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Original Article

Metabolic syndrome and atherogenic indices in school children: A worrying panorama in Brazil

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ABSTRACT

Background: Metabolic Syndrome (MS) is defined as the combination of a cluster of cardiovascular risk factors. The use of cardiovascular indices such as the ratios TC/HDL-c, LDL-c/HDL-c and TG/HDL-c may help in the assessment of cardiovascular risk. Investigation of cardio-metabolic risks in the pre-adolescent stage is essential to characterize possible patterns for MS in the earliest stages of the life avoiding further irreversible consequences.
Aims: This work aimed to investigate the presence of MS and cardiovascular indices in a group of children aged 6–10 years.
Methods: We included 150 children from a city in Brazil. Anthropometric (Body Mass Index and Waist Circumference) and biochemical parameters (glycaemia, total cholesterol, LDL-c, HDL-c, and triglycerides) were evaluated in order to identify the presence of MS. Atherogenic Indices were also calculated (TC/HDL-c, LDL-c/HDL-c and TG/HDL-c).
Results: Our results showed that there are high percentages of children with altered values for biochemical and anthropometric parameters and in the atherogenic indices. MS was identified in 17.8% of the children. The main parameters related to alterations in the atherogenic indices were waist circumference, body mass index and the presence of MS.
Conclusion: The high prevalence of MS and alterations in the atherogenic indices in schoolchildren is a worrying panorama. We suggest the performance of more studies focusing on identification, intervention and prevention programs in order to reduce the risk factors of this syndrome in childhood and to reduce future cardiovascular deaths.

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1. Introduction

Economic growth worldwide have repercussions on the eating habits and the physical activity leading to several consequences as overweight/obesity and increase of cardiovascular (CVD) risks and deaths. The association of insulin resistance/diabetes, visceral obesity, dyslipidemia, hypertension and sedentary lifestyle, unhealthy diet and some other factors extend the morbidity and increase mortality levels [1,2].

There are many definitions and criteria for Metabolic Syndrome (MS) in adults, but only a few for adolescents and none for pre-pubertal children. The criteria and cutoff points for diagnosis in adolescents may vary among the studies but most assume that, for inclusion in the definition of the syndrome, triglycerides levels should be ≥110 mg/dL, HDL-c ≤40 mg/dL, glycaemia ≥100 mg/dL, blood pressure ≥90th percentile (by age, gender and height), and waist circumference ≥ 95th percentile [3–9].

Many studies have provide strong evidences that MS increase the risk for diabetes and CVD that are among the main cause of death worldwide. Allied to this we may point that the obesity epidemic in children and youth lead to a renewed worry in the investigation of the MS in youth and on its potential impact on the health of young and adults. Once it may reach 1–23% of the total pediatric population and up to 60% in overweight/obese population, prevention is the safety way to reduce the risk factors, improve the quality of life in adults and extends the life expectancy [5,10–12].

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The control of the lipids in plasma is associated with the prevention MS and CVD. The main risk factors are related to alterations in the levels of total cholesterol, triglycerides, HDL-c and the size of LDL-c particle. The small dense LDL-c particles is linked to the atherosclerotic process due to the decreased affinity with the LDL-c receptor resulting in its incorporation in the intima of the blood vessel. Authors have been shown that the Castelli Index I (TC/HDL-c) and Castelli Index II (LDL-c/HDL-c) as well as the estimate of the size of the LDL-c particle (TG/HDL-c) may help in the assessment of cardiovascular risk [13–16].

Investigation of cardio-metabolic risks in the pre-adolescent stage is essential to characterize possible patterns for MS in the earliest stages of the life avoiding further irreversible consequences. Based on this, this work aimed to investigate the presence of MS and evaluate cardiovascular indices in a group of children aged 6–10 years.

2. Methods

2.1. Ethical principles

This study was approved by the Ethics Committee of the Methodist University of Piracicaba and only started after the parents (or guardians) signed the Free and Informed Consent Form (Resolution 196/10 of October 1996–National Health Council – CNS). All the procedures carried out followed the ethical standards of the Institutional Ethics Committee and the Helsinki Declaration of 1975, modified in 2008.

2.2. Group of children

We have included in this work 150 children (60% female and 40% male), aged 6–10 years, from 8 state schools from the city of Lins, São Paulo State, Brazil. This study was based on a cross-sectional study, with quantitative variables. To be included in the study, children should have parental consent. As a preliminary analysis showed that the gender was not a determining factor in the studied variables, we performed the study with male and female in the same sample.

2.3. Anthropometric parameters

Anthropometric measurements (weight and height) to perform the body mass index (BMI) and nutritional classification were obtained according to WHO [17] recommendations. A digital scale properly calibrated with a maximum capacity of 150 kg and accuracy of 50 g was used for the weight. Children were measured standing barefoot, with the aid of a fixed SANNY® stadiometer, set at local level. From the weight and height values, we calculated the BMI, which is represented by weight (kg) divided by height (in meters) squared. Nutritional status was performed with BMI/age, according to the Growth Curve–WHO [18]. The diagnosis of the nutritional status considers <5th percentiles for underweight; 5th < 85th for normal; p > 85 and <95th for overweight and p > 95 obesity.

Waist circumference (WC) was performed from the midpoint between the lateral iliac crest and the lowest rib using a flexible tape and it was evaluated according to percentile data from the McCarthy et al. [19] and Suarez-Ortegón, Aguilar-de Plata [3]. Qualified professionals managed the anthropometric measurements.

2.4. Biochemical parameters

Blood was collected to the evaluation of the biochemical variables as glycaemia and lipid profile (triglycerides (TG), total cholesterol (TC), low density lipoprotein (LDL-c) and high density lipoprotein (HDL-c)). Qualified professionals managed the collection of the blood. Results were based on the V Brazilian Guidelines on Dyslipidemia and Prevention of Atherosclerosis [20].

2.5. Metabolic syndrome

To identification of MS, the presence of at least three modifications in the following parameters were used: WC, glycaemia, Triglycerides, and HDL-c were used to classify the presence of MS (triglycerides ≥110 mg/dL, HDL-c ≤40, glycaemia ≥100, and waist circumference ≥95th percentile) [3,6–9].

2.6. Atherogenic indices

Castelli Index I (CI-I) and Castelli Index II (CI-II) as well as the estimate of LDL-c particle size were calculated. The indices were evaluated as follows: TC/HDL-c (CI-I) and LDL-c/HDL-c (CI-II) that indicates normal values respectively to less than 4.4 and 2.9. The estimate of LDL-c particle size (TG/HDL-c) should be higher than 2 mg/dL. As we did not find references for children, we have used the values for adults [13,16,20,21].

2.7. Statistics

The data were analyzed using ANOVA complemented with Chi-square and Tukey test (significant level of 5%).

3. Results

Table 1 shows that there are high percentages of children with altered values for biochemical and anthropometric parameters and in the atherogenic indices represented for Castelli Index I and II and the estimative of the size of LDL-c particle.

The presence of MS in the children studied in this work reached 17.8%. Levels of glycaemia do not differ among children with or without MS but the lipid parameters are higher in the group with the syndrome, as well as Castelli Index I and II and Estimative do the size of the LDL-c particle. Body mass index and waist circumference are also significantly higher in the children with MS (Table 2).

Our results also show that most children classified in the MS group significantly possess risk of overweight, overweight or obesity (Table 3)

In Table 4 we may see significant differences for total cholesterol, LDL-c, HDL-c, Body Mass Index and Waist Circumference among children with normal and altered values for Castelli Index I and II. Most of the children with MS present high values for

Table 1
Normal and altered metabolic parameters of the children.

Parameters	Classification	
	Normal	Altered
Glycaemia	83.1% B[a]	16.9% A
Triglycerides	57.7% A	42.3% A
Total cholesterol	45.4% A	54.6%A
LDL-c	53.1% A	46.9% A
HDL-c	57.7% A	42.3% A
Castelli Index I	46.9% A	53.1% A
Castelli Index II	41.6% A	58.4% A
Size of LDL-c particle	71.5% B	28.5% A
WC	8 (6.2%) A	122 (93.8%) B
BMI	66 (50.8%) A	64 (49.2%) A

[a] Different letters indicate a significant difference at a level of 5%. HDL-c: High Density Lipoprotein; LDL-c: Low Density Lipoprotein; Castelli Index I: TC/HDL-c; Castelli Index II: LDL-c/HDL-c; Estimative of the size of LDL-c particle: TG/HDL-c; WC: Waist Circumference; BMI: Body Mass Index.

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