

Letter to the Editor**The metabolic syndrome among preschool and school age children and adolescents in Crete in the first decade of the 21st century**

Christos M. Hatzis,¹ Christopher Papandreou,² Dimitra Sifaki-Pistolla,³
Christine Jildeh,³ Anthony G. Kafatos¹

¹Department of Social Medicine, Preventive Medicine and Nutrition Clinic, Medical School, University of Crete, Heraklion; ²Department of Nutrition & Dietetics, Harokopio University of Athens, Athens; ³Department of Social Medicine, Clinic of Social and Family Medicine, University of Crete, Heraklion; Greece

Dear Sir,

In Greece as well as worldwide, studies on the prevalence of metabolic syndrome (MetS) in children/adolescents began to take place in the second half of the 20th century. It was indicated that the prevalence of MetS is mostly predicted by the presence of obesity and particularly abdominal obesity.¹ A previous Greek study showed that the prevalence of MetS was higher in overweight/obese children compared to normal weight controls.² Recently, a Greek National Epidemiological Survey found a prevalence of high abdominal obesity among children 6-12 years old, higher than that recently reported from other European countries.³ Crete, a Greek island known for its favorable health status in the 1960s, experienced a rise in the prevalence of childhood obesity between 1982 and 2002,⁴ assumed to also be accompanied by increases in MetS prevalence. To our knowledge, only one previous study has examined the prevalence of MetS among Cretan children, this carried out during the period 2001-2003.⁵ Such studies are important

from a public health perspective, since identification of MetS factors that predispose to morbidity could help public health professionals to develop more effective preventive measures. Therefore, this study aims to determine the prevalence of MetS in a school-based sample of school children and adolescents in Crete extending the above period to 2011.

This study used secondary data from overweight and obesity registries in kindergarten, elementary and junior high school children during the years 2001-2011, from different regions of Chania and Heraklion prefectures in Crete. The selected children, presented in Table 1, participated in the Clinical Preventive Medicine and Nutrition program of the School of Medicine at the University of Crete. Initially, 2968 children/adolescents were recruited, of whom 1088 agreed to undergo anthropometric and biochemical measurements (blood tests). Of the participants, 887 were boys and 993 were girls aged 3-19 years.

Waist circumference (WC) was measured to the nearest 0.1 cm with the use of a non-elastic tape, with the pupil standing, at the end of a gentle expiration after placing the measuring tape on a horizontal plane around the trunk, at the level of umbilicus midway, between the lower rib margin and the iliac crest. The age- and sex-specific WC percentiles were used for the classification of central obesity (≥ 90 th percentile).

Address for correspondence:

Christopher Papandreou, Harokopio University of Athens,
Department of Nutrition and Dietetics, 70 El. Venizelou
Ave, 176 71 Kallithea, Athens-Greece, Tel.: +30 6974303995,
E-mail: papchris10@gmail.com

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Table 1. Descriptive statistics of the study population

A/A	Study groups	N(%)*	Metabolic Syndrome Components	Boys	Girls	Age (years)	Year of assessment
1	Administrative region of Rouvas (students)	192 (94)	188	89	99	4-16	2001
2	Administrative region of Chania (students)	303 (68)	246	103	143	14-17	2002
3	Administrative region of Chersonissos (preschool children)	110 (63)	89	46	43	3-7	2003
4	Administrative region of Heraklion (Dilina, Tilissos - preschool children and students)	779 (67)	686	304	382	3-17.5	2003
5	Six administrative areas of the county of Chania (preschool children)	1356 (77)	574	297	277	4-7	2004
6	Administrative region of Minoa-Pediados (students)	228 (74)	97	48	49	12-19	2011
Total		2968	1880	887	993		2001-2011

*Children who participated in each study (N=total number and %=percentage).

Blood pressure was measured in the right arm while in a sitting position and after five minutes of rest. A mercury sphygmomanometer was used covering from 50 to 75% of the perimeter of the right arm. The measurement was taken twice with a two-minute interval between readings. A third measurement was taken if there was a difference of over 10 mmHg between the previous measurements. The average value of the measurements was used in analysis. Systolic (SBP) and diastolic blood pressure (DBP) were recorded. Systolic or diastolic hypertension was defined as SBP or DBP above the 95th percentile for gender, age and height.⁶

Early morning blood samples were taken after a 12-hour overnight fast. The parents as well as the children were reminded on the previous day in order to ensure compliance with fasting. Plasma glucose, total cholesterol, triglycerides, high density lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol were measured (methods referenced in Hatzis et al).⁷ The National Cholesterol Education Program cut-off points for blood lipids were used to define dyslipidemias.⁸

The MetS was defined as the presence of ≥ 3 of the following factors among children/adolescents: impaired fasting blood glucose, hypertension, abdominal obesity, hypertriglyceridemia and low HDL-C.

The statistical analysis was conducted in SPSS

20. Descriptive statistics were exported for all variables and are presented in the accompanying tables. No extended statistical tests are presented in order not to overestimate the results that were treated as secondary data.

Table 2 shows the frequencies of MetS among children and adolescents in Crete (2001-2011). More

Table 2. Metabolic syndrome components of children and adolescents in Crete (2001-2011)

Factors	Boys N (%)	Girls N (%)	Total N (%)
0	472 (53.2)	505 (50.8)	977 (52.0)
1	287 (32.4)	364 (36.7)	651 (34.6)
2	95 (10.7)	100 (10.1)	195 (10.4)
≥ 3 (MetS)	33 (3.7)	24 (2.4)	57 (3.0)
Total	887	993	1880

N = total number; % = percentage.

Metabolic syndrome components are described as follows:

- 1) Hyperglycemia: blood sugar serum ≥ 100 mg/l
- 2) Hypertension: systolic blood pressure $> 95^{\text{th}}$ percentile (gender-age) or diastolic blood pressure $> 95^{\text{th}}$ percentile (gender-age) and 16.5 years $\geq 130/85$ mmHg
- 3) Central obesity: waist circumference $> 90^{\text{th}}$ percentile and > 16.5 years ≥ 94 cm and 80 cm for boys and girls, respectively
- 4) Hypertriglyceridemia: triglycerides ≥ 100 mg/dl and > 16.5 years ≥ 150 mg/dl
- 5) HDL-cholesterol: low $< 10^{\text{th}}$ percentile (gender-age) and > 16.5 years < 40 mg/dl

* For boys and girls aged ≥ 16.5 years, the criteria for adult men and women were used, respectively.

than half of the children and adolescents were found to have no MetS risk factor (52%: 53.2% boys; 50.8% girls), 34.6% of the children/adolescents were found to have only one risk factor (32.4% boys; 36.7% girls), while 10.4% were found to have two risk factors for MetS (10.7% boys; 10.1% girls). Of the total sample, 48% had >1 risk factors for MetS (46.8% boys versus 49.2% girls). Finally, 3% of the children/adolescents were identified as having three or more risk factors for MetS (3.7% boys; 2.4% girls).

In a previous study among elementary school children of north-east Attica, the prevalence of MetS was estimated at 3.6%.⁹ From worldwide surveys on the prevalence of MetS in children and adolescents, it is estimated that the prevalence of MetS is around 4-5%,^{10,11} and this prevalence increases with obesity. Cook S. et al¹² found that 6.8% of overweight and 28.7% of obese children and adolescents had MetS, while Duncan et al¹³ found higher rates of MetS among overweight (7.1%) and obese (32.1%) children/adolescents. As concerns children aged 2 to 20 years, a previous study found that in those with a BMI over the 95th percentile, the prevalence of MetS reached 40%.¹⁴ Another study conducted by Cruz et al¹⁵ showed that the prevalence of MetS syndrome was 6.8% among overweight children, while it was 28.7% among obese children.

The presence of MetS in childhood is crucial because there is evidence that the syndrome in childhood could predict cardiovascular disease in adulthood. Among children, and especially among those with MetS risk factors, adoption of the traditional Mediterranean diet, which is rich in antioxidant and anti-inflammatory substances, engaging in regular exercise and participation in long-term educational intervention programs is the only way to prevent and reduce those factors that affect and continuously increase morbidity and mortality from chronic diseases.

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