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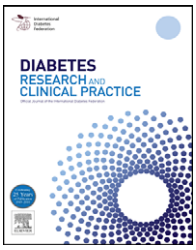

Prevalence of the metabolic syndrome among extremely obese adolescents in Italy and Germany

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ABSTRACT

Juvenile metabolic syndrome (MetS) is a growing major medical problem in industrialised countries. We estimated its prevalence among two similar clinic-based sequentially recruited cohorts of extremely obese adolescents (age: 12–18 years) from Italy ($N = 665$, males = 271, females = 394) and Germany ($N = 661$, males = 261, females = 400) using the recent IDF paediatric criteria. The prevalence of the MetS was 23.3% among the Italians and 40.4% among the Germans. A multivariate logistic regression revealed an increased risk related to age (adjusted odd ratio (AOR): 2.24; 95% confidence interval (CI): 1.59–3.16; $p < 0.001$), BMI SDS (AOR: 3.61; 95% CI: 2.33–5.60; $p < 0.001$), male gender (AOR: 2.36; 95% CI: 1.80–3.10; $p < 0.001$), and in German adolescents (AOR: 2.56; 95% CI: 1.98–3.31; $p < 0.001$). Among Italian adolescents having the MetS, 83% had 3 abnormalities, 16% had 4 abnormalities while less than 1% had all the 5 abnormalities. In the German cohort, 67%, 28% and 5% of affected individuals had 3, 4 and 5 abnormalities, respectively. These results indicate that MetS is highly prevalent among extremely obese adolescents, and suggest that (besides age, obesity and gender) national sociocultural factors, as alimentary trends, could be important. Further tools should be developed to understand international epidemiological differences concerning obesity and its comorbidities in relation to lifestyles in the countries of European Union.

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1. Introduction

Juvenile obesity is a major threat for health and an uncontrolled world-wide epidemic, considered an alarming key predictor for obesity in adulthood, whose increasing prevalence and severity have resulted in higher prevalence of comorbid conditions in children and adolescents [1]. In fact, as in adults, also in childhood and adolescence [2,3], obesity plays a central role in the development of the metabolic syndrome (MetS), an important clustering of metabolic abnormalities and anthropometric characteristics entailing an increased risk for mortality from cardiovascular and all causes in adults [4,5], as well as an increase in type-2 diabetes and early cardiovascular disease in juvenile age [6].

The mechanisms underlying the relations between the physiological functions regulating the involved abnormalities (which include also high blood pressure, low levels of high-density lipoprotein cholesterol, high triglycerides levels, high plasma glucose concentration) are not fully known. This prompted to a proliferation of clinical definitions of the MetS,

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especially in children and adolescents, which ultimately led to the release by the International Diabetes Federation (IDF) of the consensus guidelines for defining and diagnosing the MetS in adults [7] and in the paediatric age [8], with the purpose to rationalise the existing definitions and conflicting opinions and to enable the estimate of global prevalence of the syndrome. Thus, this recent IDF consensus report for the definition of the MetS in children and adolescents [8] may be used in populations of this age group as a useful tool in facilitating surveillance for the syndrome and international comparisons of prevalence estimate, as well as in helping to unravel pathogenic mechanisms.

Therefore, the objective of the present study was to employ this recent IDF paediatric definition of the MetS [8] in order to: (1) evaluate the prevalence of the MetS in two large samples of extremely obese treatment-seeking Caucasian adolescents from two European nations; (2) to assess the effect of age, obesity degree and gender on this prevalence among the two samples; and (3) to assess the prevalence of each component of the MetS and their predominant combinations.

2. Patients and methods

2.1. Subjects

Six-hundred-sixty-five Caucasian pubertal extremely obese patients (271 males and 394 females) admitted to the Auxology Division at Istituto Auxologico Italiano, Piancavallo, Italy, and 611 (261 males and 400 females) admitted at Adipositas Zentrum Insula, Bischofswiesen, Germany, were sequentially enrolled in the study, throughout a period of about 40 months. Both institutions include a medical health care division specifically devoted to the treatment of juvenile obesity, and patients were referred to by primary care practitioners in response to a request of medical help for obesity. The inclusion criteria into the study, agreed by the two institutions were: (a) Tanner stage > 3 [9]; (b) age ≤ 18 years; (c) diagnosis of extreme obesity (BMI $\geq$ 97th centile for age). No specific exclusion criterion was defined. Moreover, at the moment of the enrollment, no adolescent was following any controlled dietary regimen or structured protocol of physical activity. The Ethical Committee of both institutions approved the study and the nature of the investigation was explained to the patients and their relatives, who gave the written informed consent.

2.2. Evaluation of subjects

At hospital admission, height and weight were measured respectively with a Harpenden stadiometer (Holtain Ltd., UK) and an electronic scale (Selus, UK), and BMI was calculated and expressed as standard deviation score (BMI SDS) for the subjects of each cohort using age and sex matched standards for the respective national population [10,11]. Waist circumference (WC) was measured according with international standards [12]. Two blood pressure (BP) determinations were performed to obtain the systolic and diastolic values using a conventional manometer after the patient had been sitting at least 15 min, and the mean values were used for analyses. Blood samples were collected after an overnight fast in standard tubes; triglycerides (TG) and high-density-lipoprotein cholesterol (HDL) as well as fasting plasma glucose (FPG) were immediately measured with enzymatic-colorimetric methods, after appropriate processing.

At the time of their admission to the study, 1% of adolescents of the Italian cohort and 2% of the German one were non-insulin dependent diabetics while no Italian and 0.5% Germans were diabetics taking insulin; 1% were on a regimen of treatment for arterial hypertension among the Italians and 2% among the Germans. Table 1 shows mean and median values of the main characteristics of the subjects taking part to the study.

According to the IDF criteria for MetS diagnosis in children and adolescents [8], the youths of the study were considered to have the MetS if they had abdominal obesity, AO (WC $\geq$ 90th percentile for ages $<$ 16 years, and $\geq$94 cm for males and $\geq$80 cm for female for ages $>$ 16 years) plus two or more of the following factors: (1) raised TG level: $\geq$150 mg/dL (1.7 mmol/L) for ages $<$ 16 years and the same cutoff or specific treatment for this lipid abnormality for ages $>$ 16 years; (2) reduced HDL-cholesterol: $<$40 mg/dL (1.03 mmol/L) for males and females for ages $<$16 years, and $<$40 mg/dL for males and $<$50 mg/dL (1.29 mmol/L) for females, or specific treatment for this lipid abnormality for ages $>$16 years; (3) raised blood pressure (BP): systolic blood pressure $\geq$130 mmHg or diastolic blood pressure $\geq$85 mmHg for ages $<$16 years, and same cutoff or treatment of previously diagnosed hypertension for ages $>$ 16 years; (4) raised FPG concentration: $\geq$100 mg/dL (5.6 mmol/L) or previously diagnosed type-2 diabetes for all ages.

2.3. Statistical methods

All values are given as means $\pm$ SD. The effects of age, gender and nationality on the degree of obesity were evaluated within each cohort and in the pooled cohorts by means of two- and three-factor analysis of variance (ANOVA), as appropriate. The independent effects of age, degree of obesity, gender and nationality on the prevalence of the MetS were evaluated by means of a multivariate binary logistic regression analysis. To this purpose, the subjects were stratified into three groups for age ($<$14, 14–16, $\geq$16 years) and three groups for the degree of obesity ($<$3, 3–4, $>$4 BMI SDS). p-Values less than 0.05 were considered statistically significant. All the analyses were performed by means of the statistical software package SPSS 17 (SPSS Inc., Chicago, IL) for Windows.

3. Results

Among the adolescents of both the Italian and German cohorts, the degree of obesity, as evaluated by the SDS of BMI, increased with age ($p < 0.001$) and was higher ($p < 0.001$) in girls than in boys (two-factor ANOVA). No significant effect was detected for the interaction of factors age, gender and nationality, when the two cohorts were pooled (three-factor ANOVA).

Using the criteria of the new IDF definition of the MetS in children and adolescents [8], the overall prevalence among the obese adolescents of the Italian cohort was 23.3% and 40.4% in the German cohort. The prevalence estimated within the different strata of age and obesity degree is presented in

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