Overweight and obesity in brazilian schoolchildren aged 10 to 15 years: data from a Brazilian sports project

Andreia Pelegrini, Edio Luiz Petroski, Raildo da Silva Coqueiro, Adroaldo César Araujo Gaya

Núcleo de Pesquisa em Cineantropometria e Desempenho Humano, Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brazil. Laboratório de Pesquisa do Exercício da Escola de Educação Física, Universidade Federal do Estado do Rio Grande do Sul, Brazil

SUMMARY. The objective of this study was to determine the prevalence of overweight and obesity among Brazilian schoolchildren according to gender, age and geographic region. A descriptive association study was conducted on 36,976 schoolchildren (20,914 boys and 16,062 girls aged 10 to 15 years) between 2004 and 2005 using secondary data originating from a school-based cross-sectional epidemiological survey. The cut-off body mass index proposed by the International Obesity Task Force was used as diagnostic criterion for overweight and obesity. The prevalence of overweight and obesity was 11.9% and 2.6%, respectively, with a higher proportion of overweight among girls and of obesity among boys. An association was observed between overweight, age and region, with the demonstration of higher odds ratios for overweight among children aged 10 to 13 years and children from the South, Center-West and Southeast regions. Obesity was significantly associated with gender, age and region, indicating higher odds ratios among boys, children aged 10 to 13 years and children from the South and Southeast regions. Although lower than that observed in most developed countries, the prevalence of overweight and obesity among Brazilian schoolchildren is a matter of concern. In this respect, health policies and strategies should take into account gender and age of the individuals and geographic region of the country.
Key words: Nutritional status, body mass index, adolescent health, overweight, obesity.

RESUMO. Sobrepeso e obesidade em escolares brasileiros de 10 a 15 anos: dados do projeto esporte Brasil. O objetivo desse trabalho foi determinar a prevalência de sobrepeso e obesidade em escolares brasileiros, de acordo com sexo, idade e região geográfica. Trata-se de estudo descritivo e de associação, baseado em dados secundários originados de estudo epidemiológico transversal, de base escolar, conduzido em 36.976 escolares (20.914 do sexo masculino e 16.062 do sexo feminino; 10 a 15 anos), entre 2004 e 2005. Como critério de diagnóstico de sobrepeso e obesidade, utilizou-se os pontos de corte do índice de massa corporal, propostos pela *International Obesity Task Force*. A prevalência de sobrepeso e obesidade foi de 11,9% e 2,6%, respectivamente, com proporção mais elevada de sobrepeso no sexo feminino, e de obesidade, no masculino. Foi encontrada associação entre sobrepeso, idade e região, demonstrando que as *odds ratios para* sobrepeso são maiores nas idades de 10 a 13 anos e nas regiões Sul, Centro-Oeste e Sudeste. A obesidade foi significativamente associada com sexo, idade e região. Esses achados apontaram que as *odds ratios para* obesidade foi maior nos escolares do sexo masculino, nas idades de 10 a 13 anos e nas regiões Sul e Sudeste. A prevalência de sobrepeso e obesidade encontrada nos escolares brasileiros, apesar de ser menor do que a encontrada na maioria dos países desenvolvidos é preocupante. Políticas e estratégias de saúde devem considerar o sexo, idade e região geográfica do país.
Palavras-chave: Estado nutricional, indice de massa corporal, saúde do adolescente, sobrepeso, obesidade.

INTRODUCTION

With the decline in infectious diseases, excess body weight in the form of overweight and obesity is becoming one of the main public health threats worldwide, reaching alarming proportions in all age groups (1). However, concern regarding this event in younger ages has received special attention since obesity acquired during infancy and adolescence tends to persist into adult life (2).

Recent studies have shown that excess weight, particularly obesity, has led to a progressive increase in morbidity and mortality (3,4) because of its close relationship with the development of cardiovascular and metabolic diseases (5,6). As a consequence, there is growing concern on the part of government health agencies (1) and costs for the public health system are rising (7).

The prevalence of overweight in North-American children (6-11 years) and adolescents (12-19 years) has increased drastically between the 1960s and 1990s (8). In a multicenter study including a representative sample of children and adolescents from the United States, Brazil, China and Russia, Wang et al (9) observed an increasing trend of obesity. For the Brazilian sample, the results showed that malnutrition decreased between 1974 and 1997, whereas overweight tripled during the same period.

In Brazil, several regional studies have investigated the prevalence of overweight and/or obesity in adolescents. These studies suggest that the prevalence of these outcomes varies

according to geographic region, gender and age, and is also influenced by other sociodemographic factors (10-21). Epidemiological studies on the prevalence of overweight and obesity among adolescents involving a large sample are still scarce in Brazil, thus demonstrating that the prevalence of excess weight is still not well established.

In this respect, the objectives of the present study were (i) to investigate the prevalence of overweight and obesity among Brazilian schoolchildren according to gender, age and geographic region, and (ii) to determine the association between these outcomes and gender, age and geographic region.

MATERIALS AND METHODS

For the present descriptive association study secondary data extracted from a school-based cross-sectional survey, called Projeto Esporte Brasil (PROESP-BR), were used. The latter is a permanent observatory of growth indicators, somatomotor development and nutritional status of Brazilian children and adolescents aged 7 to 17 years, which is part of a series of projects conducted by the network of Centros de Excelência Esportiva (CENESP), connected to the Departamento de Excelência Esportiva e Promoção de Eventos, Secretaria Nacional de Esporte de Rendimento, Ministério do Esporte. More detailed information on the concept and methodological aspects of PROESP-BR has been described elsewhere (22).

The study population consisted of schoolchildren ranging in age from 10 to 15 years enrolled in public and private Brazilian schools. The sample comprised all schoolchildren examined in 2004 and 2005 (n = 37,103). Subjects with a body mass index (BMI) below or above 4 standard deviations in relation to the mean were excluded. The non-conventional value of ± 4 standard deviations was chosen to preserve as much as possible the heterogeneity of the sample. Thus, the final sample consisted of 36,976 schoolchildren, corresponding to 99.7% of individuals available in the database.

Anthropometry and demographic data
The anthropometric and demographic data were collected by the physical education teachers of each school enrolled in PROESP-BR. All teachers had been previously trained and had access to instructions regarding the application of the tests and measurements through an Internet site (www. proesp.ufrgs.br), which included a videotape prepared by the members of the School of Physical Education of Universidade Federal do Rio Grande do Sul for standardization and better visual presentation of the measurement techniques (22).

The following variables were used in this study: body weight and height [for the calculation of body mass index (BMI = kg/m^2)], age, gender and geographic region. International cut-off BMI values were used for the evaluation of nutritional status (23). Since only overweight and obesity were evaluated

in this study, "normal weight" was defined as a BMI of less than 25 kg/m^2 for each age and gender.

Statistical analysis
The sample was first described according to gender. Next, the prevalence rates of overweight and obesity according to the variables analyzed (gender, age and region) were calculated for the study population. Differences in prevalence rates were determined by a comparison of proportions test, considering a 95% confidence interval (95%CI).

Since the dependent variable (nutritional status) consisted of three categories ("normal weight", overweight and obesity), multinomial logistic regression was used to estimate the association between nutritional status and the independent variables (gender, age and geographic region). The category "normal weight" was adopted as a reference. In all analyses, gender was used as a dichotomous variable: male and female. The other variables were divided into strata: age: 10, 11, 12, 13, 14 and 15 years, and geographic region: North, Northeast, Center-West, Southeast, and South. A level of significance of 5% (p < 0.05, or 95%CI) was adopted in all analyses. Data were analyzed statistically using the SPSS, version 13.0, and MedCalc programs.

RESULTS

A total of 36,976 Brazilian schoolchildren were included in the study. The characteristics of the sample are shown in Table 1. As can be seen, boys presented a slightly higher age, body weight and height, whereas BMI was slightly higher among girls. Distribution according to age and geographic region was similar for the two genders.

TABLE 1

Mean ± standard deviation and percentage
of the variables analyzed

Variable	Boys (n = 20,914)	Girls (n = 16,062)	Total (n = 36,976)
Age (years)	12.41 ± 1.56	12.29 ± 1.52	12.36 ± 1.54
Body weight (kg)	45.13 ± 12.56	44.90 ± 10.42	45.03 ± 11.68
Height (m)	1.55 ± 0.13	1.54 ± 0.09	1.54 ± 0.11
BMI (kg/m²)	18.45 ± 3.15	18.85 ± 3.20	18.63 ± 3.18
Age (years)			
10	13.6	13.5	13.5
11	18.3	21.1	19.5
12	20.4	22.3	21.2
13	19.6	18.8	19.3
14	16.8	15.1	16.1
15	11.2	9.4	10.4
Region			
North	9.7	10.7	10.1
Northeast	15.6	14.4	15.1
Center-West	17.5	16.2	16.9
Southeast	39.3	36.2	38.0
South	18.0	22.6	20.0

The prevalence of overweight and obesity obtained for each category of the different variables analyzed, as well as for the total population studied, is shown in Table 2. With respect to gender, a higher prevalence of overweight was observed among girls and the prevalence of obesity was higher among boys. Regarding age, a higher prevalence of overweight was observed in the 11-year age group, followed by a progressive decrease at subsequent ages. Obesity was more prevalent in the 10-year age group and also decreased progressively with age. With respect to geographic region, higher prevalence rates of overweight and obesity were observed in the South region; the lowest prevalence of overweight was found in the North region and the lowest prevalence of obesity in the North and Northeast regions.

TABLE 2

Prevalence of overweight and obesity according to associated factors

Variable	Nutritional status					
	Normal weight		Overweight		Obesity	
	P*	95%CI	P*	95%CI	P*	95%CI
Gender						
Male	85.5[a]	85.1-85.9	11.6[a]	11.3-11.9	2.9[a]	2.7-3.1
Female	85.5[a]	85.1-85.9	12.3[b]	12.0-12.6	2.3[b]	2.2-2.5
Age (years)						
10	83.4[a]	83.0-83.8	11.8[a]	11.5-12.1	4.8[a]	4.6-5.0
11	83.2[a]	82.8-83.6	13.8[b]	13.5-14.2	3.0[b]	2.8-3.2
12	84.5[b]	84.1-84.9	12.8[c]	12.5-13.1	2.7[b]	2.5-2.9
13	86.4[c]	86.0-86.7	11.4[a]	11.1-11.7	2.2[c]	2.1-2.4
14	88.1[d]	87.8-88.4	10.4[d]	10.1-10.7	1.6[d]	1.5-1.7
15	89.0[e]	88.7-89.3	9.8[d]	9.5-10.1	1.2[e]	1.1-1.3
Region						
North	89.1[a]	88.8-89.4	9.0[a]	8.7-9.3	1.9[a]	1.8-2.0
Northeast	87.6[b]	87.3-87.9	10.5[b]	10.2-10.8	1.9[a]	1.8-2.0
Center-West	86.1[c]	85.7-86.4	11.5[c]	11.2-11.8	2.3[b]	2.2-2.5
Southeast	86.3[c]	85.9-86.6	11.0[bc]	10.7-11.3	2.6[b]	2.4-2.8
South	80.0[d]	79.6-80.4	16.4[d]	16.0-16.8	3.6[c]	3.4-3.8
Total	85.5	85.1-89.9	11.9	11.6-12.2	2.6	2.4-2.8

P: prevalence; 95%CI: 95% confidence interval.
* Values followed by different superscript letters were significantly different
(comparison of proportions test, 95%CI).

The prevalence of overweight and obesity obtained for each category of the variables age and geographic region according to gender are shown in Tables 3 and 4. Among boys, the highest frequency of overweight and obesity was observed at 11 and 10 years of age, respectively, with both decreasing progressively with age. Among girls, the prevalence of overweight was higher from 10 to 12 years and significantly declined after 13 years. In contrast, obesity was more prevalent in the 10-year age group and decreased progressively at older ages. Regarding geographic region, higher prevalence rates of overweight were observed in the South region (both genders) and obesity was more prevalent in the South (boys and girls) and Southeast (girls) regions.

Table 5 shows the results of multivariate analysis of overweight and obesity according to gender, age and region.

Overweight was significantly associated with age and region but not with gender. The results demonstrated higher odds ratios for overweight higher among children aged 10 to 13 years (with age 15 as a reference) and children from the South, Center-West, Southeast and Northeast regions (with the North region as a reference). Obesity was significantly associated with gender, age and region. These findings indicate that the odds ratios for obesity are higher among boys, children aged 10 to 13 years and children from the South and Southeast regions.

TABLE 3

Prevalence of overweight and obesity among boys according to associated factors

Variable	Nutritional status					
	Normal weight		Overweight		Obesity	
	P*	95%CI	P*	95%CI	P*	95%CI
Age (years)						
10	84.0[a]	83.5-84.5	10.6[a]	10.2-11.0	5.4[a]	5.1-5.7
11	81.8[b]	81.3-82.3	14.8[b]	14.3-15.3	3.4[b]	3.2-3.7
12	85.3[ac]	84.1-85.8	12.0[c]	11.6-12.4	2.6[c]	2.4-2.8
13	86.2[c]	85.7-86.7	11.4[ac]	11.0-11.8	2.4[cd]	2.2-2.6
14	87.7[d]	87.2-88.1	10.3[a]	9.9-10.7	2.0[d]	1.8-2.2
15	89.2[e]	88.8-89.6	9.4[d]	9.0-9.8	1.4[e]	1.2-1.6
Region						
North	89.7[a]	89.3-90.1	8.1[a]	7.7-8.5	2.2[ab]	2.0-2.4
Northeast	87.5[b]	87.0-87.9	10.5[b]	10.1-10.9	1.9[a]	1.7-2.1
Center-West	85.4[c]	84.9-85.9	11.9[c]	11.5-12.3	2.6[bc]	2.4-2.8
Southeast	86.8[b]	86.3-87.3	10.4[b]	10.0-10.8	2.8[c]	2.6-3.0
South	78.8[d]	78.2-79.3	16.7[d]	16.2-17.2	4.5[d]	4.2-4.8
Total	85.5	85.0-86.0	11.6	11.2-12.0	2.9	2.7-3.1

P: prevalence; 95%CI: 95% confidence interval.
* Values followed by different superscript letters were significantly different (comparison of proportions test, 95%CI).

TABLE 4

Prevalence of overweight and obesity among girls according to associated factors

Variable	Nutritional status					
	Normal weight		Overweight		Obesity	
	P*	95%CI	P*	95%CI	P*	95%CI
Age (years)						
10	82.6[a]	82.0-83.2	13.5[a]	13.0-14.0	3.9[a]	3.6-4.2
11	84.7[b]	84.1-85.2	12.7[a]	12.2-13.2	2.5[b]	2.3-2.8
12	83.5[ab]	82.9-84.1	13.7[a]	13.2-14.2	2.8[b]	2.6-3.1
13	86.7[c]	86.2-87.2	11.4[b]	10.9-11.9	1.9[c]	1.7-2.1
14	88.5[d]	88.0-89.0	10.5[b]	10.0-11.0	1.0[d]	0.9-1.2
15	88.6[d]	88.1-89.1	10.5[b]	10.0-11.0	0.9[d]	0.8-1.1
Region						
North	88.5[a]	88.0-89.0	9.9[a]	9.4-10.4	1.5[a]	1.3-1.7
Northeast	87.7[ab]	87.2-88.2	10.4[a]	9.9-10.9	1.9[a]	1.7-2.1
Center-West	87.1[b]	86.6-87.6	10.9[ab]	10.4-11.4	1.9[a]	1.7-2.1
Southeast	85.6[c]	85.0-86.1	11.9[b]	11.4-12.4	2.5[b]	2.3-2.8
South	81.3[d]	81.0-81.9	16.0[c]	15.4-16.6	2.7[b]	2.5-3.0
Total	85.5	84.9-86.0	12.3	11.8-12.8	2.3	2.1-2.5

P: prevalence; 95%CI: 95% confidence interval.
* Values followed by different superscript letters were significantly different (comparison of proportions test, 95%CI).

TABLE 5

Association of overweight and obesity with gender, age and geographic region in multinomial analysis (reference category: BMI < 25 kg/m^2)

| Variable | Nutritional status | | | | |
| | Reference group | Overweight | | Obesity | |
	n	n	OR* (95%CI)	n	OR* (95%CI)
Gender					
Male	17,886	2,430	0.99 (0.92-1.05)	598	1.34 (1.17-1.53)
Female	13,731	1,969	1.00	363	1.00
Age (years)					
10	4,178	593	1.40 (1.22-1.61)	238	4.82 (3.49-6.62)
11	6,003	997	1.65 (1.45-1.87)	215	3.04 (2.20-4.19)
12	6,632	1,003	1.50 (1.32-1.70)	212	2.69 (1.95-3.72)
13	6,153	813	1.28 (1.13-1.46)	156	2.06 (1.48-2.88)
14	5,230	616	1.13 (0.99-1.30)	93	1.42 (0.90-2.03)
15	3,421	377	1.00	46	1.00
Region					
Northeast	4,875	584	1.19 (1.03-1.37)	106	1.01 (0.74-1.37)
Center-West	5,381	720	1.33 (1.16-1.53)	143	1.25 (0.94-1.67)
Southeast	12,117	1,551	1.28 (1.13-1.45)	370	1.49 (1.15-1.93)
South	5,918	1,210	2.12 (1.87-2.41)	267	2.38 (1.83-3.11)
North	3,326	334	1.00	71	1.00

* Odds ratios simultaneously fitted to all factors in the table.

DISCUSSION

The present study involving schoolchildren from all regions of Brazil shows the prevalence of overweight and obesity according to gender, age and geographic region. The prevalence of overweight (11.9%) and obesity (2.6%) observed in this study was lower than those reported in many developed and developing countries. Data from the NHANES I and III studies revealed that 25.2% of American children and adolescents (6-18 years) present excess weight (overweight + obesity) (9). In Switzerland, the prevalence of overweight and obesity among children and adolescents (6-11 years) was 35.7% and 7.5%, respectively (24). Prevalence rates of 31.9% and 8.1%, respectively, have been observed in South Africa (6-13 years) (25), 36% and 10.6% in India (5-18 years) (26), 34.5% and 26.2% in Costa Rica (7-12 years) (27), and 28.6% and 20.4% in Chile (5-14 years) (28). In Brazil, evidence indicates a progressive increase in the prevalence of excess weight in the form of overweight and obesity among adolescents (10 to 18 years) over the last three decades, from 4.1% in 1975 to 13.9% in 1997 (9).

The present results agree with those reported in the 2002-2003 Family Budget Survey (20), which found that 12.3% and 2.3% of adolescents (10 to 19 years) were overweight or obese, respectively. However, our results disagree with regional studies showing higher prevalence rates of overweight (11,15,16,18,29) and obesity (11,15-18,29).

In the present study, the prevalence of overweight was higher among girls. National studies have reported inconsistent results, with some showing a higher proportion of overweight among females (16) and others among males (15,17), whereas other investigations identified no significant differences between genders (29,30). International surveys have indicated a higher frequency of overweight among males compared to females (27,31). Obesity was more frequent among boys. These results agree with findings reported in other national (15,16) and international studies (27), but disagree with studies not reporting differences between genders (17,29-31).

With respect to age, the prevalence of overweight and obesity was higher in the 11-12 and 10-11 year age groups, respectively, whereas lower prevalence rates were observed at ages 14 and 15. Similar results have been reported for American adolescents (32) and local Brazilian samples (15,29,30). The decline in overweight and obesity with increasing age is expected since moderate excess weight might be compensated for by growth, and may even represent a positive aspect of obesity treatment (33). Sexual maturation may also influence the increase in the prevalence of overweight and obesity among adolescents, since adolescents in more advanced stages of sexual maturation are at a higher risk of overweight (34), and the lower the age of sexual maturity, the higher the prevalence of overweight and obesity (18). Although

body weight increases during growth, this gain occurs differently in the two genders. Whereas a gradual increase of body fat stores is observed in girls, a loss of body fat and a more marked gain of muscle mass occur in boys.

With respect to the prevalence of overweight and obesity according to geographic region, the present results obtained for schoolchildren agree with those reported in the Family Budget Survey (20), with higher prevalence rates of overweight and obesity in the more developed regions (South, Southeast and Center-West) and lower rates in the economically emerging regions (North and Northeast).

Regression analysis simultaneously fitted to gender, age and geographic region showed that overweight was associated with age and region, but not with gender. The findings indicate that the odds ratios for overweight are higher among children aged 10 to 13 years (when compared to age 15) and children from the South, Southeast and Center-West regions (when compared to the North region). In contrast, obesity was associated with gender, age and region, indicating higher odds ratios for boys, children aged 10 to 13 years and children from the Southeast and South regions. Age 10 and the South region were the factors most strongly associated with obesity. These findings agree with recent studies (15,18,19). However, it should be noted that a lower prevalence or risk of overweight and obesity in less economically developed regions such as the North and Northeast does not necessarily represent a positive factor since, on the other hand, it may indicate a higher risk of malnutrition (not evaluated in the present study). A possible explanation for the higher prevalence of overweight and obesity in the South and Southeast regions might be better access to fast foods, automobiles, computers, and video games, factors directly associated with the increase of excess body weight (35).

The indicator used in the present study for the determination of the prevalence of overweight and obesity was mainly chosen because of the availability of cut-off values recommended by an important international institution (International Obesity Task Force) engaged in the study of obesity. In addition, the cut-off values were developed using data from the Brazilian population and are increasingly accepted by national (29,36) and international researchers (9,37,38).

The main limitation of the present study is related to the cross-sectional cohort design which estimates relationships between variables at a single time point and does not permit the identification of causal relationships. Another limitation is the fact that no specific assessment instrument was used for the determination of the socioeconomic level of the sample, whose relationship with the development of obesity has been well established in the literature. In addition, we did not control for variables that possibly influence the distribution of BMI, such as diet and level of physical activity. One of the advantages of the study is the representativeness of the population which includes adolescent schoolchildren from all geographic regions of Brazil, thus outlining the national situation of overweight and obesity since only studies involving local samples and restricted to specific localities of the country have been published over the last few years.

In summary, the present study permits to conclude that the prevalence of overweight and obesity among Brazilian adolescent schoolchildren is a matter of concern, although it is still lower than that found in developed countries and in some developing countries. Male gender is a risk factor for obesity, irrespective of age and geographic region. The prevalence of overweight and obesity decreased with age, whereas schoolchildren from more developed regions are more prone to overweight and obesity.

Thus, to prevent aggravation of the current situation of overweight and obesity, public policies for the prevention and control of excess weight need to be developed at the national level, with emphasis on healthy dietary habits and regular practice of physical activity. It is essential that these policies are developed and implemented in cooperation with the school, which provides the most democratic access to Brazilian youngsters in an environment that favors the understanding of contents that lead to the adoption of increasingly more healthy lifestyles. Within this context, the importance of physical education at school, which should encourage the practice of physical activity and its maintenance in adult life, is emphasized.

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