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Childhood obesity and elevated blood pressure in a rural population of northern Greece

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ABSTRACT

Introduction: The objective of this study was to determine the prevalence of childhood obesity and elevated blood pressure (BP) in a rural population of northern Greece.

Methods: In total, 572 schoolchildren between the age of 4 and 10 years were examined. Obesity was defined using three different standards: (1) body mass index (BMI) charts of the French society of Paediatrics (FR), selected because of the low cardiovascular risk profile and low prevalence of obesity in France; (2) United States BMI CDC charts (US), selected because of the high prevalence of childhood obesity in the USA; and the reference curves of the International Obesity Task Force (IOTF). Children with elevated BP were defined as BP ≥95th percentile for age, gender and height, according to the Greek national charts.

Results: The prevalence of obesity for boys was 13.6% (IOTF), 23.7% (US) and 31.7% (FR); for girls 14.4% (IOTF), 21.1% (US) and 35.1% (FR). The prevalence of elevated BP was 7.9% (45 children). It was 5 to 6 times more common for obese than non-obese children to have elevated BP (relative risk of 5.2 to 6.2 and odds ratio 6.3 to 7.7).

Conclusions: The results confirm the high prevalence of childhood obesity in Greece, in this study found to be more prevalent in rural than urban Greece. The IOTF criteria tend to underestimate obesity and may not be optimal for use in a primary clinical care setting where the approach is for health education and patient treatment, rather than purely epidemiological. The study also confirms a strong relationship between high BP and increased BMI.

Key words: blood pressure, childhood obesity, Greece, obesity definition, overweight.

Introduction

Data accumulated over the past three decades indicate that atherosclerotic disease processes begin early in childhood. This provides compelling evidence for the worth of initiating prevention of cardiovascular disease in childhood[1].

Overweight and obesity in childhood and adolescence have been associated with adverse socioeconomic outcomes as well as increased morbidity and mortality rates in adulthood[2]. Paediatric obesity is associated with an increase in psychological problems, cardiovascular disease, type 2 diabetes mellitus and asthma[3].

There is no definition of obesity among children and adolescents that is accepted worldwide. In the USA, individuals with body mass index (BMI) >30 kg/m^2 or ≥95th percentile (whichever is smaller) for age and gender are considered obese[4]. The most recent normative US charts were produced by the Centres for Disease Control in 2000[5]. Similar BMI age–sex-specific reference charts have been developed in the UK, France, Germany and Denmark[6,7]. In Greece, BMI charts were recently published for children living in urban Athens but no data exist for the entire country[8]. In 2000, reference BMI criteria based on 6 pooled international data sets were developed for children from 2 to 18 years of age: the International Obesity Task Force (IOTF) standards[9]. The IOTF reference standards are widely used, particularly outside the USA; however, some authors believe these standards do not accurately reflect the world's population and so are unsuitable for clinical use[4]. It has been suggested that a single international definition of obesity may not be appropriate[10]. Consequently, it has been advocated that prevalence studies include both IOTF cut-offs, as well as national definitions in order to provide better comparison across populations[11].

A marked increase in child and adolescent obesity in the past few decades is well established[12]. It essentially concerns populations that have recently adopted Western lifestyle, poor dietary habits and inactivity, combined with limited awareness of health issues[13]. Obesity in children between 6 and 18 years in Greece has been studied, particularly in urban areas. Its prevalence has been reported as between 8.4% and 12.3% in boys, and between 7.3% and 9.9% in girls[13-15]. In the rural population of Crete, childhood obesity prevalence was 9.4%[16].

Hypertension in addition to obesity is a known risk factor for atherosclerotic cardiovascular disease in adults[17]. There is evidence that childhood hypertension predisposes an individual to adult hypertension[18]. For each increment of 1 to 2 mmHg in systolic blood pressure (BP), children have a 10% greater risk of developing hypertension as adults[19]. Increased prevalence of elevated BP in childhood and youth has been documented in recent decades and is associated with an increased prevalence of overweight[1].

The primary objective of this study was, for the first time, to screen for obesity and elevated BP in school children in rural northern Greece. The significance of the findings were evaluated with respect to primary health care. The criteria for defining obesity and their impact on primary health care are discussed.

Methods

School health screening programs are compulsory for all Greek children and provide health information for parents. Because the programs are approved and organized by the Greek Ministries of Health and Education they are exempt from additional ethics committee or a human-subjects review board approval. Body mass index screening is performed in these programs to detect children at increased risk for

weight-related health problems. The data collected for this study were anonymous.

The Nea Madytos Health Centre of the Greek National Health System provides primary care for all inhabitants of the eastern provinces of Thessaloniki prefecture in northern Greece, an essentially rural population. Health centre practitioners visited every nursery and elementary school in the region and examined every nursery student (from 4 to 5 years of age), and students in the 1st, 3rd and 5th class of elementary school (6, 8 and 10 years, respectively) between October and December 2007. A total of 572 children were examined (287 boys and 285 girls). The sample had social and economic characteristics in common with the rural student population of northern Greece and other rural regions of Greece.

All children had height, weight and blood pressure measured at the same visit. Height was measured without shoes with a wall-mounted stadiometer. Weight was measured without heavy clothing or shoes. Blood pressure was measured twice with the child in the seated position, by auscultation with an aneroid sphygmomanometer and appropriate-size cuff, following 5 min of quiet rest. The average of these two recordings was used for further calculations.

Obesity was defined using three different methods: (i) BMI charts of the French society of Paediatrics (FR), which define school children with BMI ≥97th percentile as obese[7]; (ii) US BMI charts produced by the Centers for Disease Control in 2000[5], which define individuals 2 to 18 years of age with BMI >30 kg/m^2 or ≥95th percentile for age and gender (whichever is smaller) as obese; and (iii) the IOTF reference curves[9].

Elevated BP was defined as BP ≥95th percentile based on age, gender and height using normative Greek charts[20].

Results are presented as the mean ± standard deviation; 95% confidence intervals for the prevalence of obesity in male and female students were obtained using normal approximation to the binomial distribution[21]. To compare the risk of developing elevated BP in obese and non-obese children, 95% confidence intervals for relative risk and odds ratios were constructed using the normal distribution[21].

Results

The mean age of the children in the study was 7.3 ± 2.0 years, mean height 130 ± 14 cm, mean weight 31 ± 11.2 kg, mean BMI 17.9 ± 3.6 and mean BP 98 ± 11.5 / 59 ± 10.7 mmHg.

The prevalence of obesity varied according to the definitional method used from 13.6% to 31.7% for boys, and from 14.4% to 35.1% for girls (Table 1). It must be noted that an additional 21.3% of boys and 23.2% of girls were classified as overweight according to the IOTF standards. Therefore, even using the rather conservative IOTF standards, 34.9% of boys and 37.6% of girls could be expected to be either overweight or obese at age 18.

Forty-five children (7.9%) had elevated systolic or diastolic BP (≥95th percentile), 27 children had elevated systolic BP, 30 had elevated diastolic BP, and 12 had elevated systolic and diastolic BP. Elevated BP was more common in obese children, from 17.8% to 27.5% depending on the method used to define obesity (Table 2). Therefore, obesity was associated with an increased risk of elevated BP (relative risk of 5.2 to 6.2).

Discussion

This study applied three methods to define obesity: (i) the IOTF criteria; (ii) the French standards; and (iii) US BMI charts. France was chosen as a country with a low cardiovascular risk profile, similar to other Mediterranean countries such as Greece and with no major obesity problem. The USA has a population with a higher cardiovascular risk and a high prevalence of childhood obesity[22].

Table 1: Prevalence of obesity in male and female students, according to age group

Age group (years)	Male students				Female students			
	Total	Obese† %			Total	Obese† %		
		FR97	US95	IOTF		FR97	US95	IOTF
4-5.9	52	17.3	17.3	7.7	69	17.4	14.5	11.6
6-6.9	85	28.2	20.0	11.8	63	28.6	15.9	11.1
8-8.9	67	37.3	29.9	22.4	87	48.3	27.6	19.5
10-10.9	83	39.8	26.5	12.1	66	42.4	24.2	13.6
Total (95%CI)	287	31.7 (26.3-37.1)	23.7 (18.8-28.6)	13.6 (9.6-17.6)	285	35.1 (29.6-40.6)	21.1 (16.4-25.8)	14.4 (10.3-18.5)

†Obesity defined as a BMI ≥97th percentile using French charts (FR 97), BMI ≥95th percentile using US charts (US 95), and according to the International Obesity Task Force (IOTF) reference curve corresponding to a BMI >30 kg/m^2 at age 18 years.

Table 2: Prevalence of elevated blood pressure in obese and not obese school children

Reference	Children with elevated BP (%)		RR (95% CI)	OR (95% CI)
	Obese†	Normal weight		
FR97	17.8	2.9	6.17 (3.2-11.9)	7.28 (3.6-14.7)
US95	21.1	4.1	5.20 (3.0-9.1)	6.33 (3.4-11.9)
IOTF	27.5	4.7	5.88 (3.4-10.0)	7.73 (4.1-14.7)

BP, Blood pressure.
†Obesity defined as a BMI ≥97th percentile using French charts (FR 97), BMI ≥95th percentile using US charts (US 95), and according to the International Obesity Task Force (IOTF) reference curve corresponding to a BMI >30 kg/m^2 at age 18 years.

The prevalence of obesity found in previous Greek studies useing IOTF criteria was: 11.8% for boys and 7.5% for girls in the city of Ioannina[14], 8.4% for boys and 7.3% for girls in the city of Thessaloniki[13], 12.3% for boys and 9.9% for girls in urbanised northeast Attica[15], and 14.1% in urban provinces of Crete[16]. It was therefore surprising to find the obesity prevalence in rural northern Greece at 13.6% for boys and 14.4% for girls, which is higher than in the mainly urban Greek populations previously studied. Obesity in rural northern Greece is also more prevalent than in rural Crete, where a rate of 9.4% has recently been reported[16].

Why are children in rural areas more obese? Although multinational fast food chains are absent from rural Greece, in almost every village there is a *cantina* well stocked with junk food. In addition, the rural population is less educated in health issues and there is a general perception that being overweight is a sign of good health. These suggestions need to be verified in a future survey of children. Such research should include a questionnaire about childrens' fast-food consumption, and also the frequency and intensity of their sporting activity.

Using the French or US criteria (rather than IOTF), obesity was much more prevalent in our study (Table 1). For example, with the US charts, 23.7% of boys and 21.1% of girls in our study were obese. Childhood obesity appears to be more prevalent in Greece than in the USA where prevalences of 18% and 22% have recently been reported[12,22-23].

Our data revive the question of which childhood obesity criteria are optimal for use in general practice. The IOTF criteria seemed to underestimate obesity in the present study population and may not be the best for use in primary care where preventive strategies, public education and treatment

are far more important than an essentially epidemiological approach.

Childhood obesity tends to persist into adulthood[24]. Therefore, an obesity epidemic could be predicted for populations with a high prevalence of childhood obesity, as in Greece. In Europe, according to the SCORE project, two different tables are proposed to calculate an individual's cardiovascular risk: the first for populations at high risk (as in northern Europeans), and the second for populations at low risk (as in Mediterraneans)[17]. If the high prevalence of obesity in Greece continues unabated, the overall cardiovascular risk of the Greek population can be expected to rise. In the near future, Greece may have a population at high cardiovascular risk who are better represented by the model used for northern Europeans.

In the present study BP was measured on one occasion, although the current recommendation for diagnosing hypertension in children is detecting elevated BP on each of 3 different occasions[25]. Elevated BP was found in 7.9% of school children, which is similar to reported rates of 7.2% in Delaware and Pennsylvania, USA[12], 9.6% in Sousse, Tunisia[26], and 5.6% in Italy[27]. It must be noted, however, that BP is labile in children followed longitudinally[27]. A 19.4% prevalence of hypertension on first screening has been reduced to only 4.5% after three screenings[23]. Therefore, the single measurement in the present study may have overestimated the prevalence of elevated BP.

This study confirms the previously described relationship between higher BP and increasing BMI (OR 6.33-7.73)[12,23,28], with odds ratios for overweight school children having been reported as 2.4 for diastolic BP and 4.5 for systolic BP[28], and present in all age groups[12].

Conclusion

A high rate of childhood obesity was found in rural northern Greece, and this may imply that children in rural areas are developing an unhealthy lifestyle. The IOTF criteria may underdiagnose obesity substantially, so GPs should also use national reference charts where they are available. Because obese children have a substantially increased risk of cardiovascular disease as adults, the detection, prevention and early treatment of childhood obesity is important.

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