

# Prevalence of obesity in children aged 6-12 years in Greece: nutritional behaviour and physical activity

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## Abstract

**Introduction:** During the last two decades, obesity has proved to be one of the most important problems of public health, and it is considerably more frequent in developed countries, not only in adults, but in children, too. The aim of the current study is to evaluate the prevalence of overweight and obesity in children.

**Material and methods:** Two thousand three hundred and seventy-four pupils in primary education were considered for the study (1206 boys and 1168 girls).

**Results:** In the population-based study, the proportion of overweight children was 23.9%, of obese children 7.3%, and of those with central obesity 35.5%. The boys were obese in a higher percentage than the girls (9.2% vs. 5.3%,  $p < 0.05$ ). The obesity rates were gradually reduced as the children were growing older. The nutritional habits which were identified to have a positive association with obesity were the following: skipping breakfast, not consuming fruits and vegetables, and consuming bread and soft drinks. Children's healthy nutrition in school was related to lower rates of generalised and central obesity, while the hours spent watching TV were positively associated with all types of obesity.

**Conclusions:** Results from the study suggest that a high proportion of children are overweight or obese. Therefore, it is important to adhere to a healthy lifestyle which emphasizes healthy food choices and habits, regular physical activity, and limiting screen time.

**Key words:** childhood obesity, central obesity, prevalence, nutrition, eating behaviour, physical activity.

## Introduction

Obesity is a multifactorial condition characterized by abnormal or excessive body fat accumulation. The aetiology of obesity includes genetic, metabolic and environmental factors [1]. Obesity appears mainly when the intake of calories is higher than the calories consumed (positive energy balance) [2]. During the last two decades, obesity has emerged as a leading public health problem; it is more prevalent in developed countries, affecting adults and children alike [3-6].

In particular, childhood obesity increases the likelihood of several consequences for a child (precocious puberty, gynecomastia, polycystic ovary

syndrome, diabetes mellitus type 2, hypertension, etc) [6-11] and also later in adulthood (increased mortality due to cardiovascular disease, diabetes mellitus, colorectal cancer, etc.) [11, 12]. Obese children and adolescents have a higher probability of remaining obese later as adults [13]. Studies in Greek urban and rural areas showed higher scores for childhood obesity indicators (body mass index (BMI), waist-to-hip ratio, cutaneous wrinkles); compared to other countries, Greece is closer to those countries with higher percentages of childhood obesity (36% boys, 16% girls) [14-18].

Emphasis has been given lately to the type of obesity, as perivisceral fat accumulation is related not only to diabetes type 2, but to increased cardiovascular risk for adults and children as well [19-21]. Sex-related central obesity is diagnosed by the patient's waist circumference (according to the International Diabetes Federation (IDF) and Adult Treatment Panel III (ATP III)) and the waist-to-hip ratio [22]. Body mass index is a measure of obesity for adults and children [23]. However, BMI depends on age and it may give incorrect results, as is the case with children with increased muscle or osteal mass who have been mistakenly assessed as overweight or obese [24, 25].

The International Obesity Task Force (IOTF) linked the child BMI-sex-age percentiles with the adult-defined classes of overweight and obesity; thus, a BMI-sex-age percentile higher than the 85<sup>th</sup> percentile accords with the adult definition of overweight, while the 95<sup>th</sup> percentile or higher accords with the adult definition of obesity [26, 27]. By Cole's LMS method (L: the power in the Box-Cox transformation, M: the median, S: the coefficient of variation), curves drawn in a 2000 study were linked to the 95<sup>th</sup> and 85<sup>th</sup> percentile, corresponding to BMI 25.0 kg/m<sup>2</sup> and 30.0 kg/m<sup>2</sup> at age 18 years [28].

The main reasons for this soaring childhood obesity epidemic are excessive intake of fat- and sugar-rich foods, low fibre intake, larger portions of food, and low physical activity levels, especially in developed countries [14, 17].

The objectives of this study were (a) to investigate the prevalence of overweight and obesity among Greek students, and (b) to determine the correlation between eating habits and physical activity among Greek students aged 6-12 years.

## Material and methods

From 2009 to 2010, a sample of 2374 students (1206 males, 1168 females) 6 to 12 years old participated in our study. This cross-sectional study was based on a convenience sample of primary school students. In order for the schools to allow the distribution of questionnaires, our research protocol had to be first approved by the Pedagogical Institute.

## Questionnaires

The questionnaire was drawn up by the researchers. It included an introduction about the research and its objectives, a parental consent form for participation in the study, body measurements of the students, parents' education level and 37 questions about eating habits and physical activity levels of the students. The questions regarding eating habits and physical activity were based on the Child Feeding Questionnaire (CFQ) [29].

Closed format questions in the form of multiple-choice questions were given and the students had to circle their preferred answer. In questions regarding how often the students eat specifically Mediterranean-type foods, they had to give specific answers on lunch and dinner consumed during a week. The questionnaire was distributed to each student individually; each student's body measurements were taken by the researchers. The well-known BMI formula was used with reference to age-adjusted BMI charts by employing Cole's LMS method [28]. Parental consent forms were sent to all parents. Out of 2650 mailed forms, 2374 were returned and signed. Unsigned forms were not accepted. The parents' response rate was 89.5% ( $n = 2374$ ). Two successive pilot studies of 50 students each followed, which allowed some minor adjustments to the questionnaire to be made. Students, parents and schools were assured anonymity. No personal data were collected or used.

## Research ethics

All parents were mailed informed consent forms for the participation of children in the study. More specifically, 2650 consent forms were mailed and 2374 of them were returned signed by the parents. Children who did not return those forms signed by their parents were excluded from the study. The parents' response rate was 89.5% ( $n = 2374$ ).

Students, parents and schools were assured anonymity. No personal data were collected or used. The students could also opt out of the study at any point in time.

## Statistical analysis

Statistical analyses were performed using SPSS version 15.0 (SPSS Chicago, IL USA). A  $p$ -value  $< 0.05$  was accepted for statistical significance. The Bonferroni correction was used to correct type I errors, because of multiple comparisons, for which the level of significance was  $0.05/k$  ( $k =$  number of comparisons). Parametric analysis and data dissemination (ANOVA) were employed for the comparison of students' knowledge levels (as a quantitative variable) between three or more different groups; Student's  $t$ -test was used for the comparison of total

scores between the two groups. Reliability and internal cohesion according to Cronbach's  $\alpha$  was  $\alpha = 0.76$ .

## Results

In the results the total number of students was included (males  $n = 1206$ , females  $n = 1168$ ). The families' socioeconomic status showed that most of the parents were middle-class high-school graduates. As far as the students were concerned, BMI measurements showed that 68.8% of the children had an average BMI, 23.9% were classified as overweight, and 7.3% were classified as obese ( $p < 0.05$ ).

Cross-correlation between overweight and obese children and sex showed that more males (9.2%) were obese than females (5.3%) ( $p < 0.05$ ) (Table I). Moreover, cross-correlation between central obesity and sex showed that males slightly outnumbered females, but this was not a statistically significant difference ( $p = 0.48$ ) (Table I). The distribution of BMI scores (Table III) showed that the majority of the subjects had an average BMI (68.8%), and overweight participants outnumbered obese participants ( $p < 0.05$ ).

In our study, obesity appears to decrease with age. In fact, in the 6-9 year group the obesity percentage was 10.3%, while in the 10-12 year group the percentage was 3.3% ( $p < 0.001$ ). This striking discrepancy between the two age groups shows

a positive correlation with the increase of physical activity levels; more specifically, in the 6-9 year group cross-correlation reaches 60.3%, and in the 10-12 year group it is 68.6% ( $p < 0.05$ ) (Table II).

Nevertheless, a parallel reduction of central obesity percentages does not seem to exist. More specifically, central obesity prevalence between the two age groups (6-9 years and 10-12 years) shows no statistically significant difference (33.5% vs. 33.7%,  $p = 0.18$ ).

Some eating habits that positively cross-correlated with obesity, as shown in Figure 1 ( $p < 0.05$ ), were avoiding breakfast, not consuming fruits and vegetables, and avid consumption of white bread and cola-type beverages. Cross-correlation between these eating habits and sex showed that males are more prone to erroneous eating habits than girls.

Fast food consumption is connected to central obesity, as shown in Table I. Only 25% of children who did not eat fast (junk) food had central obesity, 33% of children with abdominal obesity consumed fast food once a week, and 42% of children having central obesity were found to consume fast food more than twice a week ( $p < 0.05$ ).

Regarding eating habits of children in school, it appears that children who were used to a healthy diet had lower percentages of general and central obesity, as shown in Figure 2 ( $p < 0.05$ ). Regarding

Table I. Distribution of overweight, obesity and central obesity of children according to sex

	<i>n</i>	Overweight [%]	Obesity [%]	Central obesity [%]
		<i>p</i> = 0.05	<i>p</i> = 0.05	<i>p</i> = 0.48
Total	2374	23.9 ( <i>n</i> = 567)	7.3 ( <i>n</i> = 173)	35.5 ( <i>n</i> = 840)
Boys	1206	26.4 ( <i>n</i> = 318)	9.2 ( <i>n</i> = 110)	36.6 ( <i>n</i> = 441)
Girls	1168	21.3 ( <i>n</i> = 249)	5.3 ( <i>n</i> = 63)	34.3 ( <i>n</i> = 399)

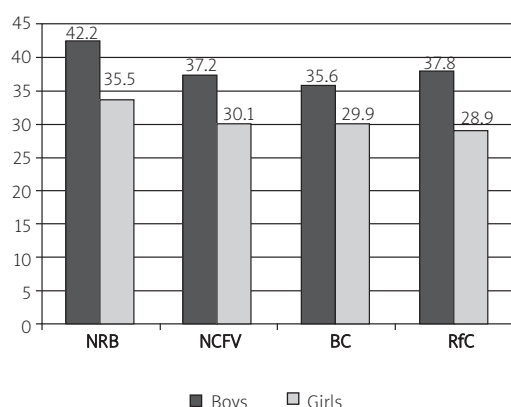
Table II. Distribution of age and obesity according to physical activity after school

Age [years]	Obesity [%]	Value of <i>p</i>	Physical activity [%]		Physical activity total [%]	Value of <i>p</i>
6-9	10.3	< 0.001	> 2 h*	39.7	60.3	< 0.05
			2-3 h**	40.1		
			3-5 h**	17.5		
			< 5 h***	2.7		
10-12	3.3	< 0.001	> 2 h	31.4	68.6	< 0.05
			2-3 h	43.3		
			3-5 h	22.1		
			< 5 h	3.2		

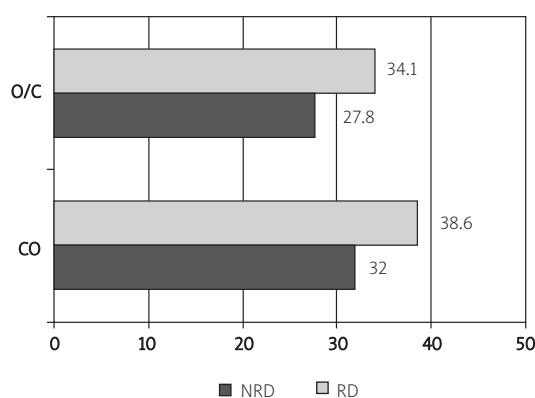
\*Physical activity in school, \*\*participation in sport, \*\*\*systematic participation in sport

Table III. Cross-correlation of daily follow-up of television and obesity

	Not active	1 h/day	> 3 h/day	Value of <i>p</i>
Overweight	27.3%	28.9%	26.1%	< 0.01
Obesity	4.1%	7.8%	8.6%	< 0.01



**Figure 1.** Distribution of alimentary habits and sex  
*NRB – not receiving breakfast, NCFV – not consuming fruits and vegetables, BC – consumption of bread, RfC – consumption of refreshments*



**Figure 2.** Cross-correlation of alimentary habits in the school environment and obesity  
*NRD – not right diet, RD – right diet, O/C – overweight/cor-pulent, CO – central obesity*

children who did not follow a healthy diet in school, 34.1% of them were overweight or obese and 38.6% had central obesity; 32% of the children who had a healthy diet in school were overweight or obese, and 27.8% of them had central obesity ( $p < 0.05$ ).

Moreover, this study found a significant increase of obesity percentage ( $p < 0.01$ ) and central obesity frequency ( $p < 0.05$ ), depending on hours of daily TV watching and spending too much time in front of the computer. On the other hand, the percentage of overweight children, as shown in Table III, does not increase significantly regardless of the time spent in front of the computer and television ( $p < 0.01$ ).

## Discussion

The present study examined the prevalence of overweight and obesity among elementary school students (6-12 years old). The percentage of overweight or obese children is high, males outnumbering females in all age groups. A significant positive cross-correlation was found among the students' BMI and frequent consumption of fast food, as well as time spent in front of the computer and television.

It appears that about 1/3 of the students (boys and girls) who participated in the study were found to be overweight and/or obese, a result which is in accordance with other international and Greek studies [30-36]. Central obesity does not present a statistically significant difference among males and females, and it does not seem to have a statistically significant difference when physical activity levels are increased. Several researchers have proposed that BMI and waist circumference are sufficient indicators for the evaluation of children's obesity, and can also be used to predict risk factors for the child's health [37, 38].

Comparative studies in 2002 and afterwards report higher rates of obesity and overweight in

boys and significantly lower levels in girls, mainly in urban areas [39-42].

Several studies report a change of eating habits and a 7-11% increase of calorie intake in the last two decades. This change appears to be a result of higher consumption of carbohydrates, fat and added sweeteners [43, 44]. Increased consumption of fast food, which results in high calorie intake, has also been established by many researchers. It has been reported that between 1977 and 1996 there was an increase of 30% in fast food consumption in US children between 2 and 5 years old (2004), while family expenses for fast food between 1992 and 2002 were doubled, and pizza and fast food restaurants were found to be the most popular places for dining in Australia (2003, 2005) [45]. Increased adult obesity rates have been connected to long hours of watching TV, but no causative relationship has been established between those two factors [46, 47]. Long hours of television watching can decrease the time for physical activities and it seems that there is a positive cross-correlation between time spent in front of the TV and percentages of overweight or obese children [17, 48].

Many agencies and non-profit organizations in several countries have required some restrictions, or even a ban, on junk food advertisements on television – especially advertisements aimed at children younger than 12 years [49, 50]. The food industry, on the other hand, considers that there is some relation between childhood obesity and watching television, but food advertising has nothing to do with obesity. Other researchers focus on high calorie intake and not on hours watching television [44].

In conclusion, the percentage of children found to be overweight or obese is high, males outnumbering females in all age groups. Childhood obesity, and in particular central obesity, is significantly

correlated with eating habits. Breakfast avoidance, lack of fruits and vegetables and increased consumption of white bread and cola-type beverages are arguably some habits leading to obesity. A significant positive cross-correlation was observed between the students' BMI and frequent consumption of fast food, as well as spending excessive time watching television, but that was not the case as far as computer and videogames were concerned.

It is considered that the students' adjustment towards better eating habits is of vital importance, as well as increased physical activity; such behavioural adjustments are achievable through expert support with well-organized and targeted educational school and governmental programmes, in order to educate all population groups. Extensive professional interventions targeting health promotion, in accordance with current health policies, are of supreme importance.

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