

Obesity and metabolic syndrome in children in Brazil

The challenge of lifestyle change

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Abstract

The purpose of this observational study was to examine the prevalence of obesity in children of 6 to 8 years of age from primary public schools over a period of 6 years and the associated environmental and metabolic health risk factors.

This was a cohort observational study to investigate the prevalence of obesity in children from 14 state primary schools in Vinhedo, Sao Paulo state. Environmental and metabolic health risk factors for obesity were investigated in a cross-sectional survey.

This present study revealed 74.0% of children with obesity consumed fried foods and sweets at school, and 84.0% consumed snacks and soft drinks at home. This cohort reported to have engaged in physical activity for less than 3 hours per week at school (93.0%) and at home (85.0%). There was a high prevalence of increased waist circumference and insulin resistance among children with obesity (84.9% and 84.5%, respectively). The body mass index had a significant Spearman correlation with waist circumference, insulin resistance, and triglycerides.

Childhood obesity was associated with a high prevalence of both environmental and metabolic risk factors. Also, the authors conclude that the lack of parents' awareness of childhood obesity and its risk factors represents a substantial barrier to lifestyle counseling.

Abbreviations: BMI = body mass index, HDL = high-density lipoprotein, LDL = low-density lipoprotein.

Keywords: Brazil, childhood obesity, health risk factors, primary public schools

1. Introduction

Obesity in children is increasing in most regions and countries.^[1] Obesity in childhood is associated with greater risk factors and increased prevalence of cardiovascular diseases, coronary heart disease, hypertension and diabetes in adulthood.^[2] Children with obesity are already at risk of cardiovascular disease as they have a

high prevalence of comorbidities such as hypertension, dyslipidemia and insulin resistance.^[3,4] Metabolic syndrome is a cluster of cardiovascular diseases risk factors, including waist circumference, measures of dyslipidemia including raised triglycerides and low high-density lipoprotein (HDL) cholesterol, measures of insulin-resistance usually expressed by fasting plasma glucose and arterial hypertension.^[5] The prevalence of metabolic syndrome in children ranges from 6.0% to 39.0% depending on the applied definition criteria.^[6] The identification at an early stage of life of high-risk children is indicated to implement adequate screening programs for metabolic syndrome and its single components.^[7]

Obesity among children has a multifactorial nature involving environmental factors that include poor eating habits and a lack of physical activity.^[10] These poor eating habits include both school and family factors such as over-eating, consuming foods and beverages high in fat, salt, and sugar and low in fiber, not eating enough fresh fruits and vegetables, not eating at the table, and doing other activity together.

Health promoting programs implemented within the context of schools and families are critical for treatment and prevention of childhood obesity. Preventive programs on obesity recommend the systematic assessment of body mass index (BMI) and environmental factors including eating and physical activity habits.^[8,9] Early identification and intervention of obesity and associated risk factors in these preventive programs are critical to prevent potential health problems in childhood or adulthood.^[10]

The purpose of this observational study was to examine the prevalence of obesity in children of 6 to 8 years of age from

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primary public schools over a period of 6 years and the associated environmental and metabolic health risk factors.

2. Methods

2.1. Study design and settings

This was a cohort observational study to investigate the prevalence of obesity in children ages 6 to 8 years from 14 state primary schools in Vinhedo municipality located at Metropolitan Region of Campinas—Sao Paulo state—Brazil. Environmental and metabolic health risk factors for obesity were investigated in a cross-sectional survey. The population of Vinhedo in 2015 was 72,550.

Participation in the study was on a voluntary basis after informing the children's parents about the study, its objectives and methods, and that all investigative procedures were cost-free to patient. This study was conducted according to the Declaration of Helsinki guidelines. All procedures involving human subjects/patients were approved by the Ethics Committee of the São Leopoldo Mandic School, Campinas—SP (CAAE: 51643715.3.0000.5374). Written informed consent was obtained by the parents/guardians of all the participating students. The Vinhedo Municipal Department of Health authorized the use of data.

The screening program comprised of:

- a) cost-free to patient clinical and laboratory analysis to detect overweight/obesity children and associated risk factors of metabolic syndrome; and
- b) a survey questionnaire on environmental risks factors.

In the first phase of the program, weight and height for BMI, waist circumference, blood pressure, and fasting glucose, insulin, triglycerides, HDL and low-density lipoprotein (LDL) were evaluated.

In the second phase of the program, the parents of the children participating in the study were invited to complete a survey questionnaire on environmental risk for childhood obesity. This questionnaire was recommended by the Municipal Health Department (Viuniski, N. *Obesidade em adultos, um desafio pediátrico?* *Nutrição Brasil*. Ano XIII, n.74, p.9–10, set/out, 2005.).

2.2. Screening of obesity and primary outcomes

Weight, height, and waist circumference were measured in light-weight sports clothing using a calibrated anthropometric mechanical balance (Welmy, up to 150 Kg), a stadiometer, and a non-elastic flexible tape at the level of the navel, respectively. Obesity was assessed in accordance with the indications of the International Obesity Task Force (IOTF), defined with reference to the BMI threshold values for boys and girls ages 2 to 18 years, calculated by Cole et al.^[11] Waist circumference was considered high when the value was within or above the 90th percentile (P90) according to sex and age.^[7]

Systemic arterial pressure was measured in a sitting position, at rest, using a sphygmomanometer with a cuff suitable for the child (width 9 cm, length 18 cm, brachial circumference 22 cm), according to current guidelines. If the brachial circumference exceeded the above value, cuff was replaced to improve suitability (width 10 cm, length 24 cm, arm circumference 26 cm).

On the day of retreatment, the parents/guardians received a previously prepared form with laboratory tests requested for

collection (hematocrit, hemoglobin, glucose, insulin, total cholesterol, HDL, LDL, triglycerides) and the 12-hour fasting orientation. The blood sampling was made available in all basic health units, and the laboratory analysis was done by the Municipal Laboratory, allowing the families to perform at the nearest place of their residence. The results of the exams were sent directly to the Municipal Health Department, where the team participating in the project carried out the data analysis. Subsequently, the first individual telephone consultation with the student and family member with the nutritionist was performed.

The questionnaire for the assessment of environmental risk for childhood obesity contained 22 questions, 9 of which were related to nutrition, 5 to physical activity, 6 to emotional aspects and 2 to school meals.

2.3. Statistical analysis

The percentage distribution of obesity prevalence was calculated. Comparison of proportions was performed with 'N-1' Chi-squared test (the K. Pearson chi-squared test but with N replaced by N-1).^[12,13] The correlations between BMI and metabolic risk measures were analyzed through Spearman's correlation. The adopted confidence interval was 95%, and the significance level was 5%. The following statistical software was used: GraphPad Prism (version 6.0e for Mac OS X, GraphPad Software, La Jolla CA, www.graphpad.com) and MedCalc Software version 12.3 (MedCalc Software bvba, Ostend, Belgium).

3. Results

The cohort in the year 2012 included 1045 children ages 6 to 8 years attending the 9 municipal elementary schools present on the days prearranged for evaluation. Of this cohort, 2.6% were underweight, 66.4% were eutrophic, 15.3% were overweight and 15.7% with obesity (Table 1).

The cohort in the year 2015 included 1930 children ages 6 to 8 years attending the 14 municipal elementary schools (5 new established schools) present on the days prearranged for evaluation. The increase in the number of schools, from 9 in 2012 to 14 in 2015, occurred due to the City Hall's investment in education, allowing a greater number of students to be enrolled. Of this cohort, 1.5% (29) were with underweight, 59.5% (1148) of eutrophic, 18.2% (352) were overweight and 20.8% (401) were children with obesity (Table 1).

A significant increase in the prevalence of obesity occurred from 2012 to 2015 (difference 5.1%, 95.0%CI 2.1–8.0, $P < .001$). The obesity prevalence per studied year was similar between girls and boys (Fig. 1).

Of the 2015 cohort of children with obesity, only 34.3% (138) completed the complementary clinical and laboratory investigation program for the screening of metabolic and environmental health risk factors. We identified school and family environmental risk factors associated with childhood obesity. This present study revealed 74.0% of children with obesity consumed fried foods and sweets at school (Fig. 2). Of this group, 44.8% were girls who consumed fried foods and sweets. Parents who considered school meal programs to be healthy totaled 26.0%, and similarly, 27.0% of the children with obesity liked and ate lunch every day at school (Fig. 2). Of this group, 38.7% were girls' parents who considered school meal healthy and similarly

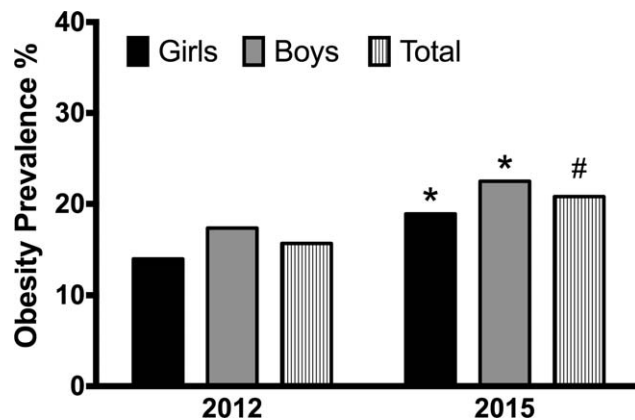


Figure 1. Obesity prevalence in children, girls and boys between 2012 and 2015. Values are percent prevalence. Comparison of proportions by Chi-squared test * $P < .05$, # $P < .001$ in comparison to group proportions in 2012.

39.4% girls ate lunch regularly at school. This present study revealed 84.0% of children with obesity consumed snacks and soft drinks at home, of which 48.1% were girls. Also, 43.0% of children with obesity ate at the table without any activity (Fig. 2), equally distributed among girls and boys (49.1% vs 50.9%, respectively).

Physical activity was less than 3 hours per week in 93.0% at school and 85.0% at home (Fig. 3), of which 42.7% and 44.3% were girls. The majority stayed more than 2 hours per day watching television (64.0%) but spent less than an hour with computer or videogaming (56.0%). Videogaming was played significantly more by boys than by girls (2.1 ± 0.1 vs 1.3 ± 0.1 hours/day respectively; mean \pm SEM, $P < .001$).

In this cohort of children with obesity, the BMI had a significant Spearman correlation with waist circumference, insulin, and triglycerides (Fig. 4). There was a prevalence of increased: waist circumference in 84.9% (39.6% girls), fasting glucose in 11.1% (4.4% girls), insulin resistance in 84.5% (40.5% girls), fasting triglycerides in 23.3% (11.1% girls) and blood pressure in 19.5% (13.0% girls), and reduced HDL in 37.8% (18.9% girls).

4. Discussion

School-based obesity screening and care management are recommended to reduce prevalence of obesity, albeit confronting challenges in encouraging students and parents to participate in such programs.^[14]

In the studied cohort of school children with obesity, there was a prevalence of increased metabolic risk factors. We identified both school and family environmental risk factors. These included diet compositions and reduced physical activity programs at school and home and also feeding practices at home. A challenge for this screening program for childhood obesity represented the parental involvement, which represents a key barrier preventing students from making sustainable changes in health-related behaviors beyond the school intervention setting.^[15] This present study revealed a decrease in the number of families participating in the phase evaluating the environmental risks factors, in comparison to those participating in the clinical and laboratory evaluation. A lack of parental awareness on childhood obesity appears to be an important obstacle for the

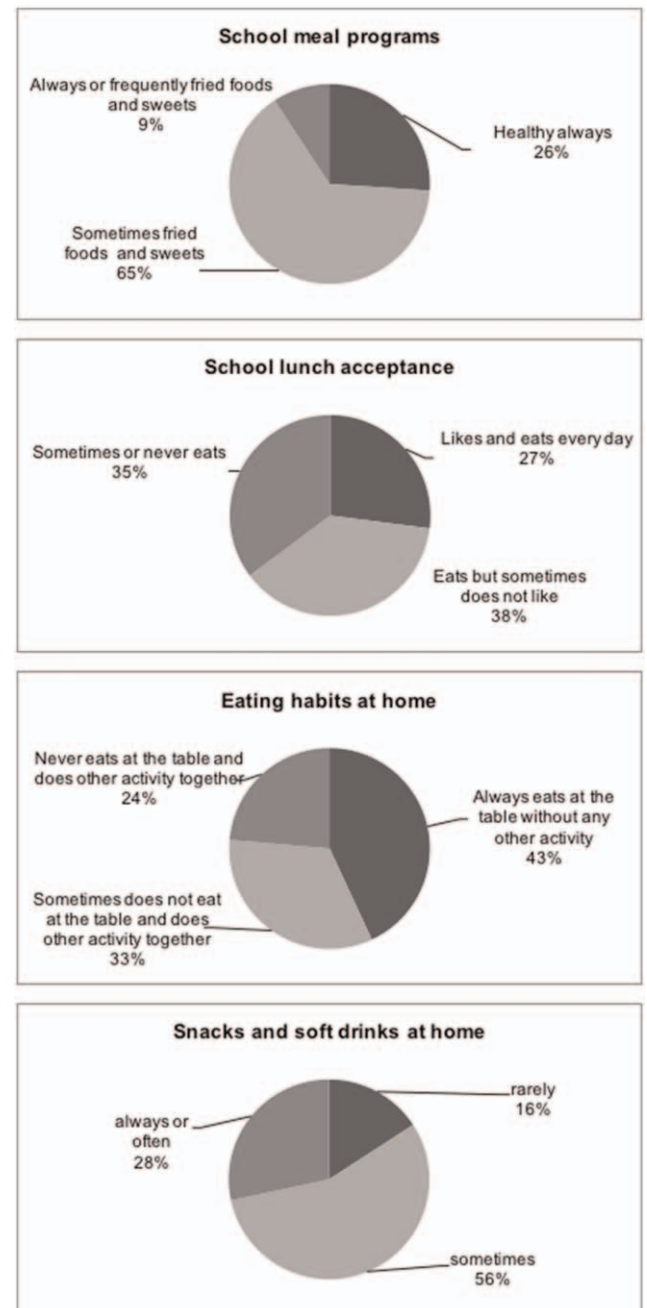


Figure 2. Spearman correlation between BMI and metabolic risk factors waist circumference, fasting glucose, insulin resistance, triglycerides, HDL and LDL. Values are Spearman's ρ coefficient, * $P < .005$, # $P < .0001$. BMI = body mass index, HDL = high-density lipoprotein, LDL = low-density lipoprotein.

motivation of the parents to adopt weight control.^[16,17] Given parents' influence over children's behaviors including diet, physical activity, and media use, family-based childhood obesity prevention interventions remain a key strategy challenge in this effort.^[18]

The scientific investigation of obesity risk environments is very much in its early stages and requires new tools that are adapted to physical, economic, political, and sociocultural contexts. Thus, since community intervention programs are contextual interventions by nature, community decision-makers have a distinct

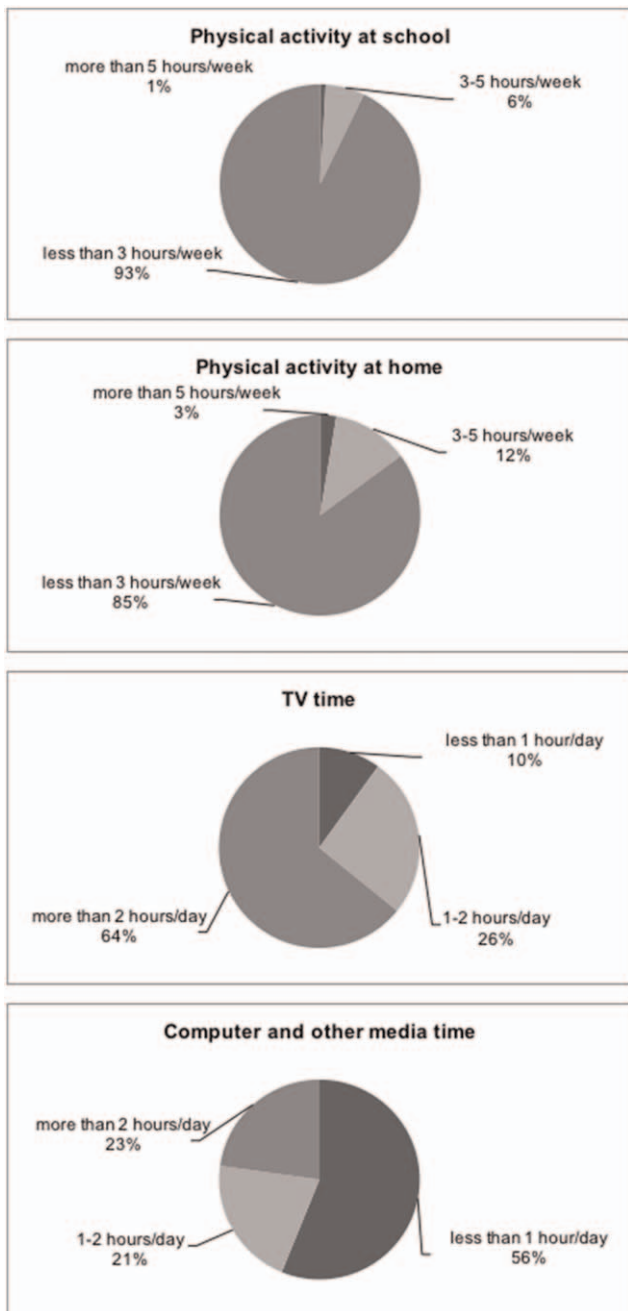


Figure 3. Diet and eating behavior in children with obesity at school and home.

role in developing “health in all policies”-strategies, as suggested by Schneider et al^[19] Schneider et al pointed out that a successful community-based health intervention requires multilevel and

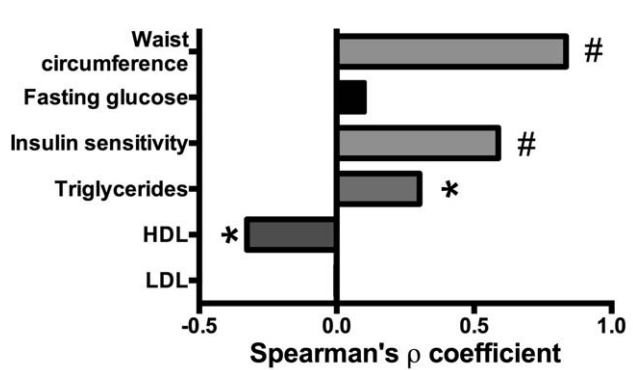


Figure 4. Physical activity in children with obesity at school and home.

multicomponent strategies.^[19] In Brazil, the Ministry of Health has recognized obesity as a serious health burden and has set guidelines for prevention and treatment through the Brazilian Unified National Health System (SUS) and National Food and Nutritional Security System (SISAN), which organizes actions by different ministries.^[20] Since Brazil has a multicultural society, municipal health departments shall consider the local cultural specific of a population when developing and applying community health care programs targeting eating behaviors^[21] and physical activity.^[22] Thus, the results from the present study may contribute to the development of culture-specific childhood obesity prevention interventions and policies.^[23]

The BMI had a significant Spearman correlation with waist circumference, and fasting insulin and triglycerides. The strong association of obesity and insulin was also found in the Filippou et al study.^[24] Although waist circumference is not used as a primary screening measure for obesity, our data indicate a high correlation with the BMI in 6 to 8 years old children. Further studies may include waist circumference as a useful measure to study obesity.^[25] For instance, a recent study suggested that combination of BMI with waist circumference may provide an added benefit in the assessment of cardiometabolic risk amongst pre-adolescents.^[26] In this present study, insulin had a strong correlation with BMI represents an independent risk factor for cardiovascular and metabolic diseases.^[27,28] Other cardiometabolic measures, particularly HDL, triglycerides (significantly associated with BMI) and high blood pressure (high prevalence in children with obesity) are important outcome measures in weight reduction programs in children with obesity.^[29]

This study has some limitations. These findings on the interaction between childhood obesity and metabolic risk and environmental factors are derived from a cross-sectional study, thus impeding causal interpretation. While the observations resulting from the present study are of public health interest, evidence from longitudinal randomized controlled trials is needed

Table 1
Prevalence of obesity among children.

	Year 2012—1045 children			Year 2015—1930 children		
	Total %	Boys %	Girls %	Total %	Boys %	Girls %
Underweight	2.6	2.5	2.7	1.5	1.8	1.2
Normal	66.4	63.4	69.5	59.5	56.7	62.5
Overweight	15.3	16.8	13.8	18.2	18.9	17.5
Obese	15.7	17.4	14.0	20.8	22.5	18.9

to indicate causality. Relatively low number of children and parents enrolled in the study could underestimate associations between obesity and metabolic and environmental risk factors. Also, voluntary response sampling methods are biased as compared to random sampling. Another limitation may be that for the multicultural society of Brazil, the race of students was not considered in this study or the socio-economic status. No results were obtained from the 3rd step of the educational program containing the parental engagement agenda. This points out to the importance of improving the training of health and schools' professionals as strategic partners in the implementation of such community/school educational programs. Gaps in intervention design and methodology to implement these parental engagement programs remain to be identified.

Programs could be delivered in a school setting by teachers to build on a teacher-parent partnership to increase effectiveness of both school and parenting practices in order to strengthen positive behavior support and behavior management at school and at home. Such program is ParentCorps that builds on the strengths of culturally-diverse families and helps schools engage parents as partners in helping children succeed.^[30]

5. Conclusion

Both school and family aspects appear to contribute as health environmental risk factors for obesity in school children. Childhood obesity was associated with metabolic syndrome. The lack of parents' awareness of childhood obesity and its risk factors represents a substantial barrier to lifestyle counseling. The present study indicates that health quality improvement projects should target both school and family health promotion interventions. Further community programs including controlled trials, specific for the pediatric populations, are necessary to tackle obesity and other conditions associated.

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Author contributions

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