

# First National Epidemiological Survey on the Prevalence of Obesity and Abdominal Fat Distribution in Greek Adults

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## Key Words

Obesity · Overweight prevalence · Abdominal fat distribution

## Abstract

**Aim:** To provide estimates of the prevalence of obesity, overweight and body fat distribution among the adult population of Greece. **Design:** Epidemiological, cross-sectional nationwide survey providing self-reported data. **Subjects:** A total of 17,341 men and women aged from 20 to 70 years and classified into five 10-year age groups participated. The selection was conducted by stratified sampling through household family members of Greek children attending school. **Measurements:** The participants reported data on weight, height, waist and hip circumference. BMI and waist-to-hip ratio were calculated. Abdominal obesity was defined as waist circumference  $\geq 102$  cm in men and  $\geq 88$  cm in women. **Results:** In the total population, the mean BMI was 26.5 kg/m<sup>2</sup>, (27.3 in men, 25.7 in women). The overall prevalence of obesity was 22.5%, (26% in men, 18.2% in women) while that of overweight was 35.2% (41.1% in men, 29.9% in women). The percentages of obesity and overweight in

men were similar in almost all age groups, while in women they progressively increased with age. Abdominal obesity was more frequent among women than men (35.8 vs. 26.6%, respectively), especially after the age of 50. **Conclusions:** Excess body weight is reaching epidemic proportions in Greece and obesity rates are among the highest, if not the highest, in Western society. The problem affects particularly men, and women after menopause. Interestingly, more women than men present with abdominal obesity. Preventive and treatment strategies are urgently needed to stop the obesity epidemic in this Mediterranean European country.

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## Introduction

Obesity is an increasing health problem associated with serious clinical consequences and high mortality rates. Its prevalence is increasing at epidemic proportions in both developed and developing societies [1] and, according to the World Health Organization (WHO), current prevalence is about 20–25% in the Americas and 10–25% in most countries of western Europe [2]. In southern European countries particularly, high prevalence of obesity is observed in both children and adults [3].

Greece, a recently modernized Mediterranean country, suffers from a paucity of national data concerning the

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epidemiology of excess body weight. Some reports show that the prevalence of obesity is particularly high in adults; however, available epidemiological data are scarce and confined to particular geographical areas [4, 5].

In a pan-European study with Greek participation conducted in 1997, Greece was shown to have high prevalence of obese (11%) and overweight subjects (35%); by contrast, the European Union average in the same study was 10 and 31%, respectively [6]. In the recent European Prospective Investigation into Cancer (EPIC) survey, higher prevalence of obesity (>25%) and large waist circumference (WC) or high waist-to-hip ratio (WHR) was observed in the centers located in Greece, Spain and Southern Italy [7]. It seems therefore that in Greece, according to these preliminary reports, obesity rates are high.

The aim of this first large-scale, cross-sectional survey was to provide estimates on the prevalence of overweight, obesity and body fat distribution in a sample of adults for the whole of Greece.

## Methods

The present study is part of a nationwide, cross-sectional epidemiological study designed to estimate obesity prevalence in Greek children and adults and to identify factors associated with obesity indices. Prevalence of obesity in children will be presented in another paper. Concerning associated factors we report here data on smoking and alcohol consumption habits and their relationship to obesity. Unfortunately, data on other factors, such as socioeconomic status, food consumption and physical activity habits, are not available for analysis in this study.

Anthropometric parameters for adults were collected through questionnaires from households by means of their children, who had direct measurements taken at school. Therefore, obesity and overweight prevalence and body fat distribution in adults were estimated from self-reported measurements of height, weight and waist and hip circumferences. Although we are aware that the procedure based on self-reported data could lead to misclassification of the true prevalence of obesity, it was decided that this procedure would be used for practical reasons.

The survey was conducted from February to June 2003 by experienced doctors, all members of the Hellenic Medical Association for Obesity, with the approval and collaboration of the Greek Ministry of Education. The selection of the population was performed in collaboration with the Department of Statistics of the Athens University of Economics.

### *Sample Selection*

Data were collected by a questionnaire from all members of selected households through the adolescents aged 13–19 years, who had direct measurement taken at the secondary schools. The method used for the selection was that of proportionate stratified random sampling.

According to the 2001 census, Greece has a population of about 11 million (women 50.5%, men 49.5%) and is divided into 52 administrative districts comprising 3,514 state secondary schools. These districts were considered as the stratum of the stratified random sampling method. In each district, independent random samplings were applied. The sample to be studied was created in proportion to the ratio of the number of schools in each district reported to the total number of Greek schools. The choice of schools per district followed a systematic sampling. By this method, a representative sample of 332 (9.45%) was randomly selected from a total of 3,514 schools. In each school, according to stratified random sampling, the total number of pupils from 4 classes out of 6 was considered for participation in the study. From each class, all adolescents aged 13–19 years were selected to participate. Each adolescent received an envelope containing a questionnaire for all relatives in the household (e.g., father, mother, brothers and sisters). All adolescents in the survey had their measurements taken at their respective schools and completed the questionnaire at school while their relatives (aged 2–70 years) were self-measured and completed their questionnaire at home (or were assessed by a proxy). The questionnaire included questions about nutritional and physical activity habits, educational level and profession, reports of cardiovascular risk factors, smoking and alcohol consumption habits. Pregnant women, homeless people and subjects living in institutions or in the armed forces were not included in this study.

### *Procedure*

Study approval was obtained from local and state school authorities. All adolescents, parents and school directors were comprehensively informed about the content and the purposes of the study. Initially, an informative letter was sent to all directors of the selected schools to explain the purpose of the study. The school directors were then invited to designate the physical training instructor who would be responsible for conducting the survey. All instructors followed a training period given by doctors of the Hellenic Medical Association for Obesity in selected organized unions in 12 representative cities of Greece. They were trained on anthropometrical techniques following standardized criteria in order to help the adolescents take measurements at school, and to explain to the adolescents how to help their relatives take the appropriate measurements at home. Suitable materials for anthropometrical measurements (portable scale, cloth tape and elastic measuring tape) and a structured questionnaire were supplied to each school. Subsequently, adolescents were invited to ask their households to take measurements and to complete the detailed questionnaire. For this purpose, households received a sealed envelope containing an informative letter guaranteeing anonymity and providing instructions and diagrams on how to measure height and body weight together with waist and hip circumference. All family members living in the house including second-degree relatives from 2 to 70 years old were invited to participate.

From an initial estimated number of 22,147 subjects, a sample of 17,341 (8,234 men and 9,107 women) entered the study (participation rate 78.3%). Respondents did not differ from non-respondents in terms of gender and age categories. The overall mean age and standard deviation ( $\pm$  SD) was  $43.13 \pm 19.26$  years (men  $44.95 \pm 25.22$ , women  $41.51 \pm 11.39$  years). Subjects were also categorized into five 10-year age groups: 20–29, 30–39, 40–49, 50–59, and 60–69 years. Because the selection of subjects was based

**Table 1.** Mean BMI in all Greek subjects and separately in men and women by age categories

Age groups, years	BMI $\pm$ SD						
	n	all subjects	n	men	n	women	p
20–29	1,521	23.7 $\pm$ 4.7	790	24.7 $\pm$ 4.7*	731	22.6 $\pm$ 4.4	<0.001
30–39	5,828	25.7 $\pm$ 4.9	1,399	27.6 $\pm$ 4.9*	4,429	25.1 $\pm$ 4.8	<0.001
40–49	7,759	27.0 $\pm$ 4.9	4,533	27.6 $\pm$ 4.6*	3,226	26.2 $\pm$ 5.1	<0.001
50–59	1,669	27.9 $\pm$ 5.0	1,230	27.7 $\pm$ 4.8	439	28.2 $\pm$ 5.5	NS
60–69	564	28.6 $\pm$ 5.3	282	27.6 $\pm$ 5.1*	282	29.5 $\pm$ 5.4	<0.001

Values of  $p < 0.05$  considered to be statistically significant.

NS = Not significant.

\*  $p < 0.001$  for BMI comparisons between men and women.

on school-aged children, there were more participants in the age groups of 30–39 and 40–49 years. Women outnumbered men in the younger age group (30–39), while there were more men in the 5th and 6th decade. This unbalanced gender distribution could be explained by the age difference between the two married parents in the household. Valid response rates for height and weight were 76.4% of the initial sample of the 17,341 respondents. Missing values for measurements of fat distribution were 8.38% for WC and 11.04% for WHR. Missing data were the same for men and women for all anthropometric measurements.

#### Measurements

Subjects were asked to weigh themselves at home or at the nearest pharmacy on electronic or manual scales wearing light clothing and no shoes, and to report weight to the nearest 0.5 kg. To measure height, subjects were asked to be measured using an elastic measuring tape and to report in centimeters to the nearest 0.5 cm. Waist circumference was advised to be measured using a cloth tape midway between the lower rib and the iliac crest, and hip circumference (HC) as the maximum circumference over the buttocks.

All household members were asked to return all data collected to the school in an envelope provided. Subsequently, the gym instructors were responsible for the collection of all data and for mailing them to the office of the Hellenic Medical Association for Obesity.

Body mass index (BMI) was calculated as  $\text{kg}/\text{m}^2$ . Weight status was defined according to WHO definitions [2]: underweight =  $\text{BMI} < 18.5$ , normal weight =  $\text{BMI}$  between 18.5 and 24.9, overweight =  $\text{BMI}$  between 25 and 29.9, obese =  $\text{BMI} > 30$ , and extreme or morbidly obese =  $\text{BMI} \geq 40$ .

For the definition of abdominal obesity the cut-off points of 102 cm in men and 88 cm in women were used according to the recommendations for the definition of metabolic syndrome [8]. These values correspond to a BMI of 30. Additionally, WC of 94–102 cm in men and 80–88 cm in women were used to identify individuals at increased cardiovascular risk as proposed by Han et al. [9]. These lower values of 94 cm in men and 80 cm in women were designed to be equivalent to a BMI of 25 and it is recently recommended that Europeans should use these values [10]. WHR was also calculated. When WHR was higher than 1.00 in men and 0.85 in women, it was considered as increased [2].

#### Statistical Analyses

Statistical analyses were carried out using the SPSS 11.0 software. All data analyses were stratified by gender and age based on five groups: 20–29, 30–39, 40–49, 50–59 and 60–69 years.

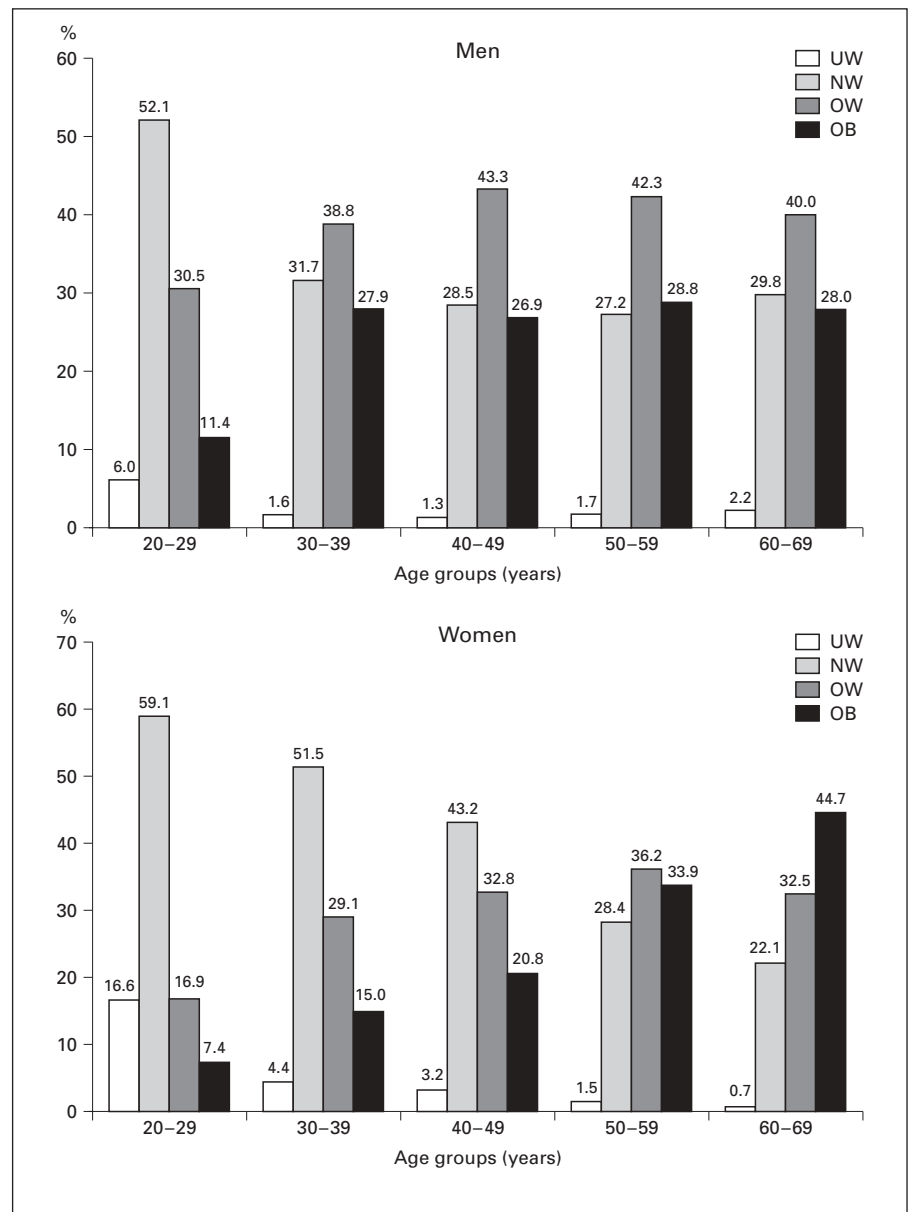
Results for BMI, WC and WHR were calculated as means  $\pm$  SD. Comparisons of these parameters between the sexes and different age groups were made by student's  $t$  test and one-way analysis of variance (ANOVA). Prevalence of overweight and obesity was estimated for stratified samples. Proportions were compared using the  $\chi^2$  test, considering  $p$  values  $< 0.05$  to be significant. Pearson correlation analysis was used to examine correlations between BMI, WC and WHR.

#### Results

The mean BMI  $\pm$  SD for the total population studied was  $26.5 \pm 5.1$  and it was higher in men than in women ( $27.3 \pm 4.8$  vs.  $25.7 \pm 5.2$ ,  $p < 0.001$ ). The overall prevalence of obesity was 22.5%, 26 in men and 18.2 in women. The overall prevalence of overweight was 35.2%, 41.1 in men and 29.9 in women.

Table 1 shows the mean BMI in the total sample and separately for men and women in all age groups. In the total sample, BMI increases progressively with age ( $p < 0.005$  between all age groups). In men, average BMI increased significantly ( $p < 0.001$ ) from the first to the second age group (from 24.7 to 27.6  $\text{kg}/\text{m}^2$ ) and then remained stable at this level until the 7th decade. In women, average BMI increased progressively with age ( $p < 0.05$  between all age groups), reaching a maximum at the 7th decade at 29.5. This BMI was significantly higher from the BMI of the other decades.

In figure 1, the percentages of BMI status are shown separately for men and women by age groups. Among men, prevalence of obesity increased significantly through



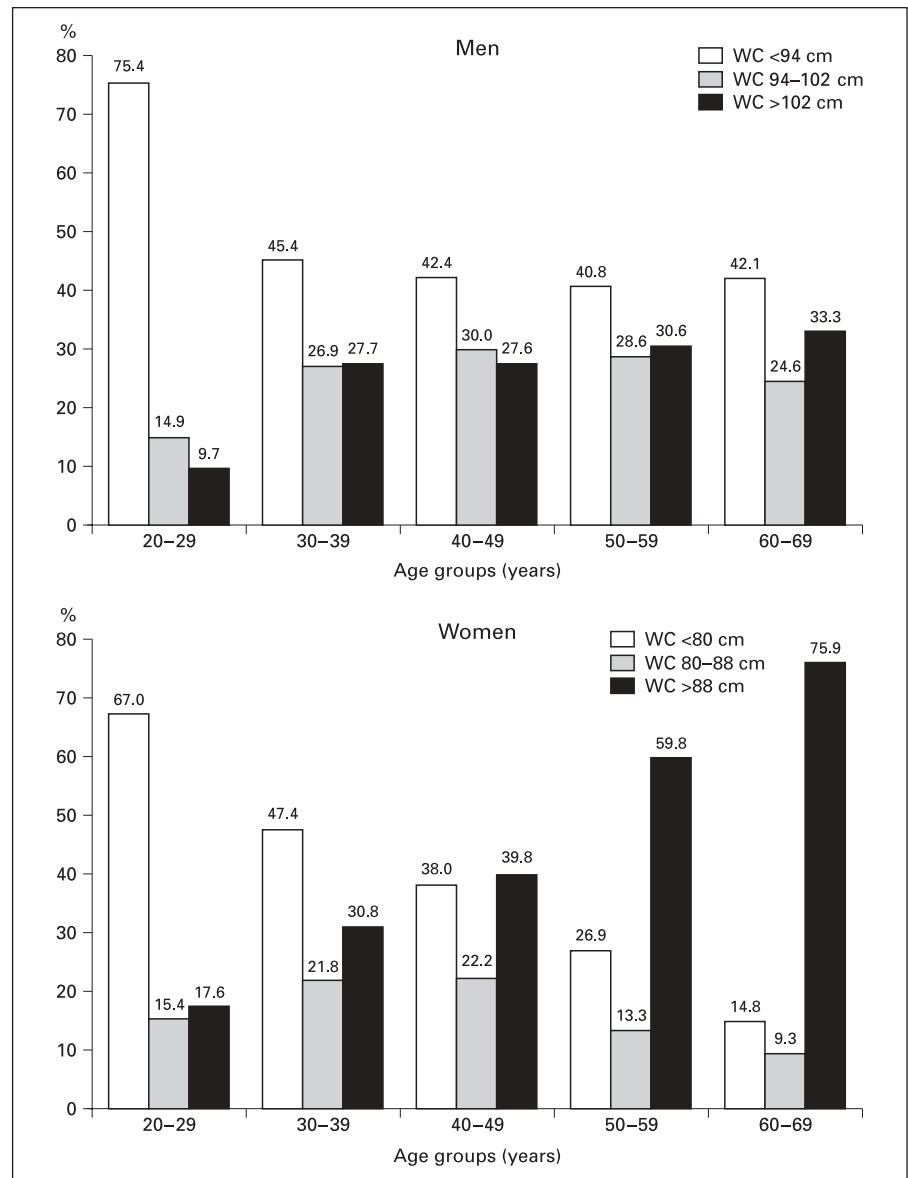
**Fig. 1.** Percentages of BMI status in men and women by age groups. UW = Underweight (BMI <18.5); NW = normal weight (BMI 18.5–24.9); OW = overweight (BMI 25–29.9); OB = obese (BMI >30).

the first two age categories from 11.4 to 27.9% ( $p < 0.001$ ) and then remained stable in the range of 27–28% until the last age group. In women, the percentage of obesity increased progressively and continually with age from 7.4% at 20–29 years to 44.7% at 60–69 years ( $p < 0.01$  between groups). Almost similar patterns in both sexes could be observed for overweight status according to age groups. In men, the percentage of overweight increased through the first three age groups from 30.5 to 43.3% ( $p < 0.005$  between groups) and then remained relatively stable. In women, the percentage of overweight increased

steadily from 16.9% at 20–29 years to 36.2% at 50–59 years and then declined to 32.5% at 60–69 years.

The mean WC  $\pm$  SD in the total population was  $90.1 \pm 16.1$  cm ( $95.4 \pm 16.1$  cm in men,  $85.5 \pm 14.6$  cm in women). Mean values of WHR in the total population were  $0.91 \pm 0.47$ , ( $0.97 \pm 0.54$  in men,  $0.87 \pm 0.43$  in women). Values of WC were strongly correlated with BMI ( $r = 0.58$ ,  $p < 0.0001$ ) and to a lesser extent with WHR ( $r = 0.31$ ,  $p = 0.001$ ).

WCs and WHRs in the total population and separately for men and women by age categories are presented in



**Fig. 2.** Percentages of waist circumference (WC) categories in men and women by age groups.

**Table 2.** Mean WCs WHRs in all Greek subjects and separately in men and women by age categories

Age groups years	All subjects				Men				Women			
	WC		WHR		WC		WHR		WC		WHR	
	n	mean ± SD	n	mean ± SD	n	mean ± SD	n	mean ± SD	n	mean ± SD	n	mean ± SD
20-29	1,388	81.7 ± 14.0	1,331	0.88 ± 0.32	721	85.7 ± 14.5**	704	0.92 ± 0.77***	667	77.3 ± 12.0	627	0.83 ± 0.16
30-39	5,401	86.4 ± 15.0	5,273	0.88 ± 0.35	1,278	96.0 ± 17.0**	1,236	0.96 ± 0.34***	4,123	83.6 ± 13.1	4,037	0.85 ± 0.35
40-49	7,065	92.4 ± 15.6	6,808	0.93 ± 0.59	4,132	96.5 ± 15.1**	4,012	0.98 ± 0.38**	2,933	86.6 ± 14.5	2,796	0.88 ± 0.41
50-59	1,545	95.0 ± 16.4	1,494	0.95 ± 0.39	1,161	95.3 ± 16.6**	1,121	0.97 ± 0.32*	384	91.3 ± 15.7	373	0.90 ± 0.22
60-69	490	96.8 ± 17.7	452	0.92 ± 0.14	247	96.0 ± 19.7*	221	0.95 ± 0.13***	243	96.9 ± 15.6	231	0.91 ± 0.15

Values of  $p < 0.05$  considered to be statistically significant.

\*  $p < 0.05$ , \*\*  $p < 0.001$  for comparison of WC between men and women.

+  $p < 0.01$ , \*\*  $p < 0.005$ , \*\*\*  $p < 0.001$  for comparison of WHR between men and women.

table 2. In the whole population, there is a steady increase in WC with increasing age ( $p < 0.001$ ). The same trend could be observed when women were examined as a separate group. In men, an important rise in WC could be observed between the age groups of 20–29 and 30–39 years ( $p < 0.001$ ), thereafter, WC remained relatively stable until the age of 70. In women, the greatest WC was observed between the ages of 60 and 69 years, while in men it was between 40 and 49 years. WC variations over different age groups parallel those of BMI in both sexes. WC was always higher in men than in women, with the exception of the age group 60–69 years where the mean WC did not differ significantly between the two sexes.

A total of 26.6% of men and 35.8% of women had a large WC and were defined as abdominally obese. Furthermore, 27.7% of men had an increased WC (between 94 and 102 cm), while 20.7% of women had an increased WC between 80 and 88 cm. In men, the prevalence of abdominal obesity increased from the first to the second age group, remained stable between 30–39 and 40–49 years and then increased gradually to reach 33.3% at ages 60–69 (fig. 2). In women, the percentage of abdominal obesity increases progressively and steadily from 17.6% at ages 20–29 to 75.9% at ages 60–69 years ( $p < 0.01$  between groups). Abdominal obesity was more frequent in women than in men in all age groups.

WHRs in the total population increased gradually from the 4th to the 7th decade ( $p < 0.001$  between groups) (table 2). In men, WHR increased during the first three age groups ( $p < 0.001$ ) and then decreased gradually until the last age group ( $p < 0.005$ ). In women, it increased over all age groups ( $p < 0.005$ ). In all age categories, WHR was higher in men than in women. Increased WHR was evident in 32.5% of men and 42.5% of women.

Data from questionnaires were also analyzed concerning the relationship between smoking and alcohol consumption habits and obesity indices. Concerning smoking habits, evaluated as the number of cigarettes per day and per year, we found that male smokers had greater WC and BMI than non-smokers ( $p < 0.01$  and  $p < 0.05$ , respectively), while female smokers had a smaller WC and BMI than non-smoking women ( $p < 0.001$  for both). However, when controlling for age, the above differences disappeared for both sexes. Regarding alcohol consumption, which was evaluated by adding the number of units of alcohol consumed weekly and multiplying the result by the alcohol content of each beverage, we found an independent significant positive association between alcohol consumption and WHR only in males ( $p < 0.05$ ).

## Discussion

This first large-scale epidemiological survey conducted in Greek adults provided self-reported data on the prevalence of excess body weight. A high proportion of the population was obese (22.5%) or overweight (35.2%), and males were much more affected than females. Additionally, abdominal obesity appears to be particularly prevalent in both sexes, with 26.6% in men and 35.8% in women.

Only a limited number of cross-sectional studies have examined the prevalence of obesity in Greece [3–7, 11]. These studies were confined to particular geographic areas. The majority had a small sample size and was conducted on the island of Crete during the 1980's and early 1990's. They showed a high prevalence of obesity among adults and the elderly population, particularly in those above 30 years of age [4]. In a European study conducted in 1997 [6], Greece was the country with the highest prevalence of obesity and overweight at 11 and 35%, respectively. During the years 2000–2001, Krassas et al. [5] examined the prevalence of obesity in the Balkans. In the sample based in northern Greece, the percentage of obesity averaged 20% and that of the overweight 35% in total. Recent data from the geographic area of Athens, the Attica area, showed obesity prevalence in men at 20% and in women at 15% [11]. Although the studies used different methodologies, the results of the present and of other recent studies [5, 11] indicate an important increase of obesity prevalence in Greece during the last years.

Compared with other recent, self-reporting European surveys, prevalence of obesity in Greece is much higher. For example, obesity rates in our study proved more than double than those observed in France [12] and Sweden [13], where rates of 10 and 9.5%, respectively, were found in studies conducted in the years 2000/2001. Likewise, a higher proportion of obese subjects were found in Greece than in Spain (22 vs. 13%), a Mediterranean country considered to be seriously affected by the obesity epidemic [14]. According to the 'position paper' published by the International Obesity Task Force in 2002 on obesity in Europe, the prevalence of both overweight and obesity in Greek women (74%) was the highest of all European countries, whereas men were second in the classification (72%) [15]. Interestingly, similar rates of obesity prevalence were found when we compared our data with those of the recent estimates of obesity in USA, also based on self-reported data. These estimates demonstrated an obesity prevalence reaching 21% [16]. However, in the recent Nutrition Examination Survey NHANES, which provid-

ed objectively measured data, obesity prevalence in the USA was found to be 30.4% [17].

The reasons for the obesity epidemic in the Greek population are not clear. A possible explanation could emerge from historical and political factors, which affected the modern way of life in general and dietary habits in particular. In Greece, World War II, the subsequent civil war from 1946 to 1949 and the era of the colonels from 1967 to 1974 had a devastating effect on the socioeconomic status of Greece. The country underwent rapid socioeconomic development during the late 1970's, joined the European Union and experienced a 'western type' modernization. This delayed but sharp economic evolution ran parallel to a rapid change from the traditional Mediterranean diet to the western-type diet [18]. Actually, the few studies that have estimated current nutrient intake levels and food group consumption patterns in Greece indicate increases in the intake of total and saturate fat, and decreases in monounsaturated fat, despite a conservation of adequate levels of fibers [19, 20]. These dietary changes probably account, at least in part, for the obesity epidemic in Greece. In the Greek leg of the EPIC study, an increase in energy intake of about 500 kcal was found to correspond to an increment of about 0.33 kg/m<sup>2</sup> of BMI, after adjustments for age and gender [21]. A similar but earlier rapid change in nutritional habits had occurred in one other Mediterranean country, Spain [22]. However, the phenomenon of the high prevalence of obesity in Greek adults reported in our study must be interpreted with some caution. First, the sample chosen, by definition, did not take into consideration the distribution of subjects in the Greek population in relation to age and gender. Second, the clustering effect due to data taken from the same household could be an additional source of error. Obesity is known to be, to a large extent, hereditary, and hence exaggeration of its prevalence could have occurred in our study.

Increasing sedentary behavior and lack of physical activity (PA) may also contribute to the problem of excess body weight in Greece. Considering the issue of PA patterns, a study with a representative sample in the European Union demonstrated that the lowest proportion of participants in PA was found in southern countries, with Greece being, after Portugal, the country with the lowest number of participants (61%) in some kind of activity [23].

Socioeconomic status is another factor that could play a role in the prevalence of obesity in Greece. In developed societies, a strong inverse relationship between socioeconomic status and obesity has been observed, mainly

among women, while in developing ones a direct relationship has been found for both genders [6, 24]. Unfortunately, data on socioeconomic status are not available for our population. Two recent studies that evaluated factors associated with obesity prevalence in northern Greece and in the area of Attica found an inverse relationship between obesity prevalence and socioeconomic status [11, 25].

An interesting finding of our study was the higher prevalence of obesity and overweight in men compared with women. Obesity prevalence in countries of the European Union is slightly higher in women than in men, according to the recent MONICA study [26]. More recent studies, however, show that trends in BMI are increasing dramatically among men and, in most European countries, overweight is much more prevalent in men than in women while obesity affects both sexes almost equally [12, 13, 27]. Possible causes have been considered to explain this gender difference in our study. Social pressures for thinness are more intense on women and more women than men are on some kind of dietary restriction [26]. Obese men, on the contrary, experience less body dissatisfaction and less disordered eating. This probably relates to the patriarchal view of the body image in countries such as Greece, in which excess body weight, at least in lower classes, is still considered an indication of social status [25]. Some habits, such as smoking and alcohol consumption, could also play a role [28]. Actually, when analyzing these factors in our population, we found that men are heavier drinkers than women and that alcohol consumption was related to abdominal obesity only in men. On the other hand, concerning smoking habits, we did not observe any significant correlation between this parameter and indices of fat distribution in both genders after controlling for age.

Similar data relating to gender differences in weight status were also observed in a recent study conducted in the Athens area, in which objectively measured data were collected. The prevalence of overweight and obesity was 53 and 20% in males and 31 and 15% in females, respectively [11].

Concerning body fat distribution, we found that 26.6% of men and 35.8% of women presented with abdominal obesity, based on the proposed cut-off values of waist girth. A substantial percentage of individuals (27.7% of men and 20.7% of women) showed smaller increases of WC and were considered to be at high cardiovascular risk [9]. Abdominal obesity was observed more frequently in women, and it was more prominent after the age of 50. One possible explanation is that menopause at that age

in women provokes a preferential increase of visceral fat independently of BMI [29]. This increase in abdominal fat by age and menopausal status may be more prominent in some populations, as observed in a sub-analysis of the MONICA project [30]. Specific dietary patterns and reduced physical activity could contribute to such a prevalence of central obesity among older Greek women. However, a possible misclassification of abdominal obesity could result from the use of the cut-off limits, which could not be adapted to the Greek population to define cardiovascular risk.

Few epidemiological studies have examined the prevalence of abdominal obesity according to WC. In the French study OBEPI [12], the prevalence was equal in both sexes, about 26%. The EPIC study examined fat distribution in 50- to 64-year-old participants from 25 centers in 9 European countries, including Greece [7]. Overall, a total of 25% of men and 27% of women had abdominal obesity and higher rates were most often observed in centers from Spain, Greece and Italy. In the Greek sample, approximately 39% of men and 55% of women presented large WC. Recently, data on prevalence and trends on abdominal adiposity in US adults were provided by the analysis of the first, third and 1999–2000 NHANES [31]. The most recent survey (1999–2000) identified 38% of men and 60% of women with abdominal obesity.

There are some limitations to our study that have to be taken into account when interpreting the results. Its greatest limitation is the use of self-reported data for measurements of height, weight, waist and hip circumferences. Most studies with self-reported data show that women and heavier persons often underestimate their weight and overestimate their height [32, 33]. Misreporting could also relate to the measurements of body fat distribution, but from the available studies it seems that the risk of misclassification of fat distribution patterns after self-measurements is minimal [34, 35]. Accuracy is generally higher for the circumferences than for the ratios. Another major limitation of the study is the fact that the age distribution of the sample is not similar to that in the Greek population, so some age groups in both sexes are overrepresented while others are underrepresented. Additionally, as the recruitment was done via adolescent children, there were no data from households without any children.

However, the major strength of our study is the fact that this is the first large-scale survey ever conducted in the whole country that provides estimates on obesity prevalence – although in a nonrepresentative manner.

Additional positive aspects are the large number of participants and the relatively high response rate.

In conclusion, we observed high percentages of obesity and overweight in Greece, reaching 22.5 and 35.2%, respectively. Globally, more men than women are affected. In men, obesity and overweight rates were similar in almost all age groups, while in women they rose continually with age to reach significant proportions after the age of 50. Interestingly, more women than men, especially after the age of 50, are affected by abdominal obesity.

The proportions of obesity and abdominal fat distribution in Greece are among the highest, if not the highest, in western Europe and although the causes are unclear, it seems that the rapid change in dietary habits in the country plays an important role. Obesity is a serious health problem and, therefore, preventive and treatment strategies are urgently needed, mainly among men and older women to combat this epidemic phenomenon.

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