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Nutritional status of schoolchildren aged 7-10 years enrolled in public and private schools of *Cascavel, Paraná, Brazil*

Estado nutricional de escolares de sete a 10 anos de escolas públicas e privadas de Cascavel, Paraná, Brasil

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ABSTRACT

Objective

To analyze the prevalence of malnutrition, overweight, and obesity in schoolchildren aged 7-10 years from public and private schools of *Cascavel, Paraná, Brazil*.

Methods

Demographic information (sex, age, and type of school) and anthropometric measurements (body mass and height) were collected from 2,180 students (1,693 from public schools and 487 from private schools). The nutritional status of the children was classified according to their body mass index Z-score.

Results

The prevalences of malnutrition, overweight, and obesity were 6.1%, 9.8% and 11.1%, respectively. Girls were 15.9% more likely to be malnourished than boys. As for overweight, 10-year-olds were 1.53 times more

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likely to be overweight than 7-year-olds. Children from private schools were 1.63 times more likely to be overweight and 2.88 times more likely to be obese than their public school peers.

Conclusion

The prevalence of malnutrition and excess weight (overweight and obesity) were high, and girls were more likely to be malnourished. Ten-year-olds and children from private schools were the most affected by overweight and obesity.

Keywords: Malnutrition. Obesity. Overweight. Health children.

RESUMO

Objetivo

Analisar a prevalência de desnutrição, sobrepeso e obesidade em escolares de sete a 10 anos em estudantes de escolas públicas e privadas de Cascavel, Paraná, Brasil.

Métodos

Informações demográficas (sexo, idade e rede de ensino) e medidas antropométricas (massa corporal e estatura) foram obtidas de 2 180 escolares (1 693 de escolas públicas e 487 de privadas). Os valores do Escore-Z do índice de massa corporal foram adotados para a determinação do estado nutricional.

Resultados

As taxas de prevalência de desnutrição, sobrepeso e obesidade foram na ordem de 6,1%, 9,8% e 11,1%, respectivamente. As meninas apresentaram mais chances (15,9 vezes) para o desenvolvimento de desnutrição do que os meninos. Por outro lado, crianças de 10 anos apresentaram mais chances (1,53 vezes) para desenvolverem sobrepeso em relação aos seus pares de sete anos. Adicionalmente, crianças de escolas privadas apresentaram mais chances para o desenvolvimento de sobrepeso (1,63 vezes) ou obesidade (2,88 vezes), em relação aos seus respectivos pares de escolas públicas.

Conclusão

As taxas de prevalência de desnutrição e excesso de peso reveladas neste estudo foram elevadas, com as meninas apresentando mais chances para tornarem-se desnutridas do que os meninos. Em contrapartida, tanto o sobrepeso quanto a obesidade foram fenômenos mais frequentemente observados aos 10 anos, em escolares de ambos os sexos e naqueles matriculados na rede privada de ensino.

Palavras-chave: Desnutrição. Obesidade. Sobrepeso. Saúde da criança.

INTRODUCTION

The nutritional status of children and adolescents has been the target of numerous Brazilian¹⁻⁴ and international⁵⁻⁸ studies. These data are critical because of the influence of underweight and excess weight (overweight and obesity) on the risk of early-onset metabolic disorders and chronic noncommunicable diseases^{1,3}.

In this sense, a gradual reduction in the prevalence of malnutrition has been observed in Brazilian children aged 5-10 years¹. The *Pesquisa Nacional de Orçamentos Familiares*² found that the prevalence of malnourished males decreased

from 5% to 2% from 1974/1975 to 1989, and increased to 4% in 2008/2009. Similarly, the prevalence of malnourished females decreased from 5.4% to 1.5% from 1974/1975 to 1989, and increased to 3.9% in 2008/2009. These data diverge from African data, where malnutrition continues to be an important public health problem^{9,10}.

On the other hand, a significant increase in the prevalence of overweight and obesity has been observed in Brazilian children aged 5-10 years¹. From 1974/1975 to 2008/2009, the prevalence of overweight males increased from 10.9% to 34.8%, and that of overweight females, from 8.6% to 32.0%. During the same period, the

prevalence of obese males increased from 2.9% to 16.6%, and that of obese females, from 1.8% to 11.8%¹. A recent Brazilian meta-analysis about obesity in children and adolescents found a prevalence of 14.1%, which did not differ by sex (16.1% vs. 15.0%, respectively)⁴.

In Brazil childhood overweight and obesity are important public health problems that affect children of all ages, more in the South and Southeast regions than in the North/Northeast regions, probably because of the socioeconomic differences between the populations living in these regions^{1,3}. Moreover, a higher prevalence of overweight and obesity has been observed in children from private schools compared with children from public schools^{2,3,11}. This phenomenon deserves attention and its analysis may promote the establishment of specific intervention actions¹²⁻¹⁴.

Based on the supposition that the prevalences of underweight, overweight, and obesity can be affected by sociodemographic and behavioral factors, the purpose of this study was to analyze the prevalence of malnutrition, overweight, and obesity, and the associated factors in a representative sample of schoolchildren aged 7 to 10 years from public and private schools of *Cascavel* (PR), Brazil. The initial hypotheses of this study were that children from public schools should have a higher prevalence of malnutrition and that children from private schools should have higher prevalences of overweight and obesity, regardless of gender.

METHODS

The municipality of *Cascavel* is in the western region of the state of *Paraná*, ranking sixth in the state with respect to demographics. The estimated population is 309,259 inhabitants¹⁵. *Cascavel* has a Municipal Human Development Index of 0.692, ranking fifteenth in the state. The local population descends mostly from Italian, German, and Polish immigrants. The number of first graders to fourth graders aged seven to ten

years old, respectively, is estimated to be 21,763 according to the municipal School Census, of which 19,030 are enrolled in public schools and 2,733, in private schools. The municipality was divided into five quadrants for selecting the study schools: North, South, East, West, and Downtown. An urban public school was then randomly selected from each quadrant (n=5), and five private schools were sampled by convenience.

The sample size was determined as suggested by the literature¹⁶, using a confidence level of 1.96 (95% Confidence Interval [95%CI]), an error of 3%, a prevalence of 50% (unknown outcome), and a design effect of 1.5. Thus, the minimum sample size estimated for this study was 1,526 children. To compensate for students who might refuse to participate in the study, an extra 20% was added, so the sample consisted of 1,831 students.

All children aged 7 to 10 years enrolled in the selected schools in 2004 were eligible for the study. The inclusion criteria were: 1) self-reported good health (not taking any medication frequently or not being treated for some disease) and 2) provided an informed consent form signed by the parents or guardians. The exclusion criteria were: 1) voluntary refusal to participate in the study and 2) absent from school on the data collection day. Hence, the total sample consisted of 2,180 students (Table 1), of which 1,693 (887 boys and 806 girls) and 487 (226 boys and 261 girls) were from public and private schools, respectively. This study is part of the project "*Crescimento e aptidão física relacionada à saúde em escolares do município de Cascavel, PR*" (Growth and physical aptitude related to health in schoolchildren from the municipality of *Cascavel*, PR). After being informed about the objective of the present study and the respective procedures, all parents or guardians signed an informed consent form. This study complied with the Declaration of Helsinki and was approved by the Research Ethics Committee of the *Universidade Estadual do Oeste do Paraná* (State University of Western Paraná) (Opinion 126/2004-CEP/CCBS).

Table 1. Distribution of the sample by age, gender, and type of school.

	Female (n=1.065)		Male (n=1.115)	
	n	(%)	n	(%)
<i>Age (years)</i>				
7	296	27.8	291	26.1
8	272	25.5	279	25.0
9	281	26.4	299	26.8
10	216	20.3	246	22.1
<i>Type of school</i>				
Public	806	75.7	887	79.6
Private	259	24.3	228	20.4

Demographic data (gender, age, and type of school) and anthropometric measurements (body mass and height) were collected from all participants. Body mass was measured by a digital scale (*Filizola*TM, São Paulo, SP, Brazil), with accuracy of 0.1 kg and capacity of 150 kg, and height was measured by the compact wall-mounted stadiometer SECA Corporation, (SECA 220, model 206, Hamburg Germany) with accuracy of 0.1 cm and length of 2.20 meters¹⁷. Body Mass Index (BMI) was given by dividing the body mass in kilograms (kg) by the square of the height in meters (m).

The nutritional status of the children was classified according to BMI Z-score as follows¹⁸.

- (a) Underweight (Z-score <-2);
- (b) Normal weight (-2 < Z-score <+1);
- (c) Overweight (+1 < Z-score <+2);
- (d) Obesity (Z-score >+2).

Descriptive procedures were used initially to represent the schoolchildren from public and private schools. The independent samples *t*-test identified the differences between the groups. Overweight and obesity prevalences were established according to the study variables (sex, age, and type of school). Since the dependent variable (nutritional status) consisted of four categories (normal weight, malnutrition, overweight, and obesity), multinomial logistic regression was used for estimating the association

between nutritional status and the independent variables (gender, age, and type of school). The normal weight category was defined as the reference group. The analyses were adjusted for all variables, regardless of *p* value. All analyses used a significance level of 5% (95%CI). The analyses were performed by the software Statistical Package for the Social Sciences for Windows, version 20.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

Table 2 shows the general characteristics of the sample. Students from private schools had statistically higher body mass, height, and body mass index than those from public schools ($p < 0.05$).

Figure 1 shows the BMI Z-scores of the entire sample.

The study prevalences for malnutrition, overweight, and obesity were 6.1%, 9.8%, and 11.1%, respectively (Table 3). Girls (11.6%), children aged 7 to 8 years (7.5% and 7.8%, respectively), and children from public schools (6.2%) had higher prevalences of malnutrition. Overweight was more prevalent in boys (11.2%), children aged 8 years (12.0%), and children from private schools (11.9%). Obesity was more prevalent in girls (14.8%), children aged 10 years (14.1%), and children from private schools (17.5%).

Table 4 shows the odds *ratios* for malnutrition, overweight, and obesity. Malnutrition was associated with gender, indicating that girls were 15.9 times more likely to be malnourished than boys. Overweight was associated with age, indicating that 10-year-olds were 1.53 times more likely to be overweight than seven-year-olds. Additionally, children from private schools were 1.63 and 2.88 times more likely to be overweight and obese, respectively, than their public school peers.

Table 2. General characteristics of schoolchildren from *Cascavel* (PR), Brazil, by age, gender, and type of school (private and public).

Variable	Female				p	Male				p
	Private		Public			Private		Public		
	M	SD	M	SD		M	SD	M	SD	
<i>Body mass (kg)</i>										
7	26.9	7.4	22.3	4.3	<0.001	25.8	5.6	22.8	4.0	<0.001
8	28.7	5.7	25.2	4.8	<0.001	30.1	7.6	26.0	5.2	<0.001
9	29.9	5.6	27.9	5.4	<0.01	33.2	7.6	29.2	6.1	<0.001
10	35.3	10.1	32.2	7.1	<0.05	36.5	7.9	32.4	7.5	<0.001
<i>Height (cm)</i>										
7	126.9	8.2	119.8	6.0	<0.001	124.8	6.8	120.9	5.7	<0.001
8	131.9	6.4	126.1	5.6	<0.001	132.6	6.6	126.9	5.6	<0.001
9	133.9	5.9	131.6	5.5	<0.01	136.6	6.1	132.8	6.1	<0.001
10	140.3	7.1	137.4	7.2	<0.05	140.9	5.9	136.8	6.7	<0.001
<i>BMI (kg/m²)</i>										
7	16.4	2.9	15.5	2.0	<0.05	16.5	2.7	15.6	1.8	<0.05
8	16.4	2.5	15.8	2.3	0.05	16.9	3.0	16.0	2.3	<0.05
9	16.6	2.5	16.0	2.4	0.10	17.7	3.1	16.5	2.6	<0.01
10	17.7	3.8	17.0	2.8	0.09	18.3	3.3	17.2	3.0	<0.05

Note: Values expressed as mean ± standard deviation.

M: Mean; SD: Standard Deviation; BMI: Body Mass Index.

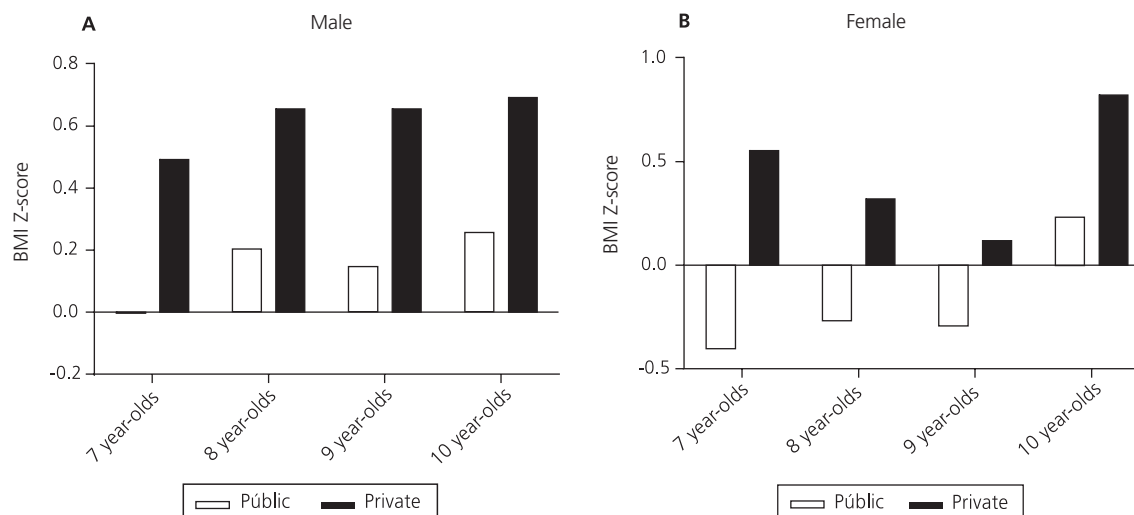


Figure 1. Body mass index Z-scores of male (A) and female (B) schoolchildren from private and public schools.

DISCUSSION

The main study findings were: (a) the prevalences of malnutrition, overweight, and obesity were 6.1%, 9.8%, and 11.1%, respectively; (b) females were more likely to be malnourished than males; (c) 10-year-olds and students from

private schools were more likely to be overweight than 7-year-olds and students from public schools; and (d) 10-year-olds and students from private schools were more likely to be obese than 7-year-olds and students from public schools.

Although childhood malnutrition decreased in Brazil in the last years¹, the present result

Table 3. Nutritional status of schoolchildren from *Cascavel* (PR), Brazil, by age, gender, and type of school.

Variable	Normal weight		Underweight		Overweight		Obese	
	%	95%CI	%	95%CI	%	95%CI	%	95%CI
<i>Gender</i>								
Male	80.4	79.0-82.0	0.9	0.9-1.0	11.2	9.9-12.3	7.4	7.1-7.4
Female	65.2	63.2-66.9	11.6	10.4-12.9	8.4	8.2-8.5	14.8	13.3-16.0
<i>Age (years)</i>								
7	74.6	72.8-76.1	7.5	7.4-7.7	8.7	8.6-8.8	9.2	9.1-9.3
8	69.3	67.4-70.9	7.8	7.6-8.0	12.0	10.7-13.1	10.9	9.6-12.0
9	75.5	74.1-77.5	5.2	4.9-5.3	8.6	8.6-8.8	10.7	9.0-11.2
10	72.1	70.2-73.7	3.7	3.5-3.9	10.2	9.0-11.2	14.1	12.6-15.4
<i>Type of school</i>								
Public	75.4	73.7-77.0	6.2	6.0-6.4	9.2	9.1-9.3	9.2	9.0-9.2
Private	64.7	62.7-66.6	6.0	5.8-6.2	11.9	10.6-13.0	17.5	15.9-18.9
Total	73.0	71.3-74.6	6.1	6.0-6.4	9.8	9.7-9.9	11.1	9.6-12.0

Note: %: relative frequency.

95%CI: 95% Confidence Interval.

Table 4. Association between nutritional status and sociodemographic factors in schoolchildren from *Cascavel* (PR), Brazil, by gender, age, and type of school.

	Underweight		Overweight		Obese	
	OR	IC95%	OR	IC95%	OR	IC95%
<i>Gender</i>						
Male	1.00		1.00		1.00	
Female	15.9	8.28-30.52	1.07	0.81-1.41	0.69	0.43-1.10
<i>Age (years)</i>						
7	1.00		1.00		1.00	
8	1.35	0.96-1.90	1.08	0.73-1.61	1.23	0.66-2.30
9	1.13	0.80-1.60	1.03	0.69-1.53	0.92	0.48-1.78
10	1.25	0.87-1.79	1.53	1.04-2.26	1.17	0.60-2.29
<i>Type of school</i>						
Public	1.00		1.00		1.00	
Private	0.82	0.60-1.12	1.63	1.20-2.22	2.88	1.80-4.61

Note: The normal weight group was defined as reference.

OR: Odds Ratio; 95%CI: 95% Confidence Interval.

indicates a prevalence of malnutrition of 6.1% in the municipality of *Cascavel* (PR), so apparently it continues to be an important public health problem. Cases of malnutrition seem to recur in the state^{19,20}, as shown by a study from the municipality of *Maringá* with 4,609 students aged 6 to 11 years¹⁹, which reported a prevalence of malnutrition of 8.0%, higher than the study prevalence and the Brazilian mean (4.1%)¹. In addition a study from *Arapoti* (PR)²⁰ with 1,647 children aged 6 to 10 years found a prevalence

of malnutrition (22.7%) approximately five times higher than the Brazilian mean, which reinforces the concern with this outcome in the interior of *Paraná*, especially because of the problems caused by malnutrition on childhood development, such as delayed growth and development, neuromotor and intellectual involvement, and low immune function²¹.

These findings show that malnutrition has not been eliminated in Brazil as this outcome still occurs frequently in children. Malnutrition has

many causes, mainly quality of basic sanitation and household socioeconomic status¹. In this study, malnutrition was associated with sex: girls were 16 times more likely to be malnourished. This result is consistent with studies with children from other countries, such as Italy⁸ and Iran²². Although other factors related to malnutrition were not investigated, one cannot discard the possible influence of maternal behavior on the nutritional status of their children²³, since they tend to perceive excess weight in their daughters negatively, probably because of the image attributed by society to the female shape²⁴. On the other hand, from the maternal viewpoint, male children should have a vigorous body, with great dimensions²⁵.

In our study, overweight and obesity prevalence rates were 9.8% and 11.1%, respectively. These prevalence rates are lower than the national prevalences for overweight (33.5%) and obesity (14.3%) in children aged 5 to 9 years¹, and lower than the prevalence of overweight (17%), but not of obesity (7%), in children aged 6 to 10 years from the municipality of *Maringá*, located in the north of *Paraná*²⁶. Moreover, the study prevalence rate of obesity was lower than the 14.1% found by a recent meta-analysis of Brazilian children and adolescents⁴. These differences may be related to behavioral determinants, such as time spent on computer games and boys' easy access to unhealthy foods, since girls are more selective about healthy foods^{2,6,7}. However, the present study did not target these determinants for analysis.

Although the prevalence of excess weight (overweight and obesity) is a typical characteristics of middle-income countries^{8,21}, this scenario may be partly justified by the Brazilian food profile, which is high in animal fat and commercially processed foods, factors apparently associated with higher socioeconomic status^{2,11,12,21,27}. Such factors contribute not only to the accumulation of body fat but also to the development of numerous disorders, and chronic and degenerative diseases, such as diabetes, high blood pressure,

dyslipidemia, and cardiopathy⁵. Even though food intake and level of physical activity have not been controlled for in the study sample, there is plenty of evidence in the literature that an inappropriate diet is specifically associated with better socioeconomic status, being one of the causes of weight gain².

Our study found a higher prevalence of obesity in girls, which is in disagreement with a higher nationwide prevalence of obesity in males (~16%)^{1,4}. Nonetheless, other municipalities in the state of *Paraná*, such as *Apucarana* (PR)²⁸ and *Arapoti* (PR)²¹, found similar prevalences of obesity.

Another important aspect found by the present study was the association between overweight and age, as 10-year-olds were 1.53 times more likely to be overweight than 7-year-olds. This finding corroborates other Brazilian studies that found a higher prevalence of overweight (35.6%) in 9-year-olds¹. However, there is no literature consensus on any specific age group as predictor of overweight and/or obesity. This fact may be illustrated by the situation in Kenya, where the prevalence of obesity (31%) was greater in children aged 5 to 9 years¹⁰. On the other hand, the highest prevalence of obesity in Thailand (20.9%) was found in children with a mean age of 10.3 years⁵. Similarly, in *Florianópolis* (SC), Brazil, the highest prevalence of obesity (11.2%) was found in adolescents aged 10 to 17 years²⁹.

Salomons *et al.*²⁰ found overweight and obesity prevalences of 19.5% and 22.2%, respectively, in children aged 6 to 10 years from *Paraná*, regardless of age. These data reinforce the hypothesis that the problem of childhood obesity in Brazil affects children of all age groups³.

Regarding type of school, children from private schools were almost three times more likely to develop obesity than their public school peers, corroborating Miranda *et al.*¹¹, who found higher prevalences of overweight (22.6%) and obesity (33.4%) in children aged 8 to 10 years from private schools. These differences were also

found in other Brazilian municipalities^{3,13}. Yet, a study from *Rio de Janeiro* (RJ) did not find different nutritional status in children aged 5 to 10 years from public and private schools¹². This outcome may be related to a set of variables associated with socioeconomic level, so children from private schools are more likely to develop sedentary behavior and buy food at the school snack bar¹²⁻¹⁴.

This fact reinforces the need of adopting healthy food habits, especially during childhood, given the obesity-related risks, which may increase later in life²⁶. In this sense, schools can play an essential role in health promotion, encouraging the adoption of healthy habits, autonomy, and biopsychosocial potentialities³⁰.

Until now most Brazilian studies on children's nutritional status have nothing but confirmed the literature reports of the growing obesity rates. Nevertheless, the present study emphasized the high prevalence of malnutrition in children from *Cascavel*, PR. Hence, the present results may encourage the establishment of public policies that aim to fight malnutrition, especially in this municipality, and of preventive measures that reduce overweight and obesity by adopting strategies that increase the level of physical activity, improve the healthiness of foods sold in school snack bars, and reduce sedentary behavior by practicing educational activities.

The present study has some limitations that cannot be ignored. The absence of information about sociocultural factors, food habits, sexual maturation (especially in children aged 9 to 10 years), habitual level of physical activity, and sedentary behavior may have important implications on children's nutritional status. What is more, the sample composition did not respect the proportion of public-to-private school students, since this proportion was 0.14 in the population and 0.29 in the sample. Therefore, it is possible that the study sample size may explain some of the differences between private and public schools. Nonetheless, the present study was concerned with analyzing the behavior of both boys and girls, from public

and private schools. Additionally, the inclusion of schools located in different regions and the high number of study children enabled the production of data more representative of the municipality of *Cascavel* (PR), Brazil.

CONCLUSION

This study found prevalence rates of malnutrition, overweight, and obesity of 6.1%, 9.8%, and 11.1%, respectively, in schools in the municipality of *Cascavel* (PR), Brazil. Moreover, the greatest difference between students from public and private schools regarded the prevalence of obesity (public=9.2% vs. private=17.5%). On the other hand, girls were more likely to be malnourished, and 10-year-olds were more likely to be overweight than 7-year-olds. Finally, private school children were 1.63 and 2.88 times more likely to develop overweight and obesity, respectively.

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CONTRIBUTIONS

KES SILVA, AA BARROS FILHO, and ES CYRINO were the intellectual mentors of the study. AA BARROS FILHO and ES CYRINO advised the study team. KES SILVA and A PELEGRINI collected data. KES SILVA, A PELEGRINI, AA PINTO, and ERV RONQUE identified studies to include in the manuscript contextualization/discussion. KES SILVA, A PELEGRINI, AA PINTO, and ERV RONQUE performed data tabulation and/or analysis. All authors contributed to data interpretation, and initial writing and final review of the manuscript.

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