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ORIGINAL ARTICLE

Evaluation of anthropometric profile in schoolchildren in the city of Vila Velha, Brazil

Avaliação do perfil antropométrico em escolares no município de Vila Velha, Brasil

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ABSTRACT

Objective: This study analized the anthropometric profile of 1,116 schoolchildren aged 6 to 12 years old from a public school in the Vila Velha, Espírito Santo, Brazil, and its trend over three years of follow-up (2017 to 2019). **Methods**: The variables used were age, skin color, weight, height, body mass index, and waist circumference, classified according to the gender and age. The chi-square test for heterogeneity and linear regression were used in the analyses. **Results**: Most of the students were boys between 6 and 7 years old, with non-white skin color. Almost 40% were overweight or obese and one fifth had an elevated waist circumference. There was an increase in body mass index with increasing age in girls (p<0.001). Of the children followed at three years, more than 40% were overweight or obese, however this profile did not change over the years. At the last follow-up, we observed an increase in body mass index with increasing waist circumference in both genders. **Conclusion**: The prevalence of overweight and obesity among schoolchildren was high and was related to the increase in waist circumference.

RESUMO

Objetivo: Este estudo analisou o perfil antropométrico de 1.116 escolares com idade entre 6 e 12 anos de uma escola pública na cidade de Vila Velha, Espírito Santo, Brasil, e sua tendência ao longo de três anos de acompanhamento (2017 a 2019). **Métodos**: As variáveis utilizadas foram idade, cor da pele, peso, altura, índice de massa corporal e circunferência abdominal, classificadas de acordo com o sexo e idade. Utilizou-se nas análises o teste qui-quadrado de heterogeneidade e a regressão linear. **Resultados**: A maioria dos escolares era meninos com 6 e 7 anos de idade e com cor da pele não branca. Quase 40% tinham sobrepeso ou obesidade e um quinto estava com a circunferência da cintura elevada. Houve aumento do índice de massa corporal com o aumento da idade nas meninas (p<0,001). Das crianças acompanhadas aos três anos, mais de 40% tinham sobrepeso ou obesidade, no entanto tal perfil não se modificou ao longo dos anos. No último acompanhamento, foi observado aumento do índice de massa corporal com o aumento da circunferência da cintura em ambos os sexos. **Conclusão**: A prevalência de sobrepeso e de obesidade dos escolares foi elevada e esteve relacionada com o aumento da circunferência da cintura.

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Nutricional status.; Anthropometry; Body mass index; Obesity; Student health

Introduction

Nutritional status is a global marker of the health conditions of the child population.[1] For this reason, anthropometric measurements are widely used in monitoring the nutritional status of children from birth, to identify possible harm to child growth.[2]

A school environment is a privileged place for anthropometric assessment and monitoring of the nutritional status of children and adolescents.[3] In this perspective, the World Health Organization (WHO) recommends carrying out school surveys on children under 15 years old.[4]

In recent decades, the Brazilian population has been going through a process called “nutritional transition”, characterized by a reduction in the prevalence of malnutrition and an increase in childhood overweight and obesity.[5] The increase in the prevalence of overweight and obesity in childhood and adolescence has become a major problem for public health, since studies point to a high risk of overweight and obese children and adolescents becoming obese adults, consequently developing chronic diseases.[6,7,8]

In Latin America, the prevalence of obesity range from 18.9% to 36.9% in children aged between 5 and 11 years old.[9] In Brazil, according to the Family Budget Survey, from 2008 to 2009 the prevalence of overweight in children aged 5 to 9 years was 33.5%, with 16.6% of boys and 11.8% of girls being obese.[10] In this same survey, carried out in three periods (1974-75, 1989, and 2008-2009), was observed a growing trend of overweight and obesity in both sex.[10] In Espírito Santo (Brazilian city), 27.2% of children aged between 5 and 10 years old were overweight in 2019, according to data of the Sistema de Vigilância Alimentar e Nutricional (SISVAN)[11]

Among the resources currently available, anthropometry is a tool widely used in the assessment of child growth, as it is minimally invasive, inexpensive, and easy to understand, being essential for identifying both overweight and the risk of childhood mortality associated with obesity, and malnutrition.[12] Therefore, the importance of assessing child growth for the prevention of obesity, which is currently an increasing epidemiological situation in Brazil.[10,13]

Therefore, understanding the anthropometric profile, as well as its tendency, constitutes an important basis for the development of effective actions in public health, since it reveals the real situation of the health

scenario of schoolchildren in their growth phase.[12] In this perspective, the present study aims to describe the anthropometric profile of elementary school students from a municipal public school and its trend over three years of follow-up.

Methods

A longitudinal and prospective study was carried out with students from a municipal elementary school, located in the city of Vila Velha - ES, from 2017 to 2019. The data come from the extension project "Health at school: a research project- intervention", carried out by a group of medical students, who were previously selected and trained to participate in the present project. A form was used to record the schoolchildren's data during follow-up, containing demographic, health, anthropometric information, blood pressure measurements, and visual acuity.

The sample consisted of 1,116 students of both sexes, regularly enrolled, and whose parents accepted and consented to participate in the extension project. Therefore, to reach the total number of students enrolled, in this study, there was no sample size calculation. Among the total, 133 participated in the three follow-ups, which allowed analyzing the trend of change in anthropometric measurements over the period. Due to lack of parental consent, student refusal, or absence on the day of measurement collection in one of the follow-up moments, 306 students were excluded from the sample.

The variables analyzed in this study were: age (years), skin color (white; non-white), weight (in grams) and classified according to sex and age (low weight; adequate; high), height (in centimeters), and classified as according to sex and age (low; adequate; high), body mass index (BMI) in kg/m^2 and classified according to sex and age (thin; normal weight; overweight; obesity), waist circumference (WC; in centimeters) and classified according to sex and age (adequate; high).

The weight (in grams), was measured with a digital scale from the Líder brand, calibrated and certified by INMETRO, with scales of 50 grams. The child, without shoes, coat, and adornments, was placed in the center of the equipment barefoot, erect, with feet together and arms extended along the body. The reading was taken after the weight value was fixed on the display. For weight classification, the curves of WHO percentile was standardized for sex and age were adopted,[14] children were classified as low weight (< 3rd percentile), adequate (≥ 3rd percentile and < 97th percentile), and high (≥ percentile 97).

Height (in centimeters), was verified using a wall stadiometer, brand MD, with a measurement range from 0 to 200 cm and graduation of 1 mm, with the child without shoes. For height verification, the child was positioned standing, barefoot, and with the head free of props, in the center of the equipment. With the arms extended along the body, the head raised looking at a fixed point at eye level, in the Frankfort horizontal plane, and the legs being parallel, forming a 90º angle with the feet, the moving part of the stadiometer is lowered, fixing the against the head, with enough pressure to compress the hair. The child is removed as soon as it is certain that the child has not moved. The height reading was performed without releasing the mobile part of the equipment. For the interpretation of height, the WHO percentile curves standardized for sex and age[14] were used, which classifies children into short stature (<3rd percentile), adequate (≥3rd percentile and <97th percentile), and tall (≥97th percentile).

The WC was measured using an inelastic measuring tape graduated in millimeters and placed at the midpoint between the lower costal margin and the iliac crest.[15] For the classification of this variable, standardized percentiles for sex and age were used, classifying children with WC as normal (<90th percentile) or high (≥90th percentile).[15]

The BMI was calculated by dividing weight (kg) by the square of height (m^2), obtaining the result in kg/m². Based on the calculation, the children were classified, according to the standardized curves for sex, age, and height,[14] recommended for children and adolescents aged 5 to 19 years old, as thin (< 3rd percentile), normal weight (≥3rd percentile) and <85th percentile), overweight (≥ 85th percentile and <97th percentile) and obesity (≥97th percentile).

The analyzes included the identification of mean and dispersion values for numerical variables and, for categorical variables, absolute and relative values. The variables were stratified by sex and the chi-square test of heterogeneity was applied to categorical variables. Linear regression was used to verify the association of BMI with age and with WC with sex.

The analyzes were carried out using the Stata, version 13.0 (StataCorp LP, College Station, United States). The study was submitted for consideration by the Ethics Committee in Research with Human Beings of the Universidade Vila Velha (no. 1.751.120). Data were collected after signing the Informed Consent Form by the mother or guardian of the child during the study. The school authorized the realization of the project, signing a Term of Authorization.

Results

Table 1 shows the characteristics of the sample. Most were boys (51.6%), aged between 6 and 7 years (43.5%), non-white (66.5%), and only 1.3% had a low height for their age. Regarding weight, although a fifth of the participants were overweight, two-fifths were overweight (18.3%) or obese (20.4%), when classified according to BMI. The WC followed a similar pattern to weight, with one-fifth of the participants presenting it

above the expected standard for their age.

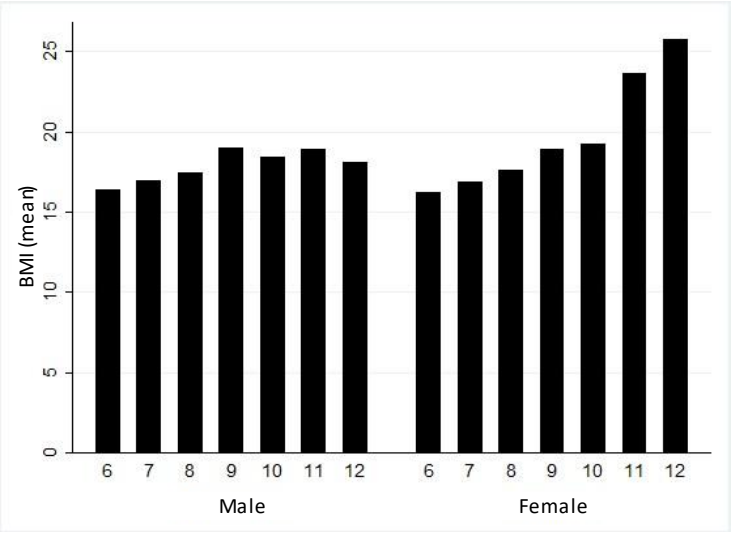
Table 1. Total distribution of students by sex according to age and classification of weight, height, body mass index, and waist circumference (n=1,116).

Variables	Male		Female		Total	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Age (year)		p=0.110†				
6-7	234	40.6 (36.7 – 44.7)	251	46.5 (42.3 – 50.7)	485	43.5 (40.6 – 46.4)
8-9	214	37.2 (33.3 – 41.2)	189	35.0 (31.1 – 39.1)	403	36.1 (33.3 – 39.0)
10-12	128	22.2 (19.0 – 25.8)	100	18.5 (15.4 – 22.0)	228	20.4 (18.2 – 22.9)
Skin color§		p=0.822†				
White	139	34.0 (29.5 – 38.7)	129	33.2 (28.6 – 38.0)	268	33.6 (30.4 – 36.9)
Not white	270	66.0 (61.3 – 70.5)	260	66.8 (62.0 – 71.4)	530	66.4 (63.1 – 69.6)
Weight (g)		p=0.630†				
Low	10	1.7 (0.9 – 3.2)	6	1.1 (0.5 – 2.5)	16	1.4 (0.9 – 2.3)
Adequate	453	78.7 (75.1 – 81.8)	422	78.2 (74.5 – 81.4)	875	78.4 (75.9 – 80.7)
High	113	19.6 (16,6 – 23,1)	112	20.7 (17.5 – 24.4)	225	20.2 (17.9 – 22.6)
Height (m)		p=0.466†				
Low	7	1.2 (0.6 – 2.5)	8	1.5 (0.7 – 2.9)	15	1.3 (0.8 – 2.2)
Adequate	478	83.0 (79.7 – 85.8)	460	85.2 (81.9 – 87.9)	938	84.1 (81.8 – 86.1)
High	91	15.8 (13.0 – 19.0)	72	13.3 (10.7 – 16.5)	163	14.6 (12.6 – 16.8)
BMI (kg/m²)		p=0.076†				
Thinness	28	4.9 (3.4 – 7.0)	15	2.8 (1.7 – 4.6)	43	3.8 (2.9 – 5.2)
Normal weight	316	54.9 (50.8 – 58.9)	325	60.2 (56.0 – 64.2)	641	57.5 (54.5 – 60.3)
Overweight	103	17.9 (15.0 – 21.2)	101	18.7 (15.6 – 22.2)	204	18.3 (16.1 – 20.7)
Obesity	129	22.2 (19.2 – 26.0)	99	18.3 (15.3 – 21.8)	228	20.4 (18.2 – 22.9)
WC (cm)		p=0.822†				
Adequate	460	79.9 (76.4 – 82.9)	435	80.6 (77.0 – 83.7)	901	80.3 (77.7 – 82.4)
High	116	20.1 (17.0 – 23.6)	105	19.4 (16.3 – 23.0)	221	19.7 (17.6 – 22.2)

§ Variable not recorded in the 2017 follow-up (n=798). † Chi-square test of heterogeneity. WC, waist circumference BMI, body mass index.

When analyzing the BMI according to the sex and age of the participants (Figure 1), a tendency for BMI to increase with increasing age is observed in girls. This trend was not observed in boys (p<0.001).

Figure 1. Mean BMI according to sex and age (n=1,116)§



§ p<0,001. Linear regression.

Table 2 shows the distribution of students present at the three monitoring moments (2017, 2018, and 2019). Differences in weight, height, and BMI were found in this period, however, no change in WC was observed. Such differences were due to the reduction in the prevalence of low weight, low height, and thinness. However, for BMI no changes in the prevalence of overweight and obesity, which remained above 40% in the three follow-ups.

Table 2. Distribution of students according to the classification of weight, height, BMI, and WC during follow-up (2017, 2018, and 2019) (n=133).

Variables	2017		2018		2019	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
Weight (g)[§]						
Low	2	1.5 (0.4 – 5.9)	3	2.3 (0.7 – 6.8)	1	0.8 (0.1 – 5.3)
Adequate	104	78.2 (70.3 – 84.5)	98	73.7 (65.4 – 80.5)	106	79.7 (71.9 – 85.8)
High	27	20.3 (14.2 – 28.1)	32	24.0 (17.5 – 32.1)	28	19.5 (13.6 – 27.3)
Height (m)[§]						
Low	5	3.8 (1.5 – 8.8)	1	0.8 (0.1 – 5.3)	1	0.8 (0.1 – 5.3)
Adequate	110	82.7 (75.2 – 88.3)	122	91.7 (85.6 – 95.4)	99	74.4 (66.2 – 81.2)
High	18	13.5 (8.6 – 20.6)	10	7.5 (4.1 – 13.5)	33	24.8 (18.1 – 32.9)
BMI (kg/m^2)[†]						
Thinness	6	4.5 (2.0 – 9.8)	4	3.0 (1.1 – 7.8)	0	-
Normal weight	67	50.4 (41.8 – 58.9)	71	53.4 (44.8 – 61.8)	71	53.4 (44.8 – 61.8)
Overweight	21	15.8 (10.5 – 23.1)	26	19.5 (13.6 – 27.3)	29	21.8 (15.5 – 29.7)
Obesity	39	29.3 (22.1 – 37.7)	32	24.1 (17.5 – 32.1)	33	24.8 (18.1 – 32.9)
WC (cm)[©]						
Adequate	111	83.5 (76.0 – 88.9)	97	72.9 (64.6 – 79.9)	102	76.7 (68.6 – 83.2)
High	22	16.5 (11.1 – 23.9)	36	27.1 (20.1 – 35.3)	31	23.3 (16.8 – 31.3)

[§] p<0,001. [†] p=0,001. [©] p>0,05. Chi-square test of heterogeneity. WC, waist circumference BMI, body mass index.

When analyzing the change in the individual pattern, comparing the student's classification in 2017 with that of 2019, more than a quarter of obese schoolchildren remained obese and a fifth became obese in this period, according to BMI. Regarding WC, 6% were above expectations and 17.3% increased WC to high, this increase being more frequent in boys.

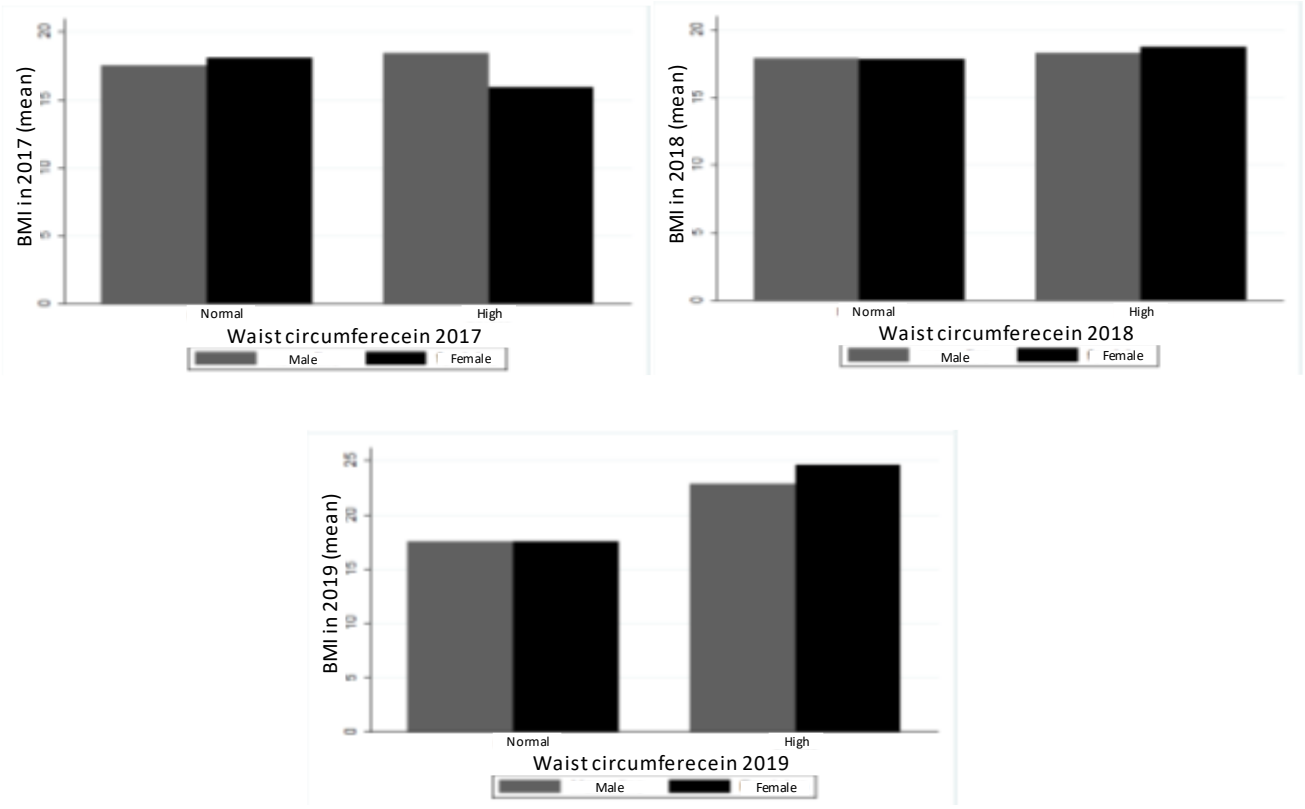
Table 3. Change in the BMI and WC classification of students from 2017 to 2019, according to the sex (n=133).

Variables	Male		Female		Total	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
BMI (kg/m^2)		p = 0.641[§]				
Never obese	20	29.8 (19.9 – 42.1)	25	37.9 (26.8 – 50.4)	45	33.8 (26.2 – 42.4)
Always obese	19	28.4 (18.7 – 40.6)	15	22.7 (14.0 – 34.7)	34	25.6 (18.8 – 33.7)
Not obese → obese	13	19.4 (11.4 – 30.9)	15	22.7 (14.0 – 34.7)	28	21.0 (14.9 – 28.9)
Obese → not obese	15	22.4 (13.8 – 34.2)	11	16.7 (9.3 – 28.0)	26	19.6 (13.6 – 27.3)
WC (cm)		p = 0.179[§]				
Always adequate	40	59.7 (47.3 – 71.0)	48	72.7 (60.4 – 82.3)	88	66.2 (57.6 – 73.8)
Adequate → high	15	22.3 (13.8 – 34.2)	8	12.1 (6.1 – 22.7)	23	17.3 (11.7 – 24.8)
High → adequate	6	9.0 (4.0 – 18.9)	8	12.1 (6.1 – 22.7)	14	10.5 (6.3 – 17.1)
Always high	6	9.0 (4.0 – 18.9)	2	3.1 (0.7 – 11.7)	8	6.0 (3.0 – 11.7)

[§] Chi-square test of heterogeneity. WC, waist circumference BMI, body mass index.

Figure 2 shows the relationship between BMI and WC in both sexes. Only in 2019, was there an increase in BMI with increasing WC in both genders (p<0.001). It's not was observed in 2017 (p=0.822) and 2018 (p=0.616).

Figure 2. Mean BMI according to the WC classification of students during follow-up (2017, 2018, and 2019) (n=133).



Discussion

This study showed that most schoolchildren were eutrophic, but more than a third were overweight according to BMI. This result was slightly higher than that found in a similar study carried out in a public school in the southern region of the country, where 30.1% of students were overweight according to the BMI classification.[16] This fact is worrying and puts health at risk. of these individuals, since it is known that obesity is a risk factor for the development of systemic diseases, including cardiovascular diseases.[17,18]

We note that this prevalence is still relatively lower when compared to studies carried out in countries with a pattern of development similar to Brazil. A study carried out in Buenos Aires[19] and another in Chile[20] found a very high prevalence of overweight in schoolchildren, 47.4% and 54.0%, respectively.

Meanwhile, underweight represented a minimal percentage of the sample, which in a way demonstrates the nutritional transition process that the country is going through,[21,22] given that currently, the prevalence of overweight has increased considerably to the detriment of the number of children. with low weight. This phenomenon may be related to the inadequate eating habits of the school population, who prefer foods with a high glycemic index, rich in sugars and fats, such as snacks, cookies or stuffed cookies, candies, and soft drinks. The intake of these foods is directly related to weight gain and nutrient deficiency since such foods have low nutritional value and demand excess calories from the body.[23,24]

Regarding height, most students had it classified as adequate for their age, although 15.8% of the boys were tall. The prevalence of low height was 1.2% in boys and 1.5% in girls, as in a cross-sectional study carried out with 20,133 schoolchildren aged between 3 and 17 years, which found a prevalence of low height of 1.3% and 1.6% for boys and girls, respectively.[25]

In our study, there was no difference in BMI between boys and girls, when analyzing the BMI classification for sex alone, which differs from national studies that indicate the male gender is associated with a higher prevalence of overweight.[25,26] However, when analyzing the mean BMI in relation to age and sex, there was a tendency for body mass gain with increasing age in girls, where the mean BMI was above 25 kg/m² at 12 years old. This finding allows us to infer a relationship

between this phase of life in which sexual maturation stands out, with the greatest gain in body mass in females.[27,28] However, did not occur in males.

In this study, no differences were found in BMI and WC about skin color in the three follow-ups, which differs from what was found in a national-based study with students from public and private schools, which identified a higher prevalence of overweight in adolescents self-declared black or indigenous,[22] as well as in a study carried out in a public school, where the highest prevalence of overweight/obesity was associated with non-white skin color.[16]

Regarding trend analysis, a study carried out in the south of the country analyzed the trend of nutritional status in schoolchildren aged 7 to 10 years[29] and identified a permanent increase in the prevalence of overweight during the period of analysis. However, in this study, a continuous pattern was not found in the three years of follow-up, despite an increase in the prevalence of overweight/obesity between the first and the last follow-up.

Regarding obesity, 25.6% of schoolchildren classified as obese in the first year of follow-up remained obese in the third year, regardless of whether they had increased their BMI or remained at baseline, which suggests that there is a tendency for this population to remain obese throughout their lives. A longitudinal study, with 153 children carried out in Spain, showed that obese women, from the age of six, had a higher risk of obesity at 18-19 years old.[30]

It is also worth mentioning that 21% of the students classified as non-obese changed to the obese profile, which shows the increasing prevalence of obesity reported in the literature in this population,[31,32] which may be a result of a new lifestyle, such as inadequate nutrition and sedentary behaviour.[31,33]

In our study, we did not analyze the socioeconomic variable, however, as it is a public teaching environment, we can infer that it is a middle/lower class public due to the relationship between public schools and low socioeconomic status. In this context, as reported by national studies,[16,22] there is a higher prevalence of overweight/obesity in individuals from lower economic classes, which may be related to the high prevalence of overweight in our study. However, several other national studies with children aged between 7 and 10 years old found a higher prevalence of overweight in private schools, compared to public schools,[34,35] which raises doubts as to whether there are other determinants for the divergence of these results.

In this study, WC did not differ between both sex and did not show a tendency to increase over the years of the study. BMI and WC were related only at the last follow-up, where boys and girls with high WC had the highest BMI means, compared to those with normal WC. This result is in agreement with a population-based study carried out with schoolchildren in Piauí, where obese and overweight students had higher mean WC compared to normal-weight and low-weight schoolchildren[36], which shows that children with higher BMI tend to present a higher AC due to fat deposition in the abdominal region, as well as a risk for the development of cardiometabolic diseases[37,38]. However, the fact that this pattern was not repeated in all the years of follow-up may be related to some limitations of this study, since, for the trend analysis, only the participants present in the three follow-ups were included, which reduced the study sample size and may have limited statistical power in finding differences between groups.

Another limitation was the lack of recording of the skin color variable in the first year of follow-up, which may have reduced the power to find differences between students with white and non-white skin color. Also, noteworthy as an important limitation is the fact that it is a student sample from a single school, which limits its representativeness for the rest of the municipality or state in which the study took place.

Among the strengths of this study, we can mention the collection environment and the prospective approach to the sample, three-year follow-up, and analysis through a trend study for participants who were present throughout the study time. Another advantage is the fact that field researchers have been rigorously trained to collect data and used calibrated and certified equipment, which reduces information bias. Having investigated WC is also another positive point, since it is a variable that has not yet been investigated in children and adolescents and, given its importance in the assessment of cardiovascular risk in adults,[15] it becomes an important variable to be evaluated in this period of life.

Conclusion

In view of the investigation, a high prevalence of overweight was observed, while low weight was little identified in the students evaluated. Weight gain was related to an increase in WC in boys and girls. It is worth highlighting the importance of actions to encourage healthy habits in this population, to reduce the prevalence of obesity, which is currently a major concern in Brazilian public health.

Conflict of interest

The authors declare that there is no potential conflict of interest.

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