. 28.1 kg/m^2)(p for trend ≤0.01).

The mean WC was 99.2 cm and 92.2 cm in men and women, respectively (Table 5). By age, the mean WC in men was 99.3 cm in those 65 to 69 years of age and 97.4 cm in those aged 75 or more years (p for trend < 0.05). In contrast, among women the highest mean was seen in those 75 and older (p for trend < 0.05). By educational level, a significant difference was found in both sex. Specifically, WC varied from 102.0 cm in those men with no education to 96.8 cm in those with third level education (p for trend < 0.05). Moreover, women in the lowest educational group had 97.2 cm of WC, whereas women in the highest group had 85.6 cm (p for trend < 0.01). Regarding the walking and sedentary levels, recognizable patterns were found in both men and women

with the highest WC values in the first walking level, and in men in the third sedentary level (p for trend < 0.05).

According to the %BF cut-off points, 66.9% of the sample (81.1% of men and 62.5% of women) suffers from excess of adiposity. Specifically, the prevalence of overweight and obesity were 47.9% and 33.2% in men, respectively and 37.3% and 25.2% in women respectively (data not shown).

The mean %BF was 29.2% in men and 39.3% in women (Table 5). By age, no significant linear trend was found (neither in men nor in women), whereas a significant linear trend was found in women in relation to educational levels. In this case, %BF varied from 40.5% to 36.81%. A significant trend was found in both sex in relation to walking levels, with those with the highest levels of these variables having lower values of %BF; 29.6 vs. 28.3% and 39.4 to 38.0%, men and women respectively.

In relation to the sedentary levels, similar patterns in both men and women were found. The most sedentary subjects had higher %BF than those who sat less than 2 hours per day: 29.8% vs. 28.4% and 39.42% vs. 37.6%, men and women, respectively.

According to Table 6, 14.9% of Spanish elderly people suffer from SO. By age, people aged 75 and more years had a greater prevalence of SO than younger participants in both sexes ($P < 0.05$). The prevalence of SO was 17.7% in men and 14.0% in women.

Discussion

The main findings of the present study are: 1) 84% of the Spanish population ≥65 years of age are overweight or obese according to their BMI values, while the number diminishes to 67% when the %BF is used as an adiposity measurement. 2) Moreover, according to the established WC cut-off values, central obesity is present in 56% of this population. 3) Sarcopenic obesity (high fat combined with low muscle) increases with age and reaches 15% of the elderly Spanish population. 4) Finally, significant linear trends between both sedentary and active behavior and adiposity measurements are present in this representative sample of Spanish elderly.

Few studies have investigated the detailed body composition in representative samples of entire developed countries among elderly people; however, studies in the general population that include elderly people are more numerous. In Spain, the only previous study including a representative sample of men and women aged 60 or more years showed that 81% of the Spanish were overweight or obese at this age. Data for the present study indicate that despite the high prevalence found in 2004, numbers are still increasing in this age group (up to 84%), showing similar prevalence between sex (85.3% vs. 84%, men and women respectively).

France and Italy showed similar patterns in studies carried out in 2006 and 2008 using BMI (36, 37). In these studies 68% and 51% of French men and women from 60 to 69 years of age were classified as overweight or obese (36) while in Italy the prevalence in people aged 65 to 69 years was 68% and 52% for men and women respectively (37). Higher prevalence was observed in England, where 75% of men and 67% of women had an excess of weight (38). Likewise, data collected in Greece showed that 84% of the population aged 60 to 70 years had a BMI≥25kg/m^2 (39). Data from NHANES (1999-2000) in the United States referencia showed that 74.1% of men and 68.1% of women were overweight or obese. The large variation found in the prevalence of overweight and obesity among studies could be in part due to methodological differences. The size of the sample and the age cohorts of the participants could be possible explanations for this fact. Specifically, the variations found between our study and data from NHANES could be because of our sample is five years older than subjects taking part of the NHANES study and also because data from USA were collected almost ten years before than ours.

Although most of the existing data in relation to adiposity prevalence, both in elderly people as well as in the younger population, are based on the same BMI cut-off points for young and older adults (25 to 29.9 kg/m^2 for overweight and ≥30 kg/m^2 for obesity)(40), it is widely known that during ageing loss in height as the result of vertebral compression and deformation occurs (41) resulting in an over-estimation of adiposity based on BMI values in this age group.

Coupled with these changes in height, it is known that ageing is normally accompanied by fat-free mass decreases and fat mass increases, and the latter being redistributed with a tendency to accumulate in the abdominal area (42-47). Thus, because fat replaces fat-free mass with increasing age, older subjects tend to have a greater proportion of fat compared to younger individuals with the same BMI (48). Consequently, we decided to use specific cut off values for the %BF using age and race-specific equations. Data from the present study show that 67% of men and women had an excess of body fat mass. Although these numbers are lower than those found using the BMI, they showed that a large proportion of elderly people take part in the overweight-obesity pandemic and have an increased risk for the development of numerous adverse health problems as a consequence of increased adiposity (5).

Additionally, adiposity with its redistribution as well as its combination with low muscle mass might be more related to health risk factors in the elderly population. Therefore, studies that measure these parameters in elderly people could be of greater importance with regard to health than those that only include BMI measurements. Specifically, WC as an indicator of central obesity is an independent risk factor for cardiovascular disease, type 2 diabetes, dyslipidemia and hypertension, as well as other poor health outcomes (40). In the present study, 56% of Spanish elderly people had increased health risk due to an excess of abdominal fat mass. This data is consistent with previous studies (8, 49), where central obesity prevalence was also higher in women than in men (according to corresponding WC cut-off points for each sex).

Moreover, coupled with the increase of fat mass among the older population, there is a considerable decrease in muscle mass that is expressed by an enhanced prevalence of low muscle among elderly (Table 6). Evidence also suggests that older adults with both sarcopenia and obesity have worse physical functioning than those with only one of these disorders; thus, sarcopenia and obesity may act synergistically, and together

increase the risk of disability (14). In spite of the importance of SO, nowadays there is no consensus on its definition. In the present study, SO was calculated according to previous published studies where representative samples were included in order to allow for future comparisons between studies (14). However, very few studies have assessed the combination of sarcopenia and obesity (33, 50) showing lower prevalence than found in our study (Table 1). While data in the US for the NHANES III study shows that approximately 9% of the population included in the study had SO (33), in Spain prevalence rise to 15% of men and women. Interestingly, high prevalence of SO is reached later in women than in men. Men achieved 23% of SO at the age of 70 years, whereas similar prevalence is found at the age of 75 in women (five years later). The fact that men reach a high prevalence (>20%) earlier than women could be due to several factors, including hormonal changes (related to lean mass losses) and/or lifestyle factors (more sedentary / less active). This could lead to the conclusion that, despite their lower life expectancy, men are more prone to suffer from SO than women.

In relation to lifestyle at this age, an inverse relationship between active lifestyle (i.e., walking-hours per day) and BMI, %BF and WC was found, especially in women. Additionally, sedentary activity (i.e., number of hours per day sitting) was associated with higher values of BMI, %BF and WC. These data agree with previous studies carried out in younger populations, where the number of subjects who practiced regular physical activity decreased in line with increasing BMI (51). The characteristic changes in body composition among elderly people are probably due to age-related reductions in energy expenditure that are disproportionately greater than the reductions in energy intake that occur with age (52, 53). The fact that both sedentary and active activities are associated with the different adiposity measurements included in the present study indicates the importance of activity with aging as a means of reducing the risk of obesity in this population. It is known that physical activity declines with age (54) and that sedentary behavior, like watching TV, is associated with obesity in younger populations (55). Furthermore, the practice of regular physical activity seems to be a protecting factor in diminishing the accumulation of whole-body subcutaneous fat mass (56); thus, sedentary lifestyle is one of the main contributors to the observed weight and body-fat gains at this age.

The results could be partially masked by the fact that the elderly more affected by aging process (e.g. oldest citizens) were not measured because they were institutionalized, died or not fit the inclusion criteria to be able to perform the tests. The strength points of this investigation are the sample size, which allows extrapolate these data to other elderly people and the large variety of methods used to identify the body composition status of the seniors.

Conclusion

The prevalence of overweight and obesity among elderly people in Spain is still increasing (from 81% in 2004 to 84% in 2010). Moreover, as age-related changes in body composition cannot be fully detected by the BMI, the %BF should be also used in this population if it is possible. Data from the present study indicate that 67% of the Spanish elderly population has an increased fat mass, besides that 56% suffer from central obesity. Moreover, sarcopenic obesity (the presence of reduced muscle mass and increased fat mass) is present in 15% of the Spanish elderly population and increases with age, reaching a high prevalence (>20%) earlier in men than in women. Finally, a clear relationship between active and sedentary lifestyles and the presence of increased adiposity is present in the representative sample of non-institutionalized Spanish elderly included in this study.

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Table 1. Comparison of different sarcopenic obesity definitions and prevalence

	Definition of sarcopenic obesity	*N*	Mean age (SD)	Prevalence
Baumgartner (2000)	- Sarcopenia: skeletal muscle mass -2 SD below mean of young population or <7.26 kg/m^2 in men and < 5.45 kg/m^2 in women. - Obesity: percentage body fat greater than median or > 27% in men and 38% in women.	M: 430 F: 401	M: 60 and over F: 60 and over	M: 4.4% F: 3.0%
Davison et al (2002)	- Sarcopenia: two lower quintiles of muscle mass (<9.12 kg/m^2 in men and <6.53 kg/m^2 in women). - Obesity: two highest quintiles of fat mass (>37.16% in men and > 40.01% in women).	M: 1391 F: 1591	M: 76.3 (1.7†) F: 77.3 (2.2†)	M: 9.6% F: 7.4%
Zoico et al (2004)	- Sarcopenia: two lower quintiles of muscle mass (<5.7 kg/m^2). - Obesity: two highest quintiles of fat mass (>42.9%).	F: 167	F: 71.7 (2.4)	F: 12.4%
Gomez-Cabello et al (2011)	- Sarcopenia: two lower quintiles of muscle mass (<8.61 kg/m^2 in men and <6.19 kg/m^2 in women). - Obesity: two highest quintiles of fat mass (>30.33% in men and >40.9% in women).	M: 671 F: 2188	M: 72.4 (5.5) F: 72.1 (5.2)	M: 17.7% F: 14.0%

M=Male; F=Female; SD=Standard Desviation

Table 2. Prevalence of overweight, obesity and central obesity in Spanish elderly by sex and age

	Overweight (%)	**Obesity (%)**	**WC > 102 cm (%)**
Men	58.7[a]	26.6[a]	34.1[a]
Age			
65-69	57.2 [a]	30.0 [a]	34.0 [a]
70-74	56.8 [a]	29.7 [a]	39.7 [a]
75 >	62.2 [a]	20.0 [a]	28.9 [a]
	Overweight (%)	**Obesity (%)**	**WC > 88 cm (%)**
Women	43.1	40.9	62.5
Age			
65-69	44.2	39.8	58.2[b]
70-74	41.1	42.6	63.7
75 >	43.7	40.4	66.1
Overall	46.7	37.6	55.9

Statistically significant ($p < 0.05$) differences between groups; [a] men vs. women; [b] 65-69 vs. 75 >.

Table 3. Percentiles of Body Mass Index in Spanish elderly by sex and age

	Men			Women		
Percentile rank	65-69	70-74	75 >	65-69	70-74	75 >
95	35.3	34.8	32.3	37.3	37.3	37.1
90	33.6	33.2	31.2	34.9	34.8	34.5
85	32.8	31.8	30.4	33.8	33.7	33.2
80	31.4	31.0	30.0	32.9	33.0	32.3
75	30.6	30.4	29.3	31.9	32.3	31.5
70	29.9	29.9	28.9	31.3	31.4	30.8
65	29.4	29.3	28.6	30.6	30.8	30.3
60	29.0	29.0	28.2	29.9	30.3	30.0
55	28.6	28.5	27.9	29.3	29.5	29.6
50	28.0	28.1	27.4	28.8	28.9	29.1
45	27.4	27.7	27.0	28.3	28.4	28.6
40	27.1	27.3	26.7	27.7	27.9	28.0
35	26.8	26.8	26.4	27.2	27.3	27.4
30	26.3	26.6	26.0	26.7	26.7	27.0
25	26.0	26.3	25.6	26.0	26.1	26.2
20	25.4	25.7	25.2	25.3	25.5	25.6
15	25.0	25.2	24.5	24.8	24.9	24.8
10	24.7	24.4	23.7	24.1	24.2	24.2
5	23.5	23.1	22.5	22.6	22.8	23.1

Table 4. Percentiles of percentage of body fat in Spanish elderly by sex and age

	Men			Women		
Percentile rank	65-69	70-74	75 >	65-69	70-74	75 >
95	37.0	38.9	36.6	48.0	47.3	47.7
90	34.5	36.5	34.6	46.0	45.8	45.7
85	33.6	34.5	33.5	44.8	45.0	44.8
80	32.8	33.7	32.8	43.9	44.0	43.8
75	31.6	33.0	32.3	42.9	43.2	43.0
70	31.0	32.2	31.3	42.3	42.2	42.2
65	30.3	31.5	30.8	41.6	41.5	41.5
60	29.8	30.8	30.3	40.9	40.8	41.0
55	29.0	30.3	29.6	40.4	40.3	40.3
50	28.6	29.7	29.1	39.7	39.7	39.6
45	28.0	29.0	28.6	39.0	39.1	39.1
40	27.4	28.5	27.8	38.3	38.2	38.4
35	27.1	27.6	27.3	37.5	37.4	37.7
30	26.4	26.8	26.7	36.8	36.6	37.0
25	25.7	26.0	26.1	36.0	35.7	36.2
20	24.9	25.4	25.2	35.1	35.0	35.3
15	23.6	24.5	24.2	34.0	33.5	33.5
10	22.7	22.8	22.6	32.7	31.8	31.9
5	20.3	20.0	19.9	30.1	29.4	29.7

Table 5. Mean (95% confidence interval [CI]) and linear trend assessment for BMI, %BF and WC for men and women across the different categories controlling for age, educational level, walking and sedentary levels.

	N	BMI (kg/m^2), mean (SD)	*N*	%BF, mean (SD)	*N*	WC (cm), mean (SD)
Men	552	28.45 (28.11-28.79)	552	29.16 (28.71-29.60)	552	99.25 (98.26-100.24)
Age						
65-69 years	215	28.56 (28.01-29.12)**	209	28.54 (27.68-29.40)	217	99.28 (97.72-100.84)**
70-74 years	176	28.45 (27.87-29.03)	172	29.53 (28.63-30.43)	177	100.69 (99.05-102.33)
75 > years	185	27.27 (26.67-27.87)	181	28.61 (27.69-29.53)	190	97.36 (95.69-99.03)
p for trend		<0.01				<0.05
Education						
No education	42	28.83 (27.80-29.86)	38	29.52 (27.87-31.17)	41	101.99 (99.04-104.93)
First level	372	28.21 (27.82-28.60)	360	28.85 (28.24-29.41)	375	98.97 (97.86-100.09)
Second level	101	27.93 (27.24-28.62)	101	29.01 (27.95-30.06)	103	98.69 (96.75-100.63)
Third level	61	27.41 (26.53-28.28)	63	28.19 (26.87-29.52)	65	96.79 (94.36-99.21)
p for trend		<0.05				<0.05
Walking levels						
First level	146	28.30 (27.67-28.94)	142	29.56 (28.57-30.54)	146	100.69 (98.89-102.50)*
Second level	300	27.97 (27.48-28.47)	296	28.79 (28.02-29.56)	308	98.15 (96.76-99.55)
Third level	130	28.01 (27.37-28.65)	124	28.33 (27.33-29.34)	130	98.48 (96.67-100.29)
p for trend				≤0.05		<0.05
Sedentary levels						
First level	72	27.75 (26.93-28.57)**	70	28.36 (27.09-29.64)**	74	98.73 (96.43-101.03)**
Second level	293	27.79 (27.31-28.27)	285	28.47 (27.73-29.21)	296	97.89 (96.54-99.24)
Third level	211	28.74 (28.21-29.27)	207	29.84 (29.02-30.66)	214	100.71 (99.21-102.20)
p for trend		<0.01		<0.01		<0.05
Women	1842	29.25 (29.07-29.44)	1842	39.33 (39.09-39.57)	1842	92.18 (91.65-92.71)
Age						
65-69 years	717	28.67 (28.26-29.04)	689	38.67 (38.15-39.20)	726	89.30 (88.13-90.46)*
70-74 years	605	28.71 (28.27-29.15)	588	38.56 (38.00-39.12)	606	90.44 (89.19-91.69)
75 > years	606	28.40 (27.96-28.83)	586	38.37 (37.81-38.92)	610	90.95 (89.71-92.18)
p for trend						<0.05
Education						
No education	230	30.68 (30.12-31.23)**	223	40.54 (39.83-41.25)**	231	97.16 (95.58-98.74)**
First level	1418	29.29 (29.03-29.55)	1370	39.34 (39.00-39.67)	1426	92.36 (91.61-93.11)
Second level	198	27.49 (26.89-28.09)	189	37.46 (36.69-38.23)	200	85.81 (84.10-87.51)
Third level	82	26.91 (25.99-27.83)	81	36.80 (35.64-37.96)	85	85.58 (83.00-88.16)
p for trend		<0.01		<0.01		<0.01
Walking levels						
First level	689	29.38 (28.97-29.78)**	674	39.39 (38.88-39.91)**	695	91.39 (90.24-92.54)*
Second level	972	28.27 (27.90-28.65)	937	38.23 (37.76-38.70)	978	90.08 (89.03-91.14)
Third level	267	28.12 (27.56-28.69)	252	37.98 (37.26-38.70)	269	89.21 (87.61-90.81)
p for trend		<0.01		<0.01		<0.01
Sedentary levels						
First level	320	27.99 (27.47-28.51)**	308	37.64 (36.97-38.30)**	325	89.12 (89.58-92.11)
Second level	1031	28.61 (28.24-28.98)	1003	38.62 (38.15-39.08)	1042	90.72 (89.68-91.76)
Third level	577	29.17 (28.73-29.62)	552	39.35 (38.78-39.91)	575	90.84 (87.64-90.59)
p for trend		<0.01		<0.01		

BMI=Body Mass Index; SD=Standard Desviation; %BF=Percentage of Body Fat; WC=Waist Circumference
Statistically significant differences between groups; *($p < 0.05$), **($p < 0.01$)

Table 6. Prevalence of normality, high fat, low muscle and sarcopenic obesity in men and women by age

	N	Normal (%)	High Fat (%)	Low Muscle (%)	Sarcopenic Obesity (%)
Men	671	39.5	22.2	20.6	17.7
65 to 69 years	241	44.4	26.6	20.7	8.3 [b]
70 to 74 years	212	37.3	22.2	17.9	22.6
≥ 75 years	218	36.2	17.4	22.9	23.4
Women	2188	35.1	25.7	25.1	14.0
65 to 69 years	801	39.2	29.5	21.2	10.1 [b]
70 to 74 years	691	34.4	26.6	26.5	12.4
≥ 75 years	696	31.2	20.4	28.3	20.1
Overall	2859	36.2	24.9	24.1	14.9
65 to 69 years	1042	40.4	28.8	21.1	9.7
70 to 74 years	903	35.1	25.6	24.5	14.8
≥ 75 years	914	32.4	19.7	27.0	20.9

Statistically significant ($p < 0.05$) differences between groups; [a] men vs. women; [b] 65-69 vs. 75 >.

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