Metabolic Syndrome Among Children and Adolescents Aged 10–18 Years

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Current definitions for the diagnosis of the metabolic syndrome are focused on adult populations (1–4), whereas specific criteria for its early diagnosis have never been formally defined for children and adolescents. Because the best approach for the prevention of the metabolic syndrome is early recognition, defining it in children and adolescents is necessary for estimating the magnitude of this health problem in the young population. In this study, we determine the prevalence of the metabolic syndrome among children and adolescents aged 10–18 years from northern Mexico and evaluate a definition for its early diagnosis in the young population.

RESEARCH DESIGN AND METHODS

— After receiving approval from the Mexican Social Security Institute Research Committee and obtaining written informed consent, a cross-sectional study that included children and adolescents from northern Mexico was carried out.

The sample to be studied was determined by two-stage random-cluster sampling. A detailed medical and family history was obtained and physical examination performed for all participants, who were required to be in good health.

Prevalence of the metabolic syndrome was estimated according to the National Cholesterol Education Program Adult Treatment Panel III (1), World Health Organization (2), American Association of Clinical Endocrinologists (AACE) (3), and European Group for the Study of Insulin Resistance (EGIR) (4) definitions. In addition, for developing a metabolic syndrome definition in children and adolescents, our group, the Research Group on Diabetes and Chronic Illnesses (REGODCI), modified the adult criteria in accordance with the reference values of the report of the National Cholesterol Education Pediatric Panel (5), Bloomgarden's (6) report on type 2 diabetes in the young, and the updated Task Force report on the diagnosis and management of hypertension in childhood (7). The REGODCI definition is based on two steps. The first step is a clinical evaluation aimed to establish the presence of family history of obesity, type 2 diabetes, and/or hypertension and to determine birth weight, blood pressure, and BMI of the children and adolescents. The presence of one or more family phenotype, the presence of low or high birth weight, and the diagnosis of obesity or hypertension are computed as 1 point each. Therefore, the maximum points that can be accumulated in the first step are 4, and the eligibility criterion for the second step is 2 points. In the second step, a fasting blood venous sample is collected to determine glucose, triglyceride, and HDL cholesterol levels. One point is assigned by each abnormal laboratory criterion. A subject with ≥3 points is considered to have the metabolic syndrome.

High blood pressure, obesity, and high triglycerides levels were defined by a value of systolic/diastolic pressure, BMI, and serum triglycerides ≥90th percentile for age and sex. Fasting glucose levels ≥6.1 mmol/l defined hyperglycemia.

RESULTS

— Data were analyzed for 965 children and adolescents (51.7% female), who had an average age of 13.0 ± 2.6 years and BMI of 23.5 ± 5.8 kg/m^2.

The prevalence of family history of diabetes, hypertension, and obesity was 43.6% (95% CI 40.5–46.8), 40.9% (37.8–44.1), and 29.4% (26.6–32.5), respectively, and the prevalence of obesity, elevated blood pressure, hyperglycemia, hypertriglyceridemia, and low HDL cholesterol was 27.7% (24.8–30.5), 7.1% (5.5–8.8), 7.7% (6.0–9.4), 9.5% (7.7–11.4), and 20.8% (18.3–23.4), respectively. Diagnosis of type 2 diabetes and hypertension was established in 17 (1.8%; 95% CI 1.0–2.8) and 13 (1.4%; 0.8–2.4) participants.

Prevalence of the metabolic syndrome, according to the Adult Treatment Panel III, AACE, World Health Organization, EGIR, and REGODCI definitions was 6.5% (95% CI 4.7–7.8), 7.7% (6.0–9.4), 4.5% (3.2–5.8), 3.8% (2.6–5.1), and 7.8% (6.1–9.5), respectively.

A total of 697 (72.2%) subjects were lean; among them at least one family phenotype, one clinical trait, or one abnormal laboratory criterion was identified in 43.8, 21.3, and 20.6%. Sixty-one (8.7%) lean subjects fulfilled the REGODCI criterion for laboratory test, establishing diagnosis of the metabolic syndrome in 13 (21.3%; 95% CI 11.8–33.7) of them. On the other hand, diagnosis of the metabolic syndrome was established in 70 (26.1%; 21.0–31.5) obese children.

The number of children and adolescents who were diagnosed with the metabolic syndrome was significantly lower according to the EGIR definition, whereas the AACE and REGODCI definitions identified the highest prevalence (Table 1).

CONCLUSIONS

— Unlike the vast majority of studies focusing on the testing of obese children and adolescents (8,9),

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Abbreviations: AACE, American Association of Clinical Endocrinologists; EGIR, European Group for the Study of Insulin Resistance; REGODCI, Research Group on Diabetes and Chronic Illnesses.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Characteristics of children with the metabolic syndrome diagnosed using the National Cholesterol Education Program Adult Treatment Panel III (ATP III), AACE, World Health Organization (WHO), EGIR, and REGODCI definitions* (n = 965)

	ATP III	AACE	WHO	EGIR	REGODCI
n	63	74	43	37	75
Family history of type 2 diabetes	41 (65.1)	38 (51.3)	26 (60.5)	20 (54.0)	50 (66.6)
Family history of obesity	51 (80.9)	44 (59.5)	37 (86.0)	28 (75.7)	67 (89.3)
Family history of high blood pressure	45 (71.4)	40 (54.0)	32 (74.4)	30 (81.1)	60 (80.0)
Male/female	23/40 (36.5/63.5)	25/49 (33.8/66.2)	30/13 (69.8/30.2)	19/18 (51.3/48.7)	21/54 (28.0/72.0)
Age (years)	12.4 ± 2.8	12.1 ± 2.7	12.1 ± 2.4	13.1 ± 2.4	12.1 ± 2.7
BMI (kg/m^2)	29.4 ± 5.4	30.3 ± 4.7	30.5 ± 5.0	33.2 ± 5.7	30.8 ± 5.2
Waist (cm)	94.4 ± 16.7	96.7 ± 16.1	98.0 ± 13.9	103.7 ± 14.5	96.8 ± 15.4
Systolic blood pressure (mmHg)	115.3 ± 20.6	115.9 ± 20.9	116.6 ± 22.1	122.6 ± 15.7	116.9 ± 19.8
Diastolic blood pressure (mmHg)	69.7 ± 13.7	69.9 ± 13.4	72.4 ± 13.8	72.1 ± 10.6	70.0 ± 13.3
Birthweight (g)	3,059 ± 1,358	2,957 ± 1,469	2,963 ± 1,321	1,942 ± 1,740	2,939 ± 1,387
Fasting glucose (mmol/l)	5.8 ± 1.2	5.9 ± 1.2	5.9 ± 1.3	5.4 ± 0.7	5.8 ± 1.2
Fasting insulin (μU/ml)	22.9 ± 25.1	21.2 ± 23.4	28.3 ± 28.2	43.2 ± 31.3	23.8 ± 26.1
HOMA index	5.7 ± 5.9	5.5 ± 5.6	7.2 ± 6.5	10.4 ± 7.5	6.1 ± 6.3
Total cholesterol (mmol/l)	5.1 ± 1.5	5.2 ± 1.5	5.2 ± 1.5	5.4 ± 1.8	5.1 ± 1.4
HDL cholesterol (mmol/l)	1.0 ± 0.4	0.9 ± 0.3	1.0 ± 0.4	1.1 ± 0.4	1.0 ± 0.4
LDL cholesterol (mmol/l)	3.3 ± 1.3	3.4 ± 1.3	3.4 ± 1.4	3.5 ± 1.7	3.4 ± 1.3
Triglycerides (mmol/l)	2.0 ± 0.9	2.0 ± 0.9	2.0 ± 1.0	2.0 ± 1.2	1.8 ± 1.0

Data are means ± SD or *n* (%). HOMA, homeostasis model assessment.

this study focused on a representative sample of an apparently healthy young population, including lean individuals. Nonetheless, the prevalence of family phenotype and laboratory abnormalities among our lean young population was high. So, bearing in mind that the presence of one risk factor for cardiovascular disease should prompt screening for additional clinical abnormalities (10), the lean young population also should be included in the policies for early detection and prevention of the metabolic syndrome. In this regard, because the decision for sending laboratory tests is based on clinical parameters, the REGODCI definition minimizes costs related to the screening of the general population.

In this study, which followed REGODCI definition steps, the proportion of the metabolic syndrome among lean (21.3%) and obese (26.1%) children and adolescents was similar. This lends support to the REGODCI definition being equally successful in screening for the metabolic syndrome in lean and obese children and adolescents and provides an opportunity to establish an early diagnosis in the lean population.

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