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Epidemiological Survey for the Prevalence of Overweight and Abdominal Obesity in Greek Adolescents

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This study was designed to provide estimates of overweight (OW), obesity (OB), and abdominal OB (AO) in a representative sample of adolescents throughout the whole of Greece. A total of 14,456 adolescents aged 13–19 years (6,677 boys and 7,779 girls) had direct measurements (height, weight, waist circumference (WC)) taken at school during 2003. The overall prevalence of OW including OB in the population studied was 29.4% in boys and 16.7% in girls. OB prevalence was also higher in boys than in girls (6.1% vs. 2.7%), whereas prevalence of AO was higher in girls than in boys (21.7% vs. 13.5%). Rates of OW, OB, and AO were significantly more prevalent in the Greek than in the foreign male population (immigrants). OW% in adolescent girls was independently associated with smoking and alcohol consumption. The prevalence of OW and OB in Greek adolescents is high, particularly in boys, comparable with that reported for most Mediterranean European countries. AO, mainly in adolescent girls, also appears high. Preventive and treatment strategies are urgently needed to combat this OB epidemic in Greece.

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INTRODUCTION

Childhood excess weight is a growing problem worldwide, and countries surrounding the Mediterranean sea show particularly high prevalence rates of overall childhood and adolescent overweight (OW) and obesity (OB), varying from 15 to 40% (1,2). Greece, a recently modernized Mediterranean country, suffers from a paucity of nationwide data concerning the epidemiology of excess weight in adolescents. Some reports show that the prevalence of adolescent OW is very high, while others show that OW prevalence in Greece does not differ from that of other southern European countries (3,4). However, available epidemiological data are scarce and mostly confined to specific geographical areas of the country (4,5). To our knowledge, the only representative survey on a national scale was conducted in 1990–1991 and reported an overall OW prevalence of 19.3% in boys and 14.8% in girls aged 10–17 years (6).

Recent studies have shown that waist circumference (WC) is a highly sensitive and specific measurement of central adiposity in young people (7). Some countries have reported epidemiological data on the prevalence of abdominal fat distribution based on WC measurements (8,9). As far as we are aware, there are no reports on the national prevalence of abdominal OB (AO) in Greek adolescents.

The aim of this large-scale, cross-sectional survey was to provide estimates of OW, OB, and abdominal fat distribution in a representative sample of adolescents throughout the whole of Greece.

RESEARCH METHODS AND PROCEDURES

This study is part of a nationwide, cross-sectional, epidemiological study designed to estimate prevalence of OW and AO throughout the whole Greek population. Data on OB in adults, aged 20–70 years, were presented previously (10). For the estimation of OB prevalence in adults, anthropometric parameters were collected using questionnaires from households completed by means of their adolescent children who had direct measurements taken at their secondary school. In this article, we present the prevalence of OW, OB, and AO in Greek adolescents using their anthropometric measurements that were taken directly at school. 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.

Sample selection

The methodology for the study was described previously (10). In brief, the population studied consisted initially of adolescent pupils aged 13–19 years from public schools throughout all parts of Greece (islands included). Secondary schools representing various social classes were included in the sample for selection. The method used for selection was proportionate stratified random sampling (SRS).

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From the 3,514 secondary public schools, a sample of 332 (9.45%) was randomly selected. In each school, according to stratified random sampling, all the pupils from four out of six classes participated in the study. All adolescents in the survey were measured and completed a questionnaire at their respective schools. Their younger relatives aged 6–12 years were also measured, and completed questionnaires at home with the help of their older siblings; however, they were not included in this study.

Procedure

Study approval was obtained from local and state school authorities. After a training period and standardized criteria given by the doctors of Hellenic Medical Association for Obesity, school physical training instructors were responsible for conducting the survey. Adolescents aged 13–19 years who were living in the same household but not attending the same school as their peers were invited to their siblings' school to have measurements taken with the aid of gym instructors. This group included <5% of all adolescents.

The initial sample included 16,578 adolescents and from this sample 14,456 (6,677 boys and 7,779 girls) entered the study and had direct measurements taken for height, weight, and WC (valid participation rate 87.2%). Reasons for exclusion were missing values or report of aberrant values in measurements and incomplete questionnaires. Respondents did not differ from nonrespondents in terms of gender and age. Mean age (±s.d.) was 15.4 ± 1.8 years for both genders.

Measurements

Weight was measured to the nearest 0.1 kg using the same kind of portable scale (Terraillon T 715; Terraillon France, Chatou, France) and with the participants in minimal clothing. Height was measured to the nearest 0.1 cm without shoes using stadiometer (Seca 220; Seca, Columbia, SC). WC was measured using a cloth tape-measure midway between the lower rib and the iliac crest. BMI was calculated as weight (kg)/height (m^2). OW and OB prevalence were calculated according to International Obesity Task Force criteria (11). As there are no international representative curves for WC, as there are for BMI, we used the percentiles and recent cutoff values for WC determined in Cypriot children aged 6–17 years for the evaluation of abdominal fat distribution (12). For subjects aged 18 and 19 years, the cutoff points of 102 cm in boys and 88 cm in girls were used in accordance with the recommendations for the definition of metabolic syndrome in adults (13). All subjects with a WC above the 90th percentile for gender and age were defined as abdominally obese. This cutoff point was chosen because, according to the Bogalusa Heart Study (14), children and adolescents with WC above this limit are more likely to have multiple cardiovascular risk factors.

Information on lifestyle and sociodemographic factors associated with the prevalence of OW, OB, and AO were collected using the questionnaires, which were anonymous. The variables examined were: age (7-year age groups); residence (urban >20,000 inhabitants, >5,000 to <20,000 semiurban, and rural <5,000); ethnicity (Greek born or foreign born); smoking status (currently smoking, ex- or never smoked), and alcohol consumption habits (users, nonusers).

Statistical analysis

Comparisons between BMI and WC for each gender and age group studied were made using Student's *t*-test. Prevalence of OW, OB, and AO was estimated for the 13–14, 15–16, and 17–19 age groups, and proportions were compared using the χ^2-test. Univariate and multiple regression analyses with logistic regression models were performed to evaluate the associations between dependent and independent variables. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were therefore calculated. Results were considered significant at $P < 0.05$. Statistical analyses were carried out using the SPSS 11.0 software (SPSS, Chicago, IL).

RESULTS

The mean BMI ± s.d. (kg/m^2) for adolescent boys and adolescent girls was 22.1 ± 3.9 and 21.1 ± 3.4 kg/m^2 while the mean WC ± s.d. (cm) was 78.2 ± 12.9 and 72.2 ± 10.7 cm, respectively (**Table 1**).

The overall prevalence of OW, including OB, in adolescent boys was 29.4% and in girls 16.7% while that of OB was 6.1% in boys and 2.7% in girls, respectively. OW and OB prevalences were higher in boys than in girls in all age categories ($P < 0.001$). The total prevalence of AO was significantly higher in girls than in boys (21.7% for girls and 13.5% for boys, $P < 0.0001$). AO prevalence in girls was more important in the 13–14 and 15–16 year age groups (25.6 and 23.1%, respectively) than at 17–19 years, where it averaged 15.6% ($P < 0.0001$). **Table 2** shows the prevalence of OW, OB, and AO by gender in the three age groups and **Figure 1** shows the respective prevalence in the total population.

When associated factors were analyzed simultaneously in a multivariate model, significant independent correlations were found. As far as the effect of nationality is concerned, the risk of overall OW% (OR: 1.69, CI: 1.19–1.39), OB% (OR: 4.27, CI: 1.36–13.37) and AO% (OR: 2.19, CI: 1.27–3.80) was increased in Greek adolescent boys. Smoking increased the risk of OW% (OR: 1.43, CI: 1.10–1.83) and OB% (OR: 2.18, CI: 1.44–3.30), only in adolescent girls. Alcohol consumption also increased the risk of OW% only in adolescent girls (OR: 1.41, CI: 1.18–1.67). In general, increasing age decreased the risk of OW%, OB%, and AO% in most adolescents. No significant trends were observed for OW% in boys at ages 13–16 years and for OB% in girls at ages 13–19 years (results not presented in detail). Finally, no differences were observed in the prevalence of OB, OW, or AO in both genders according to residence in urban, semiurban, or rural areas.

DISCUSSION

This large-scale epidemiological survey conducted in Greece showed that the overall prevalence of OW and OB in adolescents aged 13–19 years was 29.4% in boys and 16.7% in girls. OB prevalence was also higher in boys than in girls (6.1% vs. 2.7%), whereas prevalence of AO was 13.5 and 21.7% in adolescent boys and girls, respectively.

So far, only a limited number of studies have examined the prevalence of adolescent OB in Greece, and most of these have been confined to particular geographical areas (4,5). National measurements were provided by a study conducted in 1990–1991 in 6,448 children aged 6–17 years, showing an overall prevalence of OW of 17.3%, similar in both genders (6). In the age group 10–17 years, the authors reported an overall OW prevalence of 19.3% in boys and 14.8% in girls and an OB prevalence of 2.7 and 1.6%, in boys and in girls, respectively (6). More recent data (2000–2002) from different regions of Greece show some discrepancies, with OW prevalence varying from 20 to 35% in adolescents (4,5,15).

This study provides evidence that throughout the country, the prevalence of excess weight is high, particularly in boys, where it approaches 30%. Our results are consistent with data previously

Table 1 Mean BMI and waist circumference (WC) in Greek adolescents by age and gender

	Boys			Girls		
		BMI	WC (cm)		BMI	WC (cm)
Age groups	*n*	Mean ± s.d.	Mean ± s.d.	*n*	Mean ± s.d.	Mean ± s.d.
13	1,189	20.8 ± 3.8*	73.7 ± 13.1**	1,425	20.3 ± 3.7	70.2 ± 10.3
14	1,211	21.5 ± 3.8*	76.2 ± 12.4**	1,384	20.9 ± 3.3	71.6 ± 10.1
15	1,171	21.9 ± 3.9*	77.8 ± 12.2**	1,326	21.3 ± 3.2	71.4 ± 10.5
16	1,122	22.6 ± 3.8*	80.2 ± 12.6**	1,272	21.8 ± 3.5	73.0 ± 10.3
17	997	23.1 ± 3.7*	81.3 ± 12.6**	1,222	21.5 ± 3.4	73.6 ± 11.3
18	704	23.0 ± 3.4*	80.9 ± 12.1**	868	21.7 ± 3.2	73.7 ± 11.3
19	283	23.5 ± 3.4*	82.3 ± 13.4**	282	21.4 ± 3.2	74.0 ± 11.2
Total	6,677	22.1 ± 3.9	78.2 ± 12.9	7,779	21.1 ± 3.4	72.2 ± 10.7

*$P < 0.001$ for comparison of BMI between boys and girls, **$P < 0.001$ for comparison of WC between boys and girls.

Table 2 Prevalence of overweight (OW), obesity (OB), and abdominal obesity (AO) by age groups and gender

Age groups	Boys				Girls			
	n	OW%	OB%	AO%	*n*	OW%	OB%	AO%
13–14	2,400	31.5	7.5	14.6	2,809	21.1	3.0	25.6
15–16	2,293	30.1	5.7	15.6	2,598	14.2	2.2	23.1
17–19	1,984	25.9	4.8	9.9	2,372	14.0	2.7	15.6

$P < 0.0001$ for trend in OB%, OW%, AO% between all age groups in both genders, excepted for OB% in girls (P = nonsignificant). $P < 0.0001$ for comparison of OB%, OW%, AO% between boys and girls in all age groups.

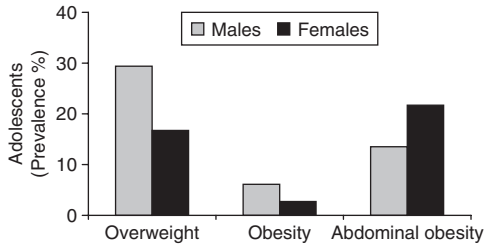

Figure 1 Prevalence of overweight, obesity, and abdominal obesity by gender in the total population.

reported in 2000 from a region of Northern Greece (4). Compared with the previous national survey conducted 12 years ago (6), which was also based on International Obesity Task Force cutoff values, we have observed a sharp increase in OW in boys by 52%, while rates in girls have remained relatively stable at ~15–17%. Similar trends in OW prevalence related to gender were observed by Magkos *et al.* (5), who found that the OW% in Cretan children had more than doubled from 1982 to 2002 among boys aged 12 years and increased by 31% among boys aged 15 years. This epidemic in adolescent OB is comparable with that observed in other Mediterranean European countries, such as Spain where overall OW prevalence is 25.7 and 19.1% in boys and girls, respectively (16), and in the United Kingdom (17), but rates are lower than those recently reported from the United States (18).

The reasons for the OB epidemic in the Greek adolescent population are not clear. Greece experienced a rapid socioeconomic development during the past 30 years which followed the decline from the Second World War, the subsequent civil war and the recent era of the colonels from 1967 to 1974. The delayed but sharp modernization has led to a shift from the traditional Mediterranean diet in Greek families to the western-type diet (10,19).

In fact, current estimates of nutrient intake in young Greeks indicate increased intake of total and saturate fat and decreased intake of complex carbohydrates (20). In addition, Greece has moved to a more sedentary lifestyle and OW in adolescence has been found to correlate well with indices of physical inactivity (15). In a representative study in the European Union, it has been reported that the lowest proportion of participants in some kind of physical activity was found in southern countries, with Greece being, after Portugal, the country with the lowest number of participants (61%) (21). These rapid dietary changes and physical activity patterns could account, at least in part, for the OB epidemic in Greek teens, as well as in Greek adults (10).

It has to be underlined that, in our study, OW, OB, and AO affect the Greek male population significantly more than the foreign male population, the latter being represented by immigrants from neighboring developing countries (e.g., some Balkan States and ex-Soviet Union countries). This is in contrast with most studies showing that a lower prevalence of OB is seen at higher income and high levels of socioeconomic status in children and adolescents in more modernized Mediterranean societies (2,22). Our findings could probably be explained by the fact that immigrants in Greece are first-generation immigrants and, therefore, they are less affected by the "western-type" lifestyle. On the other hand, we did not observe any difference in weight status related to areas of residence in Greece.

An interesting finding of our study was the positive and independent association between smoking and alcohol consumption and percentage of OW adolescent girls. This association could be explained by several reasons. These individuals may weigh more because of the high energy content of alcohol or because of clustering of other unhealthy habits, such as high intake of fat, low intake of dietary fibers, low physical activity, and frequent television watching (23,24). It has also been reported that girls are more prone to emotional and weight-related distress than

boys (25). Finally, the independent positive association between smoking and OW in girls could be attributed to the frequent tobacco use as a way to control their body weight and shape (26). This behavior deserves particular attention because smoking is an important cardiovascular risk factor and smoking habits at an early age are associated with an increased likelihood of smoking during adulthood (27).

The results of our study showed that WC identified far more adolescents as obese compared with BMI, and this difference was more striking in adolescent girls. In addition, a higher prevalence of AO was found in adolescent girls compared with boys. These discrepancies might result from a misclassification of AO due to the lack of international standardized cutoff limits. However, in agreement with the high proportion of AO, we found in adolescent girls, it was recently reported in two studies that WC has increased much faster than BMI during the past 10–20 years, and that this phenomenon is more obvious in girls than in boys (8,28). Early pubertal body composition changes, occurring more frequently in girls than in boys, could be a possible cause of these differences (28). In our study, consistent with this observation, AO prevalence in girls was more important in the 13–14 and 15–16 year age groups than at 17–19 years. The increased trend for smoking and alcohol consumption among Greek adolescent girls could also offer a possible explanation. However, we found no significant association between prevalence of AO and alcohol consumption or smoking in any age range, as was the case in the prevalence of OW and OB. Concerning the "nationality" effect, we found that adolescent Greek boys were more affected by AO than their foreign peers.

In comparison with the few available data from other countries using the same cutoff limits at the same ages, it appears that the prevalence of AO in Greece is lower for both genders to that recently recorded in the United Kingdom (8), lower for boys than that in the United States, but similar if not higher for girls, at least in younger ages (9). In these countries, an increasing trend is also noted.

The major limitation of the study is its cross-sectional design, and, therefore, it is impossible to determine a causal relationship between lifestyle and sociodemographic factors and the prevalence of OW, OB, and AO. Furthermore, data on these factors were collected using the questionnaires and some respondents may have underreported unhealthy behaviors such as smoking and alcohol consumption. On the other hand, the major strengths of the study are the large number of participants, which is representative of the Greek population, and the relatively high response rate.

In conclusion, the prevalence of OW and OB in Greek adolescents is high, particularly in boys, comparable with that reported for most Mediterranean European countries. AO, mainly in girls at younger ages, also appears high. The data from this national survey stresses the need for urgent preventing measures in this sensible age group.

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DISCLOSURE

The authors declared no conflict of interest.

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