Original Research Article

Behavioral and Physiological Indices Related to BMI in a Cohort of Primary Schoolchildren in Greece

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ABSTRACT The purpose of this study was to investigate the differences between normal weight and overweight primary schoolchildren in terms of certain cardiovascular disease (CVD) risk factors and furthermore to identify behavioral correlates significantly affecting their body mass index (BMI). The sample consisted of 198 children with a mean age of 11.5 $\pm$ 0.4 years (106 females and 92 males). Data was obtained on children anthropometry, plasma lipids, plasma glucose, dietary intake, cardiorespiratory fitness, and physical activity. Significant gender differences were observed for most of these parameters, with boys being more active and fit but also spending more time on sedentary activities and exhibiting higher intake of energy and fat compared to girls. Using the International Obesity Task Force's (IOTF) BMI cut-off points, the prevalence of overweight and obesity was estimated to be 35.6% and 6.7% among boys and 25.7% and 6.7% among girls, respectively. Overweight and obese children had higher levels of plasma triglycerides (TG) and total cholesterol to HDL-cholesterol (TC/HDL-C) ratio and lower levels of HDL-C and physical fitness compared to their normal-weight peers. Among the behavioral variables tested, only participation in organized sports, cardiorespiratory fitness, and TV watching were significantly correlated with BMI, while energy and fat intake were found to have no significant effect. The current study suggests that even in childhood, overweight and obesity are indicative of an unfavorable lipidemic profile. Among the behavioral parameters known to affect BMI, those found to exert a significant effect were organized physical activities, cardiorespiratory fitness, and TV watching, but not energy or fat intake. Am. J. Hum. Biol. 16:639–647, 2004. © 2004 Wiley-Liss, Inc.

Many recent reports have indicated that the prevalence of obesity in childhood and adolescence has been increasing worldwide at an alarming rate (Flegal and Troiano, 2000; Hanley et al., 2000; Chinn and Rona, 2001; Chu 2001; Booth et al., 2003). According to the US Surgeon General, the number of overweight children has doubled and the number of overweight adolescents has tripled since 1980. In most cases, childhood obesity tracks into adulthood (Whitaker et al., 1997; Katzmarzyk et al., 2001; Trudeau et al., 2003) and becomes associated with an increased risk for all causes of mortality and especially with an increased prevalence of cardiovascular disease (CVD). Similar to the tracking phenomenon of obesity, other CVD risk factors, such as unfavorable lipidemic and glycemic profiles, have also been reported to track from childhood to adulthood for those individuals characterized as obese (Berenson and Srinivasan, 2001).

Early prevention of obesity seems to be an emerging and appropriate approach to lowering morbidity and mortality related to obesity, since maintenance of weight loss from treatment has been proved to be very difficult (Poston et al., 1998). Despite the existence of comparatively few reports evaluating the prevention of obesity, a key aspect of this to be accomplished may be directing efforts toward changing the health behaviors associated with the onset of this medical condition among children.

In Greece there is limited data regarding the prevalence and trends of childhood obesity (Mamalakis and Kafatos, 1996; Krassas et al., 2001b) and its association to CVD risk factors, such as blood lipids and behavior-associated patterns, notably diet and physical activity (Petridou et al., 1995). Moreover, the

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determinants of BMI in Greek children and adolescents is another under-investigated topic (Petridou et al., 1995; Anastassea-Vlachou et al., 1996; Mamalakis et al., 2000; Krassas et al., 2001a), thus requiring wider investigation.

The objective of the present study was to record the differences between normal weight and overweight 11.5-year-old elementary school children living in the district area of Volos regarding the mean values of certain CVD risk factors, such as plasma lipids, glucose, and physical fitness scores. Furthermore, this study aimed at identifying behavioral parameters associated with increased BMI values in childhood, such as dietary habits and levels of physical activity in order to guide health professionals in developing more effective intervention for the prevention of childhood obesity.

SUBJECTS AND METHODS

The mean age of the children surveyed was 11.5 ± 0.4 years. All pupils registered in the sixth grade of 12 randomly selected elementary schools in the area of Volos, which is a semi-urban and less-studied region of central Greece, were invited to participate in the current study. From the total number of eligible pupils, 198 (106 females and 92 males, participation rate 73%) agreed to participate. Among those 198 pupils, full data was obtained for 195 of them, whereas three pupils with inconsistent data were excluded from the statistical analysis. Inclusion of the subjects was on a voluntary basis; prior to acceptance children's parents or guardians were fully informed about the objectives and methods of the study and signed a consent form. Data collection was carried out during morning school visits by a team of trained personnel. Approval to conduct the survey was granted by the Ethical Committee of Harokopio University Athens and the Greek Ministry of Education.

Anthropometric measurements

Body weight was measured by a digital scale (Seca) with an accuracy of ± 100 g. Subjects were weighed without shoes in the minimum clothing possible, i.e., underwear. Standing height was measured without shoes to the nearest 0.5 cm with the use of a commercial stadiometer, keeping the shoulders in a relaxed position and the arms hanging freely (Lohman et al., 1991). BMI was calculated by dividing weight (kg) by height squared (m^2). Left triceps, biceps, subscapular, and suprailiac skinfold thickness was measured with a Lange skinfold caliper. The sum of these four skinfolds was then determined (SUMSKF). Midarm muscle circumference (MAMC), an index of the body's total skeletal muscle mass, was derived from the following equation: MAMC (cm) = Left Arm Circumference – [0.314 Triceps skinfold (mm)] (Frisancho, 1981). Waist circumference was measured at the level of umbilicus and hip circumference at the level of greater trochanters and pubic symphysis to the nearest 0.1 cm. The waist-to-hip ratio (WHR) was then calculated for each child.

Definition of overweight

Participants were classified as normal weight, overweight, and obese according to IOTF's age- and sex-specific BMI cut-off points (Cole et al., 2000). For the purpose of this study, all participants falling above the overweight cut-off point (overweight plus obese subjects) were categorized as overweight, as the sample size was not sufficient to examine the health effects associated with obesity per se, given that there were only six obese males and seven obese females in the sample.

Biochemical assessment

Early morning venous blood samples were obtained from each child for biochemical screening tests following a 12-hour overnight fast. Professional staff performed venipuncture using vacutainers to obtain 10 ml of whole blood. The blood samples were stored in tanks containing ice packs that maintained the temperature at 3–4°C and were transferred to the Department of Nutrition and Dietetics, Harokopio University Athens. Blood was centrifuged for plasma separation at 3,000 rpm for 15 minutes using a bench centrifuge and 1.5-ml aliquots were pipetted into plastic Eppendorf tubes. The aliquots were then stored at –80°C until further analyses.

Plasma glucose, total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), and triglycerides (TG) were determined in duplicate using commercially available enzymatic colorimetric assays (Sigma Diagnostics, St. Louis, MO) on an automated ACE analyzer (Schiapparelli BioSystems, Columbia, MD). Low-density lipoprotein cholesterol (LDL-C) was calculated by the Friedewald equation (Friedewald et al., 1972). The TC/HDL-C ratio was estimated as well.

Physical activity assessment

Assessment of moderate to vigorous physical activity (MVPA) was performed by using a standardized activity interview, based on a questionnaire completed by the sixth graders in the presence of a member of the research team. Further details regarding the reliability and validity of the questionnaire are given elsewhere (Manios et al., 1998). Respondents reported the time spent on various physical activities on two consecutive weekdays and one day during the weekend. Children were asked to report all activities they were engaged in, either alone or with their peers or under the supervision of a trainer. The weekly time (min/week) devoted to moderate (such as ballet/dancing, horseriding, cycling, and rowing), vigorous (such as basketball/football/handball, swimming, skiing, gymnastics, and canoeing) and very vigorous activities (such as competitions and long-distance running) was considered the total moderate to vigorous physical activities (TMVPA). Organized moderate to vigorous physical activities (OMVPA) are part of TMVPA and comprise only leisure activities out of school, performed under the supervision of a trainer on a regular weekly time basis, more likely within a sports club setting. Finally, the total weekly time (min/week) spent on sedentary activities and more specifically on TV watching, video games, and recreational computer usage was characterized as TV time.

Cardiorespiratory fitness assessment

Cardiorespiratory fitness was estimated indirectly according to children's performance on the endurance 20 m shuttle run test (ERT). The ERT is a field test included in the European battery of physical fitness tests and recommended by the Committee of Experts on Sports Research for the assessment of cardiorespiratory fitness in school children (EUROFIT, 1988). Subjects start running at a speed of 8.5 km/h and speed is increased at various stages. The subjects move between two lines at a distance of 20 m apart, reversing direction and continuing backwards and forwards in accordance with a pace dictated by a sound signal on an audiotape, which gets progressively faster (0.5 km/h every minute). Each stage of the test is made up of several shuttle runs but the actual score of the subject is the last one-half stage fully completed before he/she drops out (the stages are 0.0, 0.5, 1.0, 1.5, 2.0, etc). In our study the number of shuttle runs each child completed was estimated and referred to as the ERT score. The higher the ERT score the better the cardiovascular function. The ERT is recommended for large groups of children, since it is reliable, valid, noninvasive, and requires limited facilities (Leger et al., 1988).

Dietary assessment

A 24-hour recall was used to collect information regarding children's dietary intake (Farris and Nicklas, 1993). All interviewers were rigorously trained to minimize interviewer effects. Study participants were asked to describe the type and amount of food, as well as all the beverages consumed during the previous day, provided that it was a usual day according to the participant's perception. To improve the accuracy of food descriptions, standard household measures (cups, tablespoons, etc.) and food models were used to define amounts when appropriate. At the end of each interview the interviewers reviewed the collected food intake data with the respondent in order to clarify entries, servings, and possible forgotten foods. Food intake data were analyzed using the Nutritionist V diet analysis software (First Databank, San Bruno, CA), which was extensively amended to include traditional Greek recipes, as described in Food Composition Tables and Composition of Greek Cooked Food and Dishes (Trichopoulou, 1992). Furthermore, the database was updated with nutritional information of processed foods provided by independent research institutes, food companies, and fast-food chains.

Statistical analysis

The statistical analysis was carried out using the SPSS (Chicago, IL) 10.0 statistical software package for Windows. Descriptive statistics of continuous variables were expressed as mean (SD). The unpaired Student's t-test was used in order to identify the significant differences between genders, as well as between normal weight and overweight subjects. Nonnormally distributed variables were logarithmically transformed prior to the analysis. Partial correlation analysis was performed in order to determine the association between BMI and certain behavioral patterns, such as diet, physical activity, and fitness using sex as covariate. The level of significance for all analysis was set at $P \leq 0.05$.

RESULTS

Descriptive statistics for boys and girls are summarized in Table 1. No significant differences between genders were observed for weight, BMI, MAMC, and SUMSKF. Girls were taller ($P = 0.025$) and had a lower WHR ($P < 0.001$) compared to boys. On the other hand, boys had a higher energy ($P < 0.001$), fat ($P = 0.008$), and saturated fat intake ($P = 0.017$), while they were spending more time watching TV ($P = 0.001$) and on TMVPA ($P = 0.003$) compared to girls. Finally, boys were found to score higher in ERT than girls ($P < 0.001$).

The prevalence rates of normal weight, overweight, and obesity using the IOTF's cut-off points for BMI (Cole et al., 2000) are presented in Table 2. According to these findings, 35.6% of boys, 25.7% of girls, and 30.3% of both genders were overweight, while 6.7% of boys, girls, and both genders were obese.

The differences between normal weight and overweight subjects regarding specific CVD risk factors are presented in Table 3.

*TABLE 2. Distribution of sample children who are normal weight, overweight, and obese, by IOTF's cut off points for body mass index (BMI)**

	Males (n = 90)	Females (n = 105)	All subjects (n = 195)
	n (%)	n (%)	n (%)
Normal weight	52 (57.8%)	71 (67.6%)	123 (63.1%)
Overweight*	32 (35.6%)	27 (25.7%)	59 (30.3%)
Obese*	6 (6.7%)	7 (6.7%)	13 (6.7%)

*Overweight and obesity as defined by IOTF (Cole et al., 2000).
Normal weight: BMI < 21.20 kg/m^2 (females); BMI < 20.89 kg/m^2 (males).
Overweight: 21.20 kg/m^2 < BMI < 26.05 kg/m^2 (females); 20.89 kg/m^2 < BMI < 25.58 kg/m^2 (males).
Obese: BMI > 26.05 kg/m^2 (females); BMI > 25.58 kg/m^2 (males).

For both genders, overweight subjects were found to have lower HDL-C ($P < 0.05$) and ERT scores ($P < 0.01$) but higher TC/HDL-C ($P < 0.05$), TG ($P < 0.001$), and SUMSKF ($P < 0.001$) compared to normal weight subjects. HDL-C was found to be significantly lower for overweight boys only. No other significant differences were observed.

According to the partial correlation analysis summarized in Table 4, BMI was found to be inversely correlated with OMVPA ($P < 0.05$) and ERT score ($P < 0.001$). On the contrary, BMI and TV time were found to be positively correlated ($P < 0.05$). No other significant correlations between BMI and the other behavioral indices tested were observed.

TABLE 1. Means and standard deviations (SD) of anthropometrical, dietary, physical activity, and cardiorespiratory fitness parameters

Variable	Males Mean (SD)	Females Mean (SD)	*P*-value
Anthropometrical parameters	**n = 90**	**n = 105**	
Height (cm)	150.1 (6.3)	152.5 (7.8)	0.025
Weight (kg)	45.9 (9.3)	47.7 (9.9)	ns[a]
BMI (kg/m^2)	20.2 (3.4)	20.4 (3.5)	ns
MAMC[b] (cm)	18.5 (2.4)	18.4 (3.4)	ns
SUMSKF[b] (mm)	59.1 (32.9)	61.0 (30.9)	ns
WHR	0.85 (0.06)	0.80 (0.08)	<0.001
Dietary parameters	**n = 89**	**n = 100**	
Energy intake (kcal/day)	2211.7 (751.3)	1798.2 (526.0)	<0.001
Fat intake[b] (gr/day)	103.0 (45.9)	86.1 (31.8)	0.008
Saturated fat intake (gr/day)	38.8 (18.8)	33.1 (13.2)	0.017
Physical activity parameters	**n = 84**	**n = 98**	
TV time (min/week)	1134 (504)	870 (516)	0.001
TMVPA[b] (min/week)	485 (277)	369 (288)	0.003
OMVPA[b] (min/week)	298 (198)	327 (274)	ns
Cardiorespiratory fitness parameter	**n = 63**	**n = 73**	
ERT score	32.4 (14.5)	23.9 (11.1)	<0.001

[a]ns: not significant.
[b]Parameter was log transformed.

TABLE 3. Differences of important CVD risk factors between normal weight and overweight subjects

	Males		Females		All subjects	
	Normal weight (n = 52)	Overweight (n = 38)	Normal weight (n = 71)	Overweight (n = 34)	Normal weight (n = 123)	Overweight (n = 72)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
TC (mg/dl)	191.5 (28.3)	186.1 (26.4)	189.8 (31.4)	195.3 (28.9)	190.5 (29.9)	190.6 (27.8)
HDL-C (mg/dl)	48.8 (6.9)	43.0 (7.9)***	46.4 (7.9)	45.4 (12.0)	47.4 (7.5)	44.1 (10.1)*
LDL-C (mg/dl)	127.4 (24.9)	125.1 (20.8)	126.5 (27.2)	131.3 (24.2)	126.9 (26.1)	128.1 (22.5)
TC/HDL-C	3.9 (0.6)	4.4 (0.6)**	4.1 (0.7)	4.5 (0.9)*	4.1 (0.7)	4.4 (0.7)*
TG[a] (mg/dl)	72.3 (19.9)	92.3 (26.8)***	87.3 (22.9)	101.3 (36.7)*	80.7 (22.8)	96.7 (32.0)***
Glucose (mg/dl)	92.6 (9.8)	93.4 (10.3)	91.0 (9.8)	94.7 (9.2)	91.7 (9.8)	94.0 (9.7)
SUMSKF[a] (mm)	39.2 (16.9)	86.0 (28.3)***	51.1 (18.4)	83.1 (40.8)***	45.9 (18.6)	84.6 (34.5)***
ERT score	38.1 (14.8)	25.4 (10.9)***	25.6 (11.2)	19.9 (10.1)*	30.7 (14.1)	22.9 (10.8)**

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$ vs. normal weight group.
[a]Parameter was log transformed.

TABLE 4. Partial correlation among BMI, dietary, and physical activity patterns after controlling for sex

	Energy intake	Fat intake[a]	TMVPA[a]	OMVPA[a]	TV time	ERT score
BMI	0.006	0.02	−0.21	−0.28*	0.32*	−0.53***
Energy intake		0.88***	0.01	0.01	0.15	0.21
Fat intake			0.07	0.03	0.07	0.19
TMVPA				0.38**	−0.29*	0.21
OMVPA					−0.23	0.05
TV time						−0.16

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.
[a]Parameter was log transformed.

DISCUSSION

Data from longitudinal studies suggest that childhood obesity is associated with an increased risk of morbidity and mortality through adulthood (Katzmarzyk et al., 2001). Classifying obesity for children and adolescents is complicated, since body weight and body composition are continually changing (Dai et al., 2002). Taking this into consideration plus the strong association (0.83–0.98, $P < 0.0001$) between BMI and measures of adiposity derived from dual energy X-ray adsoptiometry in children (Lindsay et al., 2001), BMI is considered one of the most appropriate measures for the indirect assessment of adiposity in childhood and adolescence (Frontini et al., 2001, Geiss et al., 2001).

In the current study the prevalence of overweight (35.6% for boys and 25.7% for girls) and obesity (6.7% for both boys and girls) (Table 2) was found to be relatively high. These prevalence rates exceeded those reported by other earlier studies conducted among children and adolescents from the south and the north districts of Greece (Mamalakis et al., 2000; Krassas et al., 2001b), as well as those reported for the same-age children living in other developed countries (Flegal and Troiano, 2000; Booth et al., 2001, 2003; Chinn and Rona, 2001). Indeed, using the same cut-off points, the prevalence of overweight was found to range from 9–18.1% for school boys and from 13.5–20.4% for school girls in the US, Australia, England, and Scotland. Likewise, the corresponding percentages for obesity were found to range from 1.7–6.9% for boys and 2.1–7.0% for girls in the same countries (Flegal and Troiano, 2000; Booth et al., 2001; Chinn and Rona, 2001).

Overweight and obesity is the outcome of a positive energy balance over a long period of time, i.e., higher energy intake versus lower energy expenditure. These parameters often differentiate between the two genders, something that is confirmed by the findings of the present study. The analyses of the current data showed that boys had significantly higher energy, fat, and saturated fat intake and possibly higher energy expenditure, as this was indicated by the significantly more time devoted to weekly TMVPA compared to girls (Table 1). These gender differences in TMVPA have been confirmed by earlier reports conducted among younger Greek children (Manios et al., 1999; Mamalakis et al., 2001), as well as by other reports worldwide (Katzmarzyk et al., 1999; Mota et al., 2003).

The observed gender difference, with respect to the cardiorespiratory fitness (ERT score) of the study participants (Table 1), may be attributed to the higher mean physical activity levels reported by boys. One recent study conducted among 6-year-old Greek children suggested that physical activity levels were higher in boys compared to girls even before physiological variables, such as hemoglobin, cardiorespiratory fitness, or fat mass differentiated between genders (Manios et al., 1999). This observation seems to lie in social and cultural beliefs of parents and teachers as to the types of activities appropriate for boys and girls. According to recent evidence, family and society appear to influence the level and type of physical activity girls are engaged in and therefore may determine their lifetime habits with respect to habitual physical activity (Vilhjalmsson and Kristjansdottir, 2003; Manios et al., 1999).

In terms of physiological parameters associated with cardiorespiratory fitness, the results of the present study indicated no significant differences between the two sexes regarding weight, BMI, MAMC, and SUMSKF (Table 1). Nonetheless, our findings do point to some gender differences in height and central adiposity, as measured by WHR, since girls were found to be taller and have lower WHR compared to boys. This finding agrees with those reported by other studies conducted among school-aged children (Mamalakis et al., 2001; Kuzawa et al., 2003).

Risk factors for CVD have been reported to occur mainly among overweight and obese adults (WHO, 1998). However, a similar occurrence has been reported for children and adolescents with increased body weight as well (Kuzawa et al., 2003). In the current study the clustering of certain plasma lipids and lipoproteins, associated with the atherogenic process, was found to be more unfavorable for overweight children (Table 3). More specifically, our analysis indicated that overweight boys had significantly lower levels of HDL-C compared to their normal-weight peers. The same applied to the TG and TC/HDL-C ratio, since the serum levels of these indices were significantly higher for both male and female overweight subjects. These findings were consistent with those reported by other cross-sectional and longitudinal studies showing that higher BMI values are indicative of an unfavorable profile of certain atherogenic CVD risk factors (Petridou et al., 1995; Chu 2001; Kuzawa et al., 2003; Katzmarzyk et al., 2003). Regarding plasma glucose levels, our findings did not reveal any significant differences between the two weight groups, either for boys or for girls. This observation is in agreement with some (Mo-Suwan and Lebel, 1996; Stensel et al., 2001), but in contrast with most studies (Csabi et al., 2000; Chu, 2001; Katzmarzyk et al., 2003) investigating the differences in glucose levels between overweight and normal-weight children. In fact, insulin resistance and hence glucose intolerance levels were described for overweight children younger than those participating in the current study (Galli-Tsinopoulou et al., 2003).

In accordance with the biochemical data presented above the findings of the present study showed that overweight was indicative of poorer cardiorespiratory fitness and higher subcutaneous fat in both genders. More specifically, lower ERT scores and higher SUMSKF were observed for overweight subjects compared to their normal-weight counterparts (Table 3). These data are consistent with the findings recently reported by another study conducted among schoolchildren, using several components of health-related physical fitness (Deforche et al., 2003). Although the data presented in Table 3 cannot provide information on the succession of risk factors development and the cause–effect relation cannot be examined, they do offer important indications of the unfavorable health profile of the heavier subjects versus the leaner ones. In order to further proceed with an understanding of the development of obesity and the behavioral variables related to it, a partial correlation analysis was performed.

Contrary to our expectations, but in agreement with another recent study (Trost et al., 2001), TMVPA was not significantly related with BMI (Table 4). The younger the children, the less probable it is to find a significant correlation between BMI and physical activity, due to the complexity of their relationship, which may has smaller variations in children compared to adults (Armstrong and Simons-Morton, 1994). On the other hand, OMVPA was found to be negatively correlated with BMI, which is consistent with another recent study (Dowda et al., 2001). This controversial finding may be attributed to the accuracy of reporting OMVPA versus TMVPA. It is generally accepted that it is easier to remember and accurately report regularly conducted organized activities compared to non-organized and irregular ones (Telama et al., 1996), thus increasing the potential of errors in estimating TMVPA. The relationship identified in the present study between OMVPA and BMI offers support to the notion that overweight children and adolescents expend less energy in physical activities compared to their normal-weight peers (DeLany et al., 2002), and this lower energy expenditure may contribute to the maintenance of obesity in these youngsters.

Cardiorespiratory fitness has been reported to be a surrogate measure of physical activity levels among children (Huang and Malina, 2002). The observed negative relation between ERT score and BMI ($P < 0.001$) was also reported by another study conducted among Greek schoolchildren (Mamalakis et al., 2000) and may reflect the effect of increased physical activity levels on BMI.

Another interesting finding of the current study was the positive correlation ($P < 0.05$) between BMI and TV time (Table 4), which was in agreement with the results of many recent cross-sectional studies, either conducted among children and adolescents living in Greece (Krassas et al., 2001a; Anastassea-Vlachou et al., 1996) or in other developed countries (Andersen et al., 1998; Hanley et al., 2000; Dowda et al., 2001; Crespo et al., 2001). The association found between television viewing and body mass may rely on the "unhealthy" and "fattening" dietary choices promoted by advertisements, as well as on the positive energy balance due to increased energy intake (Crespo et al., 2001) and to reduced energy expenditure during TV viewing (Robinson 2001).

The findings of the present study are in agreement with abundant scientific evidence showing that energy and fat intake are not related to childhood obesity. As it was believed until recently fat intake was one of the primary determinants of childhood obesity. However, after reviewing a large number of studies examining the relationship between fat intake and the prevalence of obesity, Willett and Leibel (2002) concluded that dietary fat is not a primary contributor to the increasing prevalence of obesity, since fat consumption has been decreasing over the last two decades in many developed countries. The same applies for energy intake, as recent studies have shown that positive energy balance causing overweight in childhood is not due to increased energy intake (Rocandio et al., 2001), but rather due to decreased energy expenditure (DeLany et al., 2002).

CONCLUSION

The findings of the present study, although restricted in a semi-urban region of central Greece, offer some support to the reported high prevalence of overweight and obesity among primary school children. Overweight and obesity were indicative of a more unfavorable lipidemic profile in both boys and girls. Among the behavioral parameters known to affect BMI, those found to have a significant effect were OMVPA, cardiorespiratory fitness, and TV time, but not energy or fat intake. Halting, therefore, the rising prevalence of obesity and related CVD risk factors in Greek children is considered to be a public health priority, and according to the data provided by the present study, prevention must primarily focus on the promotion of physical activity and reduction of inactivity patterns.

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