

CHILDHOOD WEIGHT STATUS: PREVALENCE AND COMBINATION OF OVERWEIGHT AND ABDOMINAL OBESITY

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ABSTRACT: To identify the prevalence of overweight and abdominal obesity in an isolated and combined way in schoolchildren aged 6 to 10 years old. 1267 schoolchildren from Macaé, RJ, and Brazil participated in the study. The anthropometric data analyzed were body mass, height, and waist circumference (WC). The World Health Organization (WHO) criteria were used to define overweight and obesity. Abdominal obesity (AO) was estimated by the waist / height ratio (WHtR) ≥ 0.50 . The prevalence of overweight and obesity in schoolchildren was 33.8% and 16.4%, respectively. The prevalence of AO was 22.7%, 11.9% girls and 10.8% boys ($p > 0.05$). We found that 37.7% of overweight children have AO, being more present among girls when compared to boys (50% vs. 26.3%, respectively; $p < 0.05$). Among obese children, 93.7% had AO. The students' weight status was accompanied by the high prevalence of overweight and the presence of a combination of obesity and AO, found in both sexes and at all ages.

KEY WORDS: Adiposity; Anthropometry; Body mass index; Schoolchildren.

STATUS DE PESO DE ESCOLARES: PREVALÊNCIA E COMBINAÇÃO DE EXCESSO DE PESO E OBESIDADE ABDOMINAL

RESUMO: Identificar a prevalência de excesso de peso e obesidade abdominal de forma isolada e combinada em escolares de 6 a 10 anos de idade. Participaram do estudo 1267 escolares do município de Macaé, RJ, Brasil. Os dados antropométricos analisados foram a massa corporal, a estatura, e a perímetria da cintura (PC). Os critérios da Organização Mundial da Saúde (OMS) foram usados para definir o sobrepeso e a obesidade. A obesidade abdominal (OA) foi estimada pela relação cintura/estatura (RC_{Est}) $\geq 0,50$. A prevalência de excesso de peso e obesidade nos escolares foi de 33,8% e 16,4%, respectivamente. A prevalência de OA foi de 22,7%, sendo 11,9% meninas e 10,8% meninos ($p > 0,05$). Verificamos que 37,7 % das crianças com sobrepeso apresentam OA, sendo mais presente entre as meninas em comparação com os meninos (50% vs. 26,3%, respectivamente; $p < 0,05$). Entre as crianças obesas, 93,7% apresentaram OA. O status de peso dos escolares esteve acompanhado pela elevada prevalência de excesso de peso e pela presença combinação de obesidade e OA, encontradas em ambos os sexos e em todas as idades.

PALAVRAS-CHAVE: Adiposidade; Antropometria; Escolares; Índice de massa corporal.

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INTRODUCTION

Environmental factors that are harmful to health today, such as inadequate nutrition and sedentary behavior, favor the increase in the prevalence of overweight children worldwide and are contributing to the promotion of changes in body composition among schoolchildren, such as the increase in abdominal obesity (AO)¹.

The interest in identifying childhood obesity is justified by the increase in its prevalence, its possible permanence in adult life and, mainly, by its potential as a risk factor for the development of chronic non-communicable diseases. In addition, it is in this age group that eating habits and physical activity are formed, making this period important for actions to promote a healthy lifestyle².

The presence of overweight, obesity and AO during childhood are strongly associated with risk factors such as cardiovascular disease, diabetes and cancer. However, the accumulation of fat in the abdomen region has been described as a better risk predictor for chronic non-communicable diseases than total obesity^{3,4}. Overweight and AO children are more susceptible to metabolic changes than overweight children without AO³.

Thus, understanding the existence of different forms of obesity and their associated risk factors directs us to the importance of assessing the presence of overweight and AO separately and combined. This assessment, both at the clinical and institutional levels, such as the school, allows better identification of cardiovascular risk in children³, and, consequently, contributes to the improvement of governmental actions.

Overweight, obesity and AO can be identified and monitored using anthropometric indicators. The Body Mass Index (BMI) is a method widely used in epidemiological studies and in the clinical area for the classification of weight status in children⁵. One of the limitations of this method is based on the fact that the BMI does not provide information on the distribution of body fat⁶, therefore not measuring AO.

The waist-to-height ratio (WHtR) method performs well as an indicator of AO in schoolchildren of both sexes⁷. The WHtR when associated with BMI facilitates the identification of schoolchildren at risk for cardiovascular diseases, it is a method of easy analysis because it has a single cut-off point and does not require adjustment by age and sex. Although studies aimed at identifying overweight

and AO in the child population are increasing, they are still scarce in the group of children under 10 years of age.

In this scenario, the present study aimed to identify the isolated and combined presence of overweight and AO in students aged 6 to 10 years in an analysis by age and sex.

STUDY SIMPLE

Cross-sectional study carried out on schoolchildren aged 6 to 9 years, 11 months and 29 days, of both sexes in the municipality of Macaé, located in the North Fluminense Region of the state of Rio de Janeiro, Brazil (figure 1). The investigation was carried out from March 2013 to November 2014 by a team from the Laboratory of Research and Innovation in Sports Sciences (LAPICE), Federal University of Rio de Janeiro (UFRJ) - Campus Macaé in partnership with the Municipal Department of Education. The city of Macaé is divided into nine administrative sectors containing 52 schools, with 10,247 students in the age group of the study. The criteria for choosing schools were defined by the intersectorial working group of the Health at School Program (PSE) Macaé: a) having at least one school in each administrative sector in the municipality. b) the school is in a perimeter close to the Basic Health Unit. Therefore, for the reference population, a school from each sector was selected, totaling 1553 students, who were invited to participate in the study.

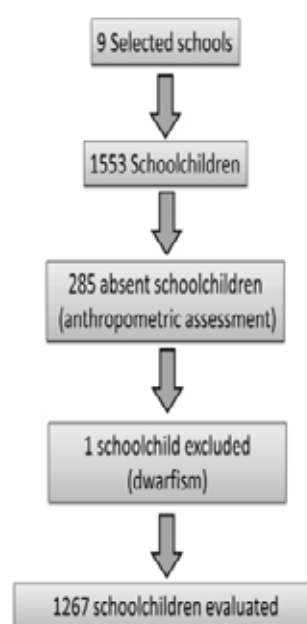


Figure 1. Flowchart of the study sample of children 6-10 y of age, Macaé, Brazil, 2013/2014.

INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria: students from 6 to 9 years, 11 months and 29 days of age, enrolled from the 1st to the 4th year, belonging to the selected schools and who had written consent by the guardians, after reading the Free Consent Form and Clarified.

Exclusion criteria: Children who presented some physical impairment that prevented the evaluations, and who did not present authorization for the investigations to be carried out in the study.

DATA COLLECT

Data were collected in schools, including body mass, height and waist circumference (BW). The team that performed the anthropometry collection was properly trained, composed of nutritionists and scientific initiation scholarship holders (undergraduate students UFRJ - Macaé), under the supervision of two experienced evaluators.

ANTHROPOMETRY

Body mass and height were measured in duplicate according to the procedures described by Lohman et al., 8 using an electronic scale and a portable Tanita® platform (Illinois, USA) with a capacity of up to 150kg and 50g variation and an Exact Height anthropometer® (Minas Gerais, Brazil) with a variation of 0.1 cm. The students were evaluated in light clothing, without shoes and without headress. The average value between the two measures was used to calculate the Body Mass Index (BMI) in kg / m². The students were classified in the categories: thinness, normal weight, overweight and obesity by z-score according to criteria proposed by WHO / WHO (2007)⁹, using the WHO ANTHRO Plus software. Waist circumference (WC) was measured using a flexible and inelastic measuring tape with 0.1 cm precision, with the student standing with a relaxed abdomen, arms relaxed at the side of the body, with the tape placed horizontally at the midpoint between the lower border of the last rib and the iliac crest (cm)⁹. AO was defined according to the waist / height ratio (RCEst) and the cutoff point was equal to or greater than 0.50¹⁰.

For the analysis of body mass and height by age,

the results were compared with the median and 1 standard deviation presented by the 5-19 year old growth reference, WHO¹¹.

ETHICAL ASPECTS

The study was approved by the Ethics and Research Committee of the Veiga de Almeida University (Opinion 876.333) and authorized by the Municipal Education Secretariat of the Municipality of Macaé, Rio de Janeiro and by the direction of the participating school. Parents or guardians interested in having their children participate in the study signed a free and informed consent form. At the end of the investigation, the participants received the individual results of their assessments.

STATISTICAL ANALYSIS

Data analysis was performed using the Statical Program for the Social Sciences, version 19.0 (SPSS, Chicago IL). Descriptive statistics were performed on continuous quantitative data and were exposed as mean $\pm$ standard deviation with confidence intervals (95%). For the qualitative nominal data, proportions were made so that the prevalence distribution among the studied characteristics was known. All data were characterized with normal distribution by the Shapiro-Wilk test with a significance level of 5%. For statistical inference, continuous quantitative data were assessed using the ANOVA test, a criterion and in the presence of difference between groups, Tukey's Post hoc was performed with a significance level of 5%. When evaluating the proportions, the Z test with adjustment of the p-value was used for multiple analyzes by the Bonferroni method, with a significance index of 5%.

RESULTS

1267 schoolchildren participated in the present study, 622 of whom were female (49.1%) and 645 were male (50.9%). The mean age of the sample was 7.76 ± 1.02 (range from 6 to 10 incomplete years). The average values of anthropometric measurements are shown in table 1. No statistically significant differences were found in height, body mass, BMI, z score of BMI and WC, according to the sex of the children.

Table 1. Characterization of the sample according to sex in schoolchildren 6-10 years old, Macaé, Brazil, 2013/2014

Variables	All		Girls		Boys		p-value
	(n= 1267)		(n= 622)		(n= 645)		
	Mean + SD	95% IC	Mean + SD	95% IC	Mean + SD	95% IC	
Age (years)	7,76 ± 1,02	7,70 - 7,82	7,76 ± 1,02	7,67 - 7,84	7.76 ± 1,01	7,68 - 7,84	0,96
Body mass (kg)	29,89 ± 8,16	29,44–30,34	29,97 ± 8,46	29,30-30,59	29,82 ± 7,87	29,21-30,43	0,74
Height (m)	1,29 ± 0,83	1,29–1,30	1,29 ± 0,84	1,28-1,30	1,30 ± 0,82	1,29-1,30	0,47
BMI (kg/m²)	17,50 ± 3,27	17,31–17,67	17,58 ± 3,43	17,31-17,83	17,42 ± 3,10	17,19-17,65	0,38
BMI (z - score)	0,59 ± 1,37	0,52–0,67	0,56 ± 1,31	0,44-0,66	0,62 ± 1,44	0,51-0,72	0,42
WC (cm)	60,61± 8,69	60,15–61,08	60,49 ± 8,85	59,79-61,17	60,71 ± 8,54	60,10-61,37	0,65

BMI: body mass index; BMI z-score: Standard deviation score for body mass index; WC: Waist circumference; SD = standard deviation; CI = Confidence interval. Test ANOVA a criterion, $p > 0.05$.

The prevalence of overweight among students was 33.8%, with 17.4% of children classified as overweight and 16.4% as obese. Boys had a higher prevalence of overweight and obesity compared to girls. Among schoolchildren

classified with the combined presence of overweight and AO, girls had a higher prevalence of AO compared to boys, ($p < 0.05$). AO was present in 50% of overweight girls and in 26.3% of overweight boys (Table 2).

Table 2. Prevalence of nutritional status and abdominal obesity according to sex in schoolchildren 6-10 years old, Macaé, Brazil, 2013/2014

Obesity Indicators	All (1267)		Girls (622)		Boys (645)		p-valor
	%	n	%	n	%	n	
Thinness	2,3	29	2,6	16	2,0	13	> 0,05
Eutrophy	63,9	810	64,8	403	63,1	407	
Overweight	17,4	220	17,0	106	17,7	114	
Obesity	16,4	208	15,6	97	17,2	111	
Without AO	77,3	979	75,7	471	78,8	508	> 0,05
With AO	22,7	288	24,3	151	21,2	137	
Eutrophic with AO	0,80	10	1,2	5	1,2	5	< 0,05
Overweight with AO	6,5	83	50,0*	53	26,3	30	
Obesity with AO	15,4	195	95,9	93	91,9	102	

AO: Abdominal obesity. Z test with Bonferroni correction. $p > 0.05$

Table 3 shows the anthropometric data of the sample according to sex and age. There was an increase in height and body mass with advancing years in both sexes ($p < 0.05$). BMI in 9 year old girls was significantly higher when compared to 6 and 7 year old girls and in 9 year old boys when compared to 6 year old boys. With regard to

WC, girls of 8 years old showed significant differences in relation to girls of 6 years and girls of 9 years in relation to girls of 6, 7 and 8 years. Among boys, WC was significantly higher at the age of 8 years compared to the age of 6 years and, at 9 years old, when compared to the ages of 6 and 7 years old.

Table 3. Anthropometry of the sample according to sex and age in schoolchildren 6-10 years old, Macaé, Brazil, 2013/2014

Age						Age			
Mean + SD			Mean + SD			Mean + SD			
95% IC			95% IC			95% IC			
Boys						Girls			
Body mass (kg)	All	6 years	7 years	8 years	9 years	6 years	7 years	8 years	9 years
	(n=1267)	(n= 95)	(n = 145)	(n = 225)	(n = 180)	(n = 86)	(n = 167)	(n = 181)	(n = 188)
	29,89 ± 8,16	24,16 ± 5,30	27,74 ± 6,32 ^A	30,62 ± 7,55 ^{AB}	33,46 ± 8,35 ^{ABC}	24,25 ± 5,08	26,99 ± 6,53 ^A	30,46 ± 7,21 ^{AB}	34,75 ± 9,59 ^{ABC}
	29,44 – 30,34	23,09 - 25,28	26,74 - 28,76	29,59 - 31,68	32,26 - 34,71	23,21 - 25,32	26,05 - 27,99	29,49 - 31,50	33,42 - 36,11
Height (m)	1,29 ± 0,83	1,20 ± 0,06	1,25 ± 0,04 ^A	1,32 ± 0,06 ^{AB}	1,36 ± 0,06 ^{ABC}	1,20 ± 0,05	1,25 ± 0,05 ^A	1,30 ± 0,06 ^{AB}	1,36 ± 0,06 ^{ABC}
	1,29 - 1,30	1,18 - 1,21	1,25 - 1,26	1,31 - 1,32	1,35 - 1,37	1,19 -1,21	1,24 - 1,26	1,29 - 1,31	1,35 - 1,37
BMI (kg/m²)	17,50 ± 3,27	16,64 ± 2,70	17,40 ± 3,08	17,39 ± 3,10	17,87 ± 3,24 ^A	16,68 ± 2,58	17,05 ± 3,02	17,61 ± 3,23	18,43 ± 4,09 ^{AB}
	17,31 - 17,67	16,11 - 17,27	16,93 - 17,90	16,96 - 17,83	17,40 - 18,37	16,15 - 17,22	16,61 - 17,48	17,14 - 18,09	17,85 - 18,98
BMI (z- score)	0,59 ± 1,37	0,58 ± 1,57	0,83 ± 1,46	0,58 ± 1,41	0,53 ± 1,38	0,56 ± 1,21	0,56 ± 1,28	0,58 ± 1,20	0,54 ± 1,47
	0,52 - 0,67	0,27 - 0,93	0,60 - 1,06	0,39 - 0,76	0,32 - 0,73	0,30 - 0,80	0,37 - 0,75	0,41 - 0,76	0,32 - 0,74
WC (cm)	60,61 ± 8,69	57,05 ± 6,07	59,61 ± 8,09	61,01 ± 8,38 ^A	63,16 ± 9,38 ^{AB}	56,56 ± 6,32	58,30 ± 7,74	60,98 ± 8,57 ^A	63,77 ± 9,78 ^{ABC}
	60,15 - 61,61	55,84 - 58,47	58,39 - 61,00	59,92 - 62,23	61,79 - 64,52	55,29 - 57,87	57,19 - 59,44	59,75 - 62,23	62,45 - 65,13

BMI: body mass index; BMI z-score: Body mass index standard deviation score WC: Waist circumference (p <0.05); Z test with Bonferroni correction, The statistical difference with the age of 6 of the same sex (p <0.05); B statistical difference at the age of 7 of the same sex (p <0.05); C statistical difference at the age of 8 years of the same sex (p <0.05).

Table 4 shows the prevalence of nutritional status and AO according to sex and age. The presence of overweight and AO did not differ statistically between ages and between boys and girls. Among schoolchildren identified with the combination of overweight and AO, significant differences were found between girls aged 8 and 9 compared to boys aged 8 years.

The average body mass verified at all ages and in both sexes was above 1 standard deviation comparing the results with the WHO reference table of 5 to 19 years of growth¹¹. Regarding height, the average by sex was within the limit of up to 1 standard deviation.

Table 4. Prevalence of nutritional status and OA among schoolchildren aged 6 to 10 years according to sex and age. Macaé, Brazil, 2013/2014

Age n %						Age n %			
Boys						Girls			
	All	6 years	7 years	8 years	9 years	6 years	7 years	8 years	9 years
	(n=1267)	(n= 95)	(n = 145)	(n = 225)	(n = 180)	(n = 86)	(n = 167)	(n = 181)	(n = 188)
Eutrophic	810 63,93%	61 64,21%	88 60,69%	150 66,67%	108 60,00%	58 67,44%	106 63,47%	123 67,96%	116 61,70%
Overweight	220 17,36%	16 16,84%	28 19,31%	33 14,67%	37 20,56%	14 16,28%	32 19,16%	30 16,56%	30 15,96%
Obesity	208 16,42%	15 15,79%	27 18,62%	38 16,89%	31 17,22%	13 15,12%	25 14,97%	27 14,92%	32 17,02%
With AO	288 22,73%	22 23,16%	35 24,14%	38 16,89%	42 23,33%	19 22,09%	36 21,56%	44 24,31%	52 27,66%
Overweight with AO	83 6,55%	6 6,31%	9 6,21%	2 0,89	13 7,22	5 5,81	12 7,18%	16 ^c 8,84%	20 ^c 10,64%
Obesity with AO	195 15,39%	14 14,74%	26 17,93%	33 14,67%	29 16,11%	13 15,11%	24 14,37%	27 14,92%	29 15,42%

AO = abdominal obesity; Z test with Bonferroni correction, C = statistical difference between 8 and 9 year old girls with 8 year old boys (p <0.05).

DISCUSSION

In the present study, the weight status of the students was accompanied by the presence of overweight, and the combination of obesity and abdominal obesity, in both sexes and at all ages. The prevalence of overweight among children was 33.8%, with 16.4% being obese.

Data from the International Obesity Task Force IASO / IOTF (2010) demonstrated that in the European Union more than 20% of school-age children are overweight or obese¹². Data from the Family Budget Survey (POF) 2008-2009¹³, also show that in Brazil the prevalence of overweight among children aged 5 to 9 years was 33.5% and 14.3% obese.

More recent research conducted in other municipalities in Brazil has shown trends similar to those observed in the present study on the prevalence of overweight and obesity, although using different classification criteria to those adopted in the present study. Ribas and Silva¹⁴ in a study carried out with students aged 6 to 10 years from public and private schools, in Belém-PA, observed the presence of overweight and obesity in 31.4% and 19.0%, respectively. Rossi and de Vasconcelos¹⁵ observed 42.4% of overweight and 10.9% of obesity among children aged 7 to 9 years, from public and private schools in Florianópolis, Santa Catarina. In São Paulo, Miranda et al.¹⁶ found 31.7% overweight and 16.7% obesity among children aged 8 to 10 years, from public and private schools.

The significant increase of 19.8% in the prevalence of overweight among Brazilian schoolchildren in the last decade, 15% in 1989, evolving to 34.8% in 2008/2009, led the Ministry of Health to idealize the Strategic Action Plan for Coping of Chronic Non-Communicable Diseases (NCDs) in 2011 to 2022¹⁷. The plan set the goal of reducing the prevalence of obesity in children from 5 to 9 years old, male, from 16.6% identified in the POF in 2008/2009, to 8.0% in 2022 and in female children, from 11.8% to 5.1%.

In the present study, the prevalence of obesity observed was 17.2% among boys and 15.6% among girls, pointing out that in the municipality of Macaé, Rio de Janeiro, in 2013, the prevalence of obesity was above values observed in 2008/2009¹³. Based on these findings, it is

possible to conclude that for the municipality of Macaé to achieve the goals established by the Ministry of Health, there should be a change in the strategy of health policies to deal with childhood obesity.

In the present study, the prevalence of overweight did not differ statistically between girls (32.6%) and boys (34.9%) ($p > 0.05$). Batista et al.¹⁸ did not observe differences between the sexes, verifying the prevalence of 30.2% in girls and 30.7% in boys. Additionally, Dias, Bandeira and Monteiro¹⁹ also did not identify differences between genders, having verified 25% among girls and 27% among boys.

Overweight in childhood is associated with a higher risk and earlier onset of chronic diseases, such as type 2 diabetes, cardiovascular diseases and dyslipidemia, and range from the physical to the psychological state, decreasing the quality of life²⁰. Considering that weight loss and maintenance after weight loss are difficult to achieve, it is to be expected that excessive weight gain in childhood is likely to lead to overweight and obesity in adulthood²¹.

According to the Brazilian Society of Pediatrics (SBP)²², one of the critical periods for the development of excess weight is seen between the ages of 7 to 9 years, a phase in which an increase in the amount of fat cells (hyperplasia) may occur. In the present study, the presence of overweight was high in all ages, with a variation from 31.5 to 34.1% among girls and from 31.5 to 37.9% among boys without statistically significant differences ($p > 0.05$).

The various methodologies that are adopted for the classification of weight status and the reduced number of publications in Brazil that present the results stratified by age make a comparative analysis difficult. In a study carried out in Serbia, with schoolchildren between 6 and 8 years old, using the cutoff points recommended by the International Obesity Task Force (IOTF), the prevalence of overweight was 23.1% at 6 years old, 24.3% at 7 years old and 23.2% at 8 years old in girls and 24.6%, 22.1% and 22.9%, respectively among boys²³.

Abdominal adiposity, and in particular visceral adiposity, is strongly related to insulin resistance (IR), type 2 diabetes mellitus, systemic arterial hypertension (SAH) and dyslipidemia²⁴. The simple presence of AO suggests an increase in cardiovascular risk factors when compared

to total obesity, assessed from BMI / age²⁵. The prevalence of AO, identified in 22.7% of the sample, did not differ between girls (11.9%) and boys (10.8%) ($p > 0.05$). This prevalence can be considered high when compared to other national studies, as in the study by Barbosa et al.², which identified AO in 16.8% of their sample with 7.7% in boys and 9.9% in girls. In the study by Valentim-Silva et al.²⁶ they demonstrated 19.05%, 11.37% in boys and 7.68% in girls. Corroborating with our study, there were no differences in the prevalence of AO between genders in studies carried out in Portugal²⁷ and Spain²⁸. The results of the present study demonstrated a high prevalence of AO in all ages.

According to Janssen³, it indicates that in clinical practice the combined use of the identification of overweight and AO should be adopted. Their research found that in overweight children the AO group was 2 times more likely to have high levels of triglycerides, insulin and metabolic syndrome, compared to the overweight group without AO. The combined presence of overweight and AO was identified in 21.4% of the children studied. Similar results (21.9%) were observed by Rodrigues, Padez and Machado-Rodrigues²⁷.

In the present study, almost all obese children (93.7%) had AO, which in a way would be expected. However, we emphasize that AO was also present in 38% of overweight students and more frequently among girls (50.0%), with the prevalence almost double that found in boys (26.3%). This greater presence of the combination of overweight and AO occurred among girls between the ages of 8 and 9 years. These results can be explained by the prepubertal repletion phase, which begins at around 8 to 10 years of age. Greater central adiposity has already been observed in girls with relatively accelerated maturation²⁹.

On the other hand, the excess weight verified in the present study, did not influence growth among the evaluated students. According to the Brazilian Society of Pediatrics (SBP)²², the pre-pubertal phase, the period between the third year of life and the beginning of puberty, is characterized by a more stable growth, approximately 5-7 cm / year. This stable growth was observed in the present study, in which the stature had an average growth variation of 4 to 7 cm / year. The average height found by

age was between the median and 1 standard deviation, in accordance with the recommended by WHO¹¹

CONCLUSION

The students' weight status was accompanied by the high prevalence of overweight and the combination of obesity and abdominal obesity, observed in both sexes and at all ages. This fact increases the concern with the possible development of NCDs, which can result from excessive adiposity during the entire growth process. Among overweight girls, the presence of AO was more frequent than among overweight boys. Thus, strategies for coping with excess child weight need to be implemented in the school environment, in order to reverse the high prevalence of overweight, obesity and abdominal obesity among schoolchildren, contributing to reduce the possibility of early development of diseases associated with excessive adiposity. as well as improving child health

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