



Original article

Prevalence of metabolic syndrome in children with and without obesity[☆]



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ABSTRACT

Background and objective: Childhood obesity is considered the main risk factor for the development of metabolic syndrome (MetS) during childhood, adolescence and adulthood. This study aimed to determine the prevalence of MetS components and its main defining combinations in a sample of school children with and without obesity.

Patients and methods: A total of 225 children aged 6–12 years, 106 obese and 119 with normal weight were included. MetS was defined by the presence of 3 or more of the following: obesity as a body mass index \geq 95th percentile, fasting glucose \geq 100 mg/dl, triglycerides \geq 150 mg/dl, high density lipoproteins cholesterol (HDL-c) $<$ 40 mg/dl and systolic and diastolic blood pressure \geq 95th percentile.

Results: We found MetS components in both groups. Most frequent abnormalities in the obese group included increased levels of HDL-c, triglycerides, fasting glucose and total cholesterol, while increased levels of glucose and total cholesterol, and lower HDL-c levels predominated in the normal weight group. The prevalence of MetS in the obese group was 44.3% and, in normal weight children, it was 0.84%. The 3 main components that defined the MetS in the obese group were obesity/triglycerides/HDL-c (34.0%), obesity/glucose/triglycerides/HDL-c (29.8%) and obesity/glucose/HDL-c (14.9%), while the only combination observed in the normal weight group was glucose/HDL-c/triglycerides.

Conclusion: A percentage of 44.3 of obese school children had MetS, and dyslipidemia showed to be strong determinants of MetS. Although the prevalence of MetS was low in children with normal weight, one third of them showed one of the components of MetS.

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Prevalencia de síndrome metabólico en niños con obesidad y sin ella

RESUMEN

Fundamento y objetivo: La obesidad infantil es el principal factor de riesgo para el desarrollo de síndrome metabólico (SM) durante la infancia, adolescencia y vida adulta. El objetivo de este estudio fue determinar la prevalencia de los componentes del SM, y de las principales combinaciones que lo definen, en una muestra de niños escolares con y sin obesidad.

Pacientes y métodos: Un total de 225 niños con edades entre 6 y 12 años, 106 con obesidad y 119 con peso normal, fueron incluidos. El SM fue definido por la presencia de 3 o más de los siguientes componentes: índice de masa corporal \geq percentil 95, glucosa en ayunos \geq 100 mg/dl, triglicéridos \geq 150 mg/dl, colesterol unido a *high density lipoproteins* (HDL, «lipoproteínas de alta densidad») $<$ 40 mg/dl, presión arterial sistólica y diastólica \geq percentil 95.

Resultados: En ambos grupos analizados se encontraron componentes del SM. En el grupo con obesidad, el colesterol HDL, los triglicéridos, la glucosa en ayunos y el colesterol total fueron las alteraciones más frecuentes; en los de peso normal predominó el incremento en los valores de glucosa, colesterol total y disminución de colesterol HDL. La prevalencia de SM en niños con obesidad fue del 44,3%, y

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en niños de peso normal, del 0,84%. Las 3 principales combinaciones que definieron el SM en niños obesos fueron: obesidad/triglicéridos/colesterol HDL (34,0%); obesidad/glucosa/triglicéridos/colesterol HDL (29,8%) y obesidad/glucosa/colesterol HDL (14,9%); en el grupo con peso normal: glucosa/colesterol HDL/triglicéridos.

Conclusión: El 44,3% de los niños escolares con obesidad presentaron SM; las dislipidemias mostraron ser fuertes determinantes del SM. Aunque en los niños con normopeso la prevalencia es baja, la tercera parte presentó al menos uno de los componentes del SM.

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Introduction

The prevalence of obesity has increased worldwide and in every age group. However, in the child population, in the last decade, the increase has been 3 times greater.^{1,2} Recently, the World Health Organization (WHO) reported over 42 million children aged below 5 years with overweight.³ In Mexico, the combined prevalence of overweight and obesity in children aged 5–11 years is 34.4%, representing approximately 5,664,870 of grade schoolers affected.⁴ The main risk associated with obesity in childhood and adolescence is the presence of clinical–metabolic alterations that include hypertension, hyperglycaemia and atherogenic dyslipidaemia and that, grouped together, constitute the metabolic syndrome (MS),^{5,6} considered a predictor of insulin resistance, type 2 diabetes (DM2) and cardiovascular disease (CVD).^{7–9} Currently, the MS has become one of the main health issues in the paediatric population.¹⁰ The increase in the prevalence of MS, particularly in children, is associated with the combined phenomena of urbanization, diet, sedentary life, environmental factors and genetic predisposition.^{11,12} Some studies have determined the prevalence of MS in child population with obesity, reporting figures of 30%,¹³ and 50% in children with a higher-grade obesity.¹⁴ Thus, among children and adolescents with obesity, the described prevalence is 30% and 50%.¹⁵ The variability in the prevalence described in child population is attributed to population differences and to the lack of clearly defined diagnosis criteria, promoting the use of several cut-off values to determine the alteration of the parameters that constitute it.¹⁶ In the Mexican child population, little is known regarding the prevalence of MS and the combination of components that define it, due to the fact that each component independently represents a risk factor for CVD, their identification being important to implement control measures. The purpose of this study was to determine the prevalence of MS, its main components and combinations in a sample of Mexican children with and without obesity.

Subjects, material and methods

A cross-sectional study approved by the Ethics and Research Committee of the Universidad Autónoma de Guerrero was performed. The study included 225 children selected during the year 2008 from 3 primary education schools, located in the urban area of the city of Chilpancingo, all of them born in the state of Guerrero, Mexico. The sample included 117 boys and 108 girls aged from 6 to 12 years, 106 of which were obese and 119 of which had normal weight. The written informed consent was obtained from every parent or tutor, and the procedures were carried out in accordance with the ethics guidelines of 2008 set forth in the Declaration of Helsinki.

Clinical and anthropometric measurements

All children were submitted to the anthropometric assessment determining body weight, in light clothing and without shoes, using a body composition monitor (Tanita BC-553, Arlington, USA). The

height was measured with a portable stadiometer (Seca, Hamburg, Germany). The body mass index (BMI) was calculated as weight (kg)/height (m²). The waist circumference was measured in duplicate passing by the navel and the edge of the iliac crest, using an anthropometric tape with an accuracy of ± 0.1 cm (Seca 201, Hamburg, Germany). The classification of obesity was performed using the *Centres for Disease Control and Prevention*¹⁷ growth charts from the year 2000, determining normal weight in children with a BMI between the 5 and 85 percentiles, and with obesity those with a BMI percentile ≥ 95 . Blood pressure was measured in the child's right arm in sitting position and at rest for at least 5 min, using a sphygmomanometer (Riester CE 0124, Jungingen, Germany). Two consecutive readings were taken for each child, with at least one minute between each reading and the average of the readings was registered and used in the subsequent analysis. Altered systolic and diastolic blood pressure was determined by the presence of percentile ≥ 95 values, in accordance with age and gender, considering the *National High Blood Pressure Education Programme Working Group on High Blood Pressure in Children and Adolescents*¹⁸ data.

Biochemical determinations and definitions

Blood samples were collected by venous puncture after one night fasting. Total cholesterol, triglycerides, cholesterol joined to *high density lipoproteins* (HDL), cholesterol joined to *low density lipoproteins* (LDL) and glucose values were determined from a serum sample using a semi-automatic equipment (COBAS MIRA, Roche Diagnostics).

In this study, the definition of MS was performed considering 3 items of the criteria set forth for children and adolescents aged from 10 to 16 years by the *International Diabetes Federation* (IDF): glucose ≥ 100 mg/dl, triglycerides ≥ 150 mg/dl, HDL cholesterol < 40 mg/dl, and 2 items of the criteria proposed by the WHO: obesity, defined by a BMI ≥ 95 percentile, and altered blood pressure ≥ 95 percentile.^{19,20}

Statistical analysis

The statistical analysis was performed with the STATA v9.2 software. The descriptive statistic was generated for all the variables. The nominal qualitative ones were expressed as proportions and the differences were calculated using the chi square test. Continuous variables with normal distribution were expressed as mean \pm standard deviation, and those without normal distribution, as median and 5 and 95 percentiles. The differences among groups were determined through the Student's *t* test and the Mann–Whitney *U* test, respectively. MS frequencies and its components were defined as percentages. The $p < 0.05$ values were considered statistically significant.

Results

The current study included 225 children (119 with normal weight and 106 with obesity); the mean age in both groups was of 9 years and the proportion of boys and girls participating was

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