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Metabolic syndrome's risk factors and its association with nutritional status in schoolchildren

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ABSTRACT

The metabolic risk factors (RF) to the diagnosis of metabolic syndrome (MetS) have been evidenced at early ages, including children. The aim of the present study was to identify the prevalence of RF to the diagnosis of MetS and its association with nutritional status of schoolchildren from 6 to 10 years old. A cross-sectional study was carried out in 505 students of municipal schools in Macae, Brazil, conducted from 2013 to 2014. The RF evaluated were: blood pressure (mm Hg), triglycerides (mmol/L), HDL-cholesterol (mmol/L) fasting glucose (mmol/L) and waist circumference (cm). At least one RF was present in 61% ($n = 308$) of the sample. By nutritional status, there was higher prevalence of RF in overweight/obese schoolchildren compared to those with normal weight, except in the concentration of HDL-c. The prevalence of one, two and three RF (MetS) were 34.7% ($n = 175$), 21.0% ($n = 106$) and 5.3% ($n = 27$), respectively. Two RF were more present in overweight (28.2% 95%CI 19.0; 39.0) and obese (41.5% 95%CI 31.4; 52.1) compared to normal weight children (13.5% 95%CI 9.9; 17.8). Three or more RF were more frequent among obese (25.5% 95%CI 17.0; 35.5) in relation to overweight (2.4% 95%CI 0.2; 8.2) and normal weight children (0.3% 95%CI 0; 1.7). The data indicate high prevalence of RF and its relationship with the magnitude of body weight excess. Therefore, the identification and early treatment of these RF might minimize the risk of MetS and related diseases.

1. Introduction

Metabolic syndrome (MetS) can be defined as the co-occurrence of metabolic risk factors (RF) that contributes to the development of cardiovascular disease (CVD) and type 2 diabetes mellitus (DM2) (Alberti et al., 2009). The RF, as insulin resistance (IR), hypertension (HAS), hyperglycemia, hypertriglyceridemia, low high density lipoprotein cholesterol concentration (HDL-c) and excess waist circumference (WC), have been identified at earlier ages, including children (Agirbasli et al., 2016).

There is no consensus for the diagnosis of MetS in children (Corte and Nobili, 2015; D'Adamo et al., 2011; Pergher et al., 2010). Some criteria have been suggested and differentiated for RF as their cutoffs (Ford and Li, 2008). However, regardless of the criteria, commonly it is required at least three RF for the diagnosis of MetS in children (D'Adamo et al., 2011). When RF is present during childhood, it tend to persist through adolescence and adulthood (Magnussen et al., 2014); thus, it has been suggested that the focus of research in children be in the RF of MetS regardless of its diagnosis (D'Adamo et al., 2011; Faienza et al., 2016; Kassi et al., 2011; Sinaiko, 2015).

The RF in children are more common in the obese population (Abrams and Levitt Katz, 2011; Ode et al., 2009), which increased significantly in recent years, representing a serious public health problem in Brazil and worldwide (IBGE, 2010; Gupta et al., 2013; Marie et al., 2014). Although studies to evaluate the nutritional status, blood pressure (BP), lipid profile and blood glucose levels in the juvenile group are growing (Kuschnir et al., 2016; Onzuz and Demir, 2015; Strufaldi et al., 2009; Wee et al., 2011), they are not so frequent in children, especially in developing countries (Gupta et al., 2013). Early identification of the presence of RF predictors of MetS enables the planning and implementation of programs for the prevention of CVD and DM2 in

Abbreviations: RF, metabolic risk factors; MetS, metabolic syndrome; CVD, cardiovascular disease; DM2, type 2 diabetes mellitus; IR, insulin resistance; HAS, hypertension; HDL-c, high density lipoprotein cholesterol concentration; TG, triglycerides; BP, blood pressure; BMI, body mass index; WC, waist circumference; SBP, systolic blood pressure; DBP, diastolic blood pressure; 95%CI, 95% confidence interval.

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adulthood. Thus, the aim of this study is to identify the prevalence of RF to MetS and its association with nutritional status in schoolchildren from 6 to 10 years old in the city of Macae, Brazil.

2. Methods

2.1. Study design and sample population

This investigation was a cross-sectional study conducted from March 2013 to November 2014 in schoolchildren (6–10 years) from public schools in the city of Macae, located in the state of Rio de Janeiro, Brazil, with 1219.8 km^2 of area and about 217,000 inhabitants. It has the petroleum as main economic activity, being the low social class prevalent among schoolchildren of municipal schools. The city is divided into 9 administrative sectors, with 52 schools and 10,247 schoolchildren (6–10 years). For the reference population, by logistical issues, it was selected one school of each sector, totaling 1553 schoolchildren, who were invited to participate. A simple random sample size was carried based on the national prevalence of obesity in the study age group (14.2%) (IBGE, 2010), 95%CI, maximum error 2.5% and the population (1553). The final sample size was 502 schoolchildren.

The exclusion criteria were: children who had physical impairment that prevented the evaluations, with diabetes mellitus and/or hypothyroidism and/or use of medications that could interfere in the results. Of the 1553 schoolchildren, one was exclude due to dwarfism. Were not authorized for biochemical examination 936 schoolchildren. The total of children evaluated in all parameters was 505 (Fig. 1).

2.2. Data collection

Data were collected in schools under the supervision of responsible research including: body weight, height, WC, BP and biochemical examination. The team that carried out the collection was properly trained.

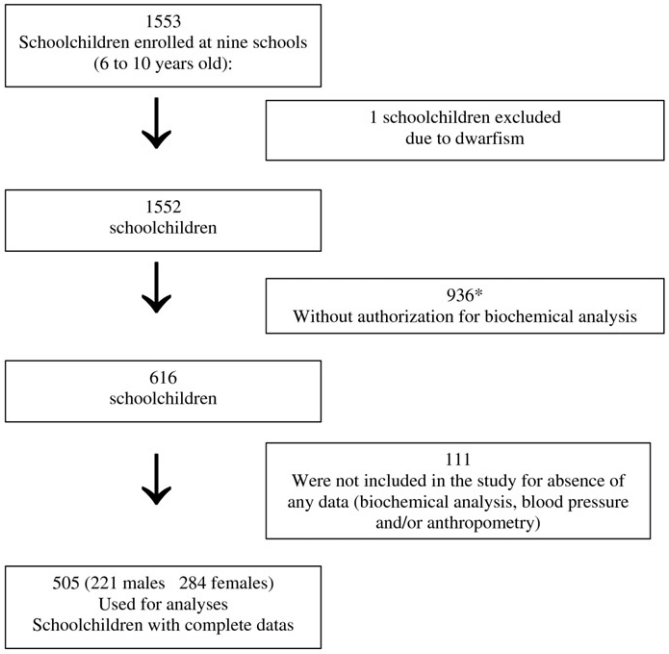

Fig. 1. Flow chart of the study sample in children aged 6–10 years, Macae, Brazil, 2013/14.

2.3. Anthropometry

Body weight and height were measured in duplicate according to the technique proposed by Lohman et al. (1988), through electronic and portable scale Tanita® platform (Illinois, USA) with capacity of up to 150 kg and range of 50 g and anthropometer Height Exata® (Minas Gerais, Brazil) with a 0.1 cm. The children were evaluated with light clothing without shoes and without headdress. The value of the average of the two measurements was used to calculate body mass index (BMI) in kg/m^2. The schoolchildren were classified in four categories: underweight, normal weight, overweight and obese by z-score as the criteria proposed by WHO (2007).

Waist circumference (cm) was measured at the midpoint between the last rib and the upper edge of the iliac crest as recommended by WHO (2014) in duplicate and the average of the measurementswas calculated. It was considered excess abdominal fat WC value above the 90th percentile according to sex and age (Maffeis et al., 2001), obtained from the sample data that consists of all schoolchildren who had WC measured (Dias et al., 2014).

2.4. Blood pressure

The procedures for measuring BP of the schoolchildren were based on the guidelines of the Brazilian Society of Cardiology (SBC, 2005), without having done exercise for an hour before the procedure and after 5 min of rest, sitting, reclining in chair and legs uncrossed. It used validated digital equipment OMRON HEM-705 CP® (G-Tech International- Republican of Korea) and the cuffs were adequate to arm size. The measurements were performed in duplicate and with an interval of 2 min between them. To classify, the PA was considered the average value of the measures. The cutoff point used were the suggested by the Brazilian Society of Cardiology (high BP ≥95 percentile for age, sex and height percentile for age) (SBC, 2005).

2.5. Biochemical measurements

A venous blood sample was collected overnight past 12 h. To make sure about fasting, it was sent to the children's parents a reminder the day before the procedure. It was also requested a signed confirmation of fasting state of each child delivered at the time of biochemical analysis. Approximately 10 mL blood sample was collected and centrifuged for 5 min. Then, the samples were placed in coolers and transported within a maximum of 2 h to the laboratory where they were frozen for later analysis. They were analyzed by enzymatic colorimetric method, kit LABTEST®: Glucose (mmol/L), HDL-c (mmol/L) and triglycerides (TG) (mmol/L).

For classification, were used the cutoff points suggested by the Brazilian Society of Cardiology (SBC, 2005): HDL-c (<1.16 mmol/L), TG (≥1.13 mmol/L) and fasting glucose was used to reference the Brazilian Society Diabetes (SBD, 2016) of ≥5.55 mmol/L. The diagnosis of MetS was based on the concurrent presence of three or more of RF cited as criteria proposed by the NCEP-ATPIII (Grundy et al., 2004) with cutoff points adapted for the child population.

2.6. Ethical aspects

The study was approved by the Research Ethics Committee of the University Veiga de Almeida (Number: 876333) and authorized by the Municipal Department of Education of the city of Macae, Rio de Janeiro and the direction of each participating school. Parents or guardians interested in their children's participation in the study signed the free