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# Excess weight in preschoolers: prevalence and associated factors☆

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Excess weight;
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## Abstract

*Objective:* To study the prevalence and factors associated with excess weight in children enrolled in public schools in the states of Rio Grande do Sul (RS) and Santa Catarina (SC).

*Methods:* This was a cross-sectional study, carried out with children aged 4 to 6 years. The studied outcome was excess weight, defined by z-score > two standard deviations for body mass index (BMI)/age, compared with the World Health Organization (WHO) reference population of 2006/2007. Anthropometric measurements of body mass and height were measured in duplicate using standard techniques, in accordance with the WHO. Data were double entered using EPI-INFO software, release 6.04. Absolute and relative frequencies were calculated, as well as mean values and standard deviations. Associations between excess weight and other variables were assessed by using Poisson model with robust variance. STATA software release 12.0 was used ($p < 0.05$).

*Results:* A total of 4,914 children were evaluated (2,578 in RS and 2,336 in SC). In RS, the incidence of excess weight was 14.4% (95% CI = 13.1% to 15.8%) and in SC, 7.5% (95% CI = 6.5% to 8.7%). The variables associated with excess weight were number of household members, maternal education, marital status, number of children, mother's age at birth of first child, gestational age, and birth weight.

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*Conclusion:* Children enrolled in public preschools in RS had a two-fold higher excess weight prevalence than that identified in SC, demonstrating a significant difference in the magnitude of childhood obesity in two Brazilian states located in the same region.


**PALAVRAS-CHAVE**
Excesso de peso;
Crianças;
Estado nutricional;
Fatores de risco

## Excesso de peso em crianças de pré-escolas: prevalência e fatores associados

### Resumo

*Objetivo:* Estudar a prevalência e os fatores associados ao excesso de peso em crianças matriculadas em escolas públicas dos estados do Rio Grande do Sul (RS) e Santa Catarina (SC).

*Métodos:* Realizou-se estudo transversal com crianças de idade entre quatro e seis anos. O desfecho estudado foi o excesso de peso, definido através do escore Z > 2DP para o Índice de Massa Corporal (IMC)/idade, em comparação com a população de referência da OMS 2006/2007. As medidas antropométricas de massa corporal e altura foram aferidas em duplicata, utilizando-se técnicas padronizadas conforme a Organização Mundial de Saúde (OMS). Os dados foram duplamente digitados utilizando o software EPI-INFO, versão 6.04. Foram calculadas frequências absolutas e relativas e médias (DP). Associações entre excesso de peso e demais variáveis foram avaliadas em modelo de Poisson de variância robusta. Foi utilizado o programa STATA versão 12.0 ($p < 0,05$).

*Resultados:* Foram avaliadas 4.914 crianças (RS 2.578 e SC 2.336). No RS, o excesso de peso foi de 14,4% (IC 95% = 13,1-15,8%) e, em SC, de 7,5% (IC 95% = 6,5-8,7%). As variáveis que apresentaram associação com o excesso de peso foram: número de moradores no domicílio; escolaridade materna; situação conjugal; número de filhos; idade materna ao nascimento do primeiro filho; idade gestacional; e o peso ao nascer.

*Conclusão:* As crianças matriculadas nas pré-escolas públicas do RS apresentaram uma prevalência de excesso de peso duas vezes maior do que a identificada em SC, demonstrando uma diferença significativa na magnitude da obesidade infantil em dois estados brasileiros situados em uma mesma região.


## Introduction

The increasing prevalence of obesity has represented a significant change in the profile of health and disease worldwide in recent years.[1-3] In preschool ages, the early occurrence of body adiposity and fast weight gain represents a risk factor for the development of obesity in later life.[4]

The 2006 National Survey on Demographics and Health (Pesquisa Nacional sobre Demografia e Saúde – PNDS) evaluated children under 5 years of age and demonstrated a national prevalence of overweight of 6.6%, and of 8.8% in the South.[5] The results of the 2008-2009 Household Budget Survey (Pesquisa de Orçamento Familiar – POF) pointed to an increase in the prevalence of overweight in Brazil that reached 33.5% of children aged between 5 and 9 years, ranging from 32% to 40% in the Southeast, South, and Midwest, and from 25% to 30% in the North and Northeast.[6]

Among the main determinants of childhood obesity that have been studied are high birth weight; maternal obesity during pregnancy, especially in the first trimester; parental obesity; low socioeconomic status; and low maternal education.[7-10] In the study on the prevalence of obesity among preschool children in five cities of the state of São Paulo,[11] obesity increased with the increasing *per capita* income. In São Leopoldo, RS, Vitolo et al.,[12] found a positive association between excess weight in children younger than 5 years of age and high socioeconomic status in the area of the health facility.

Moreover, important population-based studies on the prevalence of obesity measured in two cohorts of live births in Pelotas in 1982 and 1993[13] recorded an increase in this prevalence of approximately 40% over almost a decade; obesity also increased with the family income level. In this same population, nutritional deficits (weight/age and length/age) were higher in children from families with lower incomes (10%) and lower in those from families of higher income categories (3%).

This article describes the main results of a study aimed to determine the prevalence of excess weight and associated factors in preschool children enrolled in public schools in the states of Rio Grande do Sul (RS) and Santa Catarina (SC), Southern Brazil.

## Methods

This was a school-based cross-sectional study with data obtained from schools located in RS and SC. The study

population consisted of children aged between 4 and 6 years old, enrolled in 2007.

Public school records from the Brazilian Ministry of Education (MEC) were used to calculate sample size. Only schools that had 39 or more students enrolled in preschool were considered. Sampling was conducted by conglomerates, which were defined according to the mesoregions established by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística - IBGE).

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) 13.0 software, using the Complex Samples module, according to the complex sampling plan that was used. Each child was assigned a sample weight according to the school and municipality to whom he/she belonged, within each state. To calculate the weight assigned to each child, sampling fractions were defined (inclusion probabilities) of $f_1$ and $f_2$, where $f_1$ is the sampling fraction of the municipality within the stratum and $f_2$ is the sampling fraction of the school within the municipality. The final inclusion probability of each child was: $f = f_1 * f_2$. The final weight assigned to each child was $w = 1 / f$, equal for children from the same school.

The working team consisted of 21 dietitians, and data collection occurred between September and December of 2007. Anthropometric measurements were measured in duplicate using standard techniques according to the World Health Organization (WHO).[14] Body mass (in kg) was obtained using a portable digital scale with a capacity of 200 kg and precision of 50 g. Height (cm) was measured using a portable stadiometer with an accuracy of 1 mm. Excess weight was considered in children with z-score values > + two standard deviations for body mass index for age (BMI/A) compared with the WHO reference population.[15,16]

Descriptive analysis of data was performed by calculating absolute and relative frequencies, and means and standard deviations. Comparisons between frequencies and means were carried out, respectively, using the chi-squared test and Student's *t*-test for independent samples; values were considered significant when $p < 0.05$.

The variables studied were: 1. related to the child: gender, age, ethnicity, birth weight, gestational age, total time of breastfeeding, state of residence; 2. related to the child's mother: educational level, number of children, maternal age at birth of first child, maternal age at child's birth, marital status, 3. related to the child's family and school: number of people in the household, number of rooms used for sleeping, location of residence, type of school, and school period (morning/afternoon/full-time).

Factors associated with excess weight were first analyzed from crude prevalence ratios and their respective 95% confidence intervals (95% CI); associations with p-values < 0.25 (chi-squared test for heterogeneity and linear trend) were selected. Then, the selected independent variables were studied by multiple analysis with Poisson regression with robust variance. Statistical analysis was performed using STATA software, release 12.0.

The study protocol was approved by the Research Ethics Committee of the Universidade Federal do Rio Grande do Sul (CEP/UFRGS) under protocol No. 2007736.

## Results

A total of 4,914 children (2,578 from RS and 2,336 from SC) from 14 municipalities (eight in RS and six in SC) were evaluated. Among the general characteristics, it was observed that most children lived in urban areas, studied in public schools in the afternoon, and more than half were born to mothers with educational level equivalent to elementary school education (Table 1). There were significant differences in the two states regarding the number of rooms used for sleeping and the mother's marital status. In RS there were more households with fewer rooms used for sleeping, and a higher proportion of mothers that did not live with a husband or partner.

The general prevalence of excess weight was 14.4% (95% CI = 13.1-15.8) and 7.5% (95% CI = 6.5-8.7), respectively, for the states of RS and SC. Variables that were associated with a higher prevalence of excess weight in the total population were: the number of household members, maternal education, number of children, maternal age at birth of the first child, birth weight, and gestational age. Children from families with the highest number of household members had the lowest rates of excess weight. Regarding the maternal education variable, children of mothers with higher levels of education had the lowest prevalence of overweight. As for maternal age, those born to teenage mothers had the lowest rates of excess weight. The variable birth weight was associated with the prevalence of excess weight; the lowest rates were found among those born with low birth weight, and the highest were found among those born weighing more than 4,000 g. Preterm children had lower rates of excess weight, compared to the rates of those born at term (Table 2).

In the analysis by state, the prevalence of overweight was associated, in both states, to the variables number of residents in the household, maternal age at birth of the first child, number of children, birth weight, and gestational age. Only in RS was the prevalence associated with maternal education, mother's marital status, and school period.

Those who attended school full-time had lower proportion of excess weight; children of mothers with high school education had the highest rates of excess weight compared to children of mothers with elementary school or college/university education. When the husband or partner of the child's mother lived with the family, the prevalence of excess weight was higher.

Table 3 shows the results of the multiple Poisson models, where for the total population, the following variables maintained a statistically significant association with the prevalence of excess weight: number of household members, number of rooms used for sleeping, marital status, number of children, birth weight, and gestational age. In the analysis by state, the variables that remained associated with the prevalence of excess weight in RS were: the number of rooms used for sleeping, maternal education, mother's marital status, number of children, birth weight, and gestational age. For the state of SC, the variables that remained associated with the prevalence of excess weight were: school period, number of household members, number of rooms used for sleeping, and mother's marital status.

**Table 1** General characteristics of the total population and according to the state in relation with the study variables. Rio Grande do Sul and Santa Catarina, Brazil, 2007.

| Variables | Total (RS and SC) | | RS | | SC | | p |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| *Type of school* | 4,914 | | 2,578 | | 2,336 | | |
| Municipal | 3,440 | 70 | 1,824 | 78.8 | 1,620 | 67.4 | 0.185 |
| State | 1,470 | 30 | 754 | 21.2 | 716 | 32.6 | |
| *School period* | 4,914 | | 2,578 | | 2,336 | | |
| Morning | 1,624 | 33 | 802 | 32.4 | 822 | 34.1 | 0.818 |
| Afternoon | 2,438 | 49.6 | 1,282 | 48.4 | 1,156 | 49.4 | |
| Full-time | 852 | 17.4 | 494 | 19.2 | 358 | 16.5 | |
| *Number of household members* | 4,851 | | 2,551 | | 2,300 | | |
| ≤ 3 | 1,428 | 29.4 | 777 | 31.4 | 651 | 28.5 | 0.328 |
| 4-5 | 2,657 | 54.8 | 1,356 | 53.3 | 1,301 | 56.8 | |
| ≥ 6 | 766 | 15.8 | 418 | 15.4 | 348 | 14.7 | |
| *Number of rooms used for sleeping* | 4,837 | | 2,548 | | 2,289 | | |
| ≤ 2 | 2,928 | 60.5 | 1,655 | 64.6 | 1,273 | 55.5 | 0.001 |
| 3-4 | 1,716 | 35.5 | 798 | 31.9 | 918 | 40.3 | |
| ≥ 5 | 193 | 4.0 | 95 | 3.5 | 98 | 4.2 | |
| *Household location* | 4,681 | | 2,482 | | 2,199 | | |
| Urban | 4,522 | 96.6 | 2,425 | 97.3 | 2,097 | 95.1 | 0,277 |
| Rural | 159 | 3.4 | 57 | 2.7 | 102 | 4.9 | |
| *Maternal education* | 4,697 | | 2,480 | | 2,217 | | |
| Elementary school | 2,522 | 53.4 | 1,277 | 51.5 | 1,245 | 55.8 | 0.399 |
| High school | 1,740 | 37.0 | 968 | 39.7 | 772 | 35.2 | |
| College/university | 435 | 9.3 | 235 | 8.7 | 200 | 9 | |
| *Husband/partner* | 4,757 | | 2,504 | | 2,253 | | |
| Yes | 3,813 | 80.1 | 1,939 | 79.1 | 1,874 | 83.4 | 0,019 |
| No | 944 | 19.9 | 565 | 20.9 | 379 | 16.6 | |
| *Number of children* | 4,821 | | 2,544 | | 2,277 | | |
| 1 | 1,302 | 27.0 | 715 | 29.5 | 587 | 26 | 0.460 |
| 2 | 1,726 | 35.8 | 888 | 35.5 | 838 | 36.9 | |
| 3-4 | 1,396 | 29.0 | 721 | 27.4 | 675 | 29.3 | |
| ≥ 5 | 397 | 8.2 | 220 | 7.6 | 177 | 7.8 | |
| *Mother's age at birth of first child* | 4,067 | | 2,145 | | 1,922 | | |
| ≤ 19 years | 1,899 | 46.7 | 971 | 44.7 | 928 | 47.6 | 0.162 |
| 20-29 years | 1,927 | 47.4 | 1,023 | 48 | 904 | 47.6 | |
| ≥ 30 years | 241 | 5.9 | 151 | 7.3 | 90 | 4.8 | |
| *Mother's age at birth of the child* | 4,698 | | 2,478 | | 2,220 | | |
| ≤ 19 years | 929 | 19.8 | 468 | 19.2 | 461 | 20.4 | 0.509 |
| 20-29 years | 2,362 | 50.3 | 1,236 | 49.8 | 1,126 | 50.7 | |
| ≥ 30 years | 1,407 | 29.9 | 774 | 31 | 633 | 28.9 | |
| *Gender* | 4,914 | | 2,578 | | 2,336 | | |
| Male | 2,475 | 50.4 | 1,268 | 48,9 | 1,207 | 51,4 | 0,073 |
| Female | 2,439 | 49.6 | 1,310 | 51.1 | 1,129 | 48.6 | |
| *Ethnicity* | 4,883 | | 2,559 | | 2,324 | | |
| White | 3,586 | 73.4 | 1,897 | 77.6 | 1,689 | 73 | 0.235 |
| Non-white | 1,297 | 26.6 | 662 | 22.4 | 635 | 27 | |
| *Age (years)* | 4,914 | | 2,578 | | 2,336 | | |
| 4 -4.99 | 770 | 15.7 | 382 | 15.7 | 388 | 16.4 | 0.485 |
| 5- 5.99 | 1,881 | 38.3 | 1,000 | 41.7 | 881 | 37.3 | |
| 6-6.99 | 2,263 | 46.0 | 1,196 | 42.7 | 1,067 | 46.3 | |
| *Breastfeeding duration (months)* | 4,278 | | 2,255 | | 2,023 | | |
| ≤ 1 | 248 | 5.8 | 134 | 6.4 | 114 | 5.6 | 0.063 |
| 1.01-2 | 358 | 8.4 | 207 | 9.8 | 151 | 7.3 | |
| 2.01-4 | 734 | 17.2 | 389 | 18.4 | 345 | 16.8 | |
| 4.01-6 | 643 | 15.0 | 349 | 15.3 | 294 | 14.8 | |
| 6.01-12 | 810 | 18.9 | 395 | 16.7 | 415 | 20.7 | |

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**Table 1** *(Continuation)* General characteristics of the total population and according to the state in relation with the study variables. Rio Grande do Sul and Santa Catarina, Brazil, 2007.

| Variables | Total (RS and SC) | | RS | | SC | | p |
|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | |
| > 12 | 1,485 | 34.7 | 781 | 33.4 | 704 | 34.7 | |
| *Birth weight (g)* | 4,772 | | 2,523 | | 2,249 | | |
| < 2,500 | 495 | 10.4 | 251 | 10.5 | 244 | 10.9 | 0.817 |
| 2,500-4,000 | 4,028 | 84.4 | 2,129 | 84.2 | 1,899 | 84.2 | |
| > 4,000 | 249 | 5.2 | 143 | 5.3 | 106 | 4.9 | |
| *Premature* | 3,758 | | 2,041 | | 1,717 | | |
| No | 2,400 | 63.9 | 2,578 | 62.1 | 1,083 | 64.4 | 0.263 |
| Yes | 1,358 | 36.1 | 1,268 | 37.9 | 634 | 35.6 | |

RS, Rio Grande do Sul; SC, Santa Catarina.

**Table 2** Prevalence (%) of excess weight in the total population and by state according to variable categories. Rio Grande do Sul and Santa Catarina. Brazil, 2007.

| Variables | Total (RS and SC) | | | | Rio Grande do Sul | | | | Santa Catarina | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Obese | | p | Total | Obese | | p | Total | Obese | | p |
| | n | n | % | | | n | % | | | n | % | |
| *Type of school* | 4,914 | | | 0.185 | 2,578 | | | 0.346 | 2,336 | | | 0.204 |
| Municipal | 3,444 | 376 | 10.8 | | 1,824 | 263 | 12.9 | | 1,620 | 113 | 7.3 | |
| State | 1,470 | 171 | 12.8 | | 754 | 108 | 14.7 | | 716 | 63 | 8.8 | |
| *School period* | 4,914 | | | 0.144 | 2,578 | | | 0.035 | 2,336 | | | 0.406 |
| Morning | 1,624 | 176 | 12.7 | | 802 | 113 | 16.1 | | 822 | 63 | 7.9 | |
| Afternoon | 2,438 | 282 | 11.8 | | 1,282 | 202 | 14.6 | | 1,156 | 80 | 7.2 | |
| Full-time | 852 | 89 | 9.0 | | 494 | 56 | 8.4 | | 358 | 33 | 9.3 | |
| *Number of household members* | 4,851 | | | 0.001 | 2,551 | | | 0.004 | 2,300 | | | 0.016 |
| ≤ 3 | 1,428 | 210 | 14.7 | | 777 | 141 | 16.6 | | 651 | 69 | 10.7 | |
| 4 to 5 | 2,657 | 284 | 11.5 | | 1,356 | 197 | 14.3 | | 1,301 | 87 | 6.8 | |
| ≥ 6 | 766 | 50 | 6.5 | | 418 | 32 | 7.5 | | 348 | 18 | 6.0 | |
| *Number of rooms used for sleeping* | 4,837 | | | 0.364 | 2,548 | | | 0.236 | 2,289 | | | 0.347 |
| ≤ 2 | 2,928 | 326 | 11.1 | | 1,655 | 235 | 12.6 | | 1,273 | 91 | 7.2 | |
| 3-4 | 1,716 | 194 | 12.6 | | 798 | 118 | 15.9 | | 918 | 76 | 8.7 | |
| ≥ 5 | 193 | 25 | 11.4 | | 95 | 18 | 14.4 | | 98 | 7 | 6.8 | |
| *Household location* | 4,914 | | | 0.469 | 2,482 | | | 0.994 | 2,199 | | | 0.476 |
| Urban | 4,522 | 516 | 11.8 | | 2,425 | 359 | 13.9 | | 2,097 | 157 | 7.7 | |
| Rural | 159 | 15 | 9.9 | | 57 | 9 | 14.6 | | 102 | 6 | 6 | |
| *Maternal education* | 4,697 | | | 0.007 | 2,480 | | | 0.028 | 2,217 | | | 0.600 |
| Elementary school | 2,522 | 257 | 10.5 | | 1,277 | 168 | 12.7 | | 1,245 | 89 | 7.4 | |
| High school | 1,740 | 231 | 13.9 | | 968 | 165 | 16.9 | | 772 | 66 | 8.6 | |
| College/university | 435 | 47 | 9.8 | | 235 | 31 | 10.7 | | 200 | 16 | 8.2 | |
| *Husband/partner* | 4,914 | | | 0.020 | 2,504 | | | 0.021 | 2,553 | | | 0.067 |
| Yes | 3,813 | 436 | 12.0 | | 1939 | 289 | 14.6 | | 1,874 | 147 | 8.1 | |
| No | 944 | 95 | 9.9 | | 565 | 75 | 11.8 | | 379 | 20 | 5.2 | |
| *Number of children* | 4,821 | | | 0.001 | 2,544 | | | 0.001 | 2,277 | | | 0.049 |
| 1 | 1,302 | 187 | 14.8 | | 715 | 128 | 17.6 | | 587 | 59 | 10.3 | |
| 2 | 1,726 | 206 | 12.5 | | 888 | 144 | 15.7 | | 838 | 62 | 7.8 | |
| 3-4 | 1,396 | 131 | 9.7 | | 721 | 86 | 11.7 | | 675 | 45 | 6.5 | |
| ≥ 5 | 397 | 18 | 4.5 | | 220 | 11 | 4.6 | | 177 | 7 | 4.2 | |
| Mother's age at birth of first child | 4,067 | | | 0.001 | 2,145 | | | 0.014 | 1,922 | | | 0.005 |
| ≤ 19 years | 1,899 | 168 | 0.3 | | 971 | 115 | 11.7 | | 928 | 53 | 5.6 | |

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**Table 2** *(Continuation)* Prevalence (%) of excess weight in the total population and by state according to variable categories. Rio Grande do Sul and Santa Catarina. Brazil, 2007.

| Variables | Total (RS and SC) | | | | Rio Grande do Sul | | | | Santa Catarina | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Obese | | p | Total | Obese | | p | Total | Obese | | p |
| | n | n | % | | | n | % | | | n | % | |
| 20-29 years | 1,927 | 250 | 13.2 | | 1,023 | 170 | 16.0 | | 904 | 80 | 9.1 | |
| ≥ 30 | 241 | 31 | 11.3 | | 151 | 24 | 12.9 | | 90 | 7 | 7.5 | |
| *Mother's age* | 4,698 | | | 0.280 | 2,478 | | | 0.467 | 2,220 | | | 0.334 |
| ≤ 19 years | 929 | 82 | 10.1 | | 468 | 55 | 12.8 | | 461 | 27 | 6.2 | |
| 20-29 years | 2,362 | 268 | 11.4 | | 1,236 | 176 | 13.5 | | 1,126 | 92 | 8.2 | |
| ≥ 30 years | 1,407 | 172 | 12.4 | | 774 | 126 | 15.1 | | 633 | 46 | 7.6 | |
| *Gender* | 4,914 | | | 0.360 | 2,578 | | | | 2,336 | | | 0.073 |
| Male | 2,475 | 294 | 12.1 | | 1,268 | 191 | 14.2 | | 1,207 | 103 | 8.9 | |
| Female | 2,439 | 253 | 10.8 | | 1,310 | 180 | 13.5 | | 1,129 | 73 | 6.5 | |
| *Ethnicity* | 4,883 | | | 0.174 | 2,559 | | | 0.221 | 2,324 | | | 0.436 |
| White | 3,586 | 420 | 12.1 | | 1,897 | 287 | 14.8 | | 1,689 | 133 | 8.0 | |
| Non-white | 1,297 | 126 | 10.1 | | 662 | 83 | 11.7 | | 635 | 43 | 7.2 | |
| *Age (years)* | 4,914 | | | 0.316 | 2,578 | | | 0.234 | 2,336 | | | 0.851 |
| 4 -4.99 | 770 | 89 | 11.8 | | 382 | 57 | 14.2 | | 388 | 32 | 8.3 | |
| 5- 5.99 | 1,881 | 195 | 10.4 | | 1,000 | 132 | 12.0 | | 881 | 63 | 7.7 | |
| 6-6.99 | 2,263 | 263 | 12.3 | | 1,196 | 182 | 15.2 | | 1.067 | 81 | 7.7 | |
| *Breastfeeding duration (months)* | 4.278 | | | 0.194 | 2,255 | | | 0.471 | 2,023 | | | 0.586 |
| ≤ 1 | 248 | 35 | 14.8 | | 134 | 22 | 17.4 | | 114 | 13 | 10.8 | |
| 1.01-2 | 358 | 47 | 13.5 | | 207 | 33 | 15.5 | | 151 | 14 | 9.9 | |
| 2.01-4 | 734 | 78 | 11.7 | | 389 | 53 | 13.4 | | 345 | 25 | 7.3 | |
| 4.01-6 | 643 | 73 | 11.8 | | 349 | 49 | 10.1 | | 294 | 26 | 9 | |
| 6.01-12 | 810 | 70 | 9.1 | | 395 | 44 | 13.3 | | 415 | 26 | 6.5 | |
| > 12 | 1,485 | 167 | 11.2 | | 781 | 114 | 13.1 | | 704 | 53 | 7.8 | |
| *Birth weight (g)* | 4,772 | | | 0.001 | 2,523 | | | 0.001 | 2,249 | | | 0.038 |
| < 2,500 | 495 | 27 | 5.9 | | 251 | 16 | 6.7 | | 244 | 11 | 4.8 | |
| 2,500-4,000 | 4,028 | 456 | 11.7 | | 2,129 | 309 | 14.0 | | 1,899 | 147 | 7.9 | |
| > 4,000 | 249 | 53 | 21.0 | | 143 | 39 | 25.0 | | 106 | 14 | 13 | |
| *Premature* | 3,758 | | | 0.001 | 2,041 | | | 0.004 | 1,717 | | | 0.006 |
| Yes | 1.358 | 123 | 9.1 | | 724 | 87 | 11.2 | | 634 | 36 | 5.8 | |
| No | 2,400 | 316 | 13.4 | | 1,317 | 220 | 15.9 | | 1,083 | 96 | 9.2 | |

RS, Rio Grande do Sul; SC, Santa Catarina.

**Tabela 3** Factors associated with excess weight in preschoolers according to the study variables for the total population (Rio Grande do Sul and Santa Catarina) and by state, obtained by multivariate analysis (Poisson regression). Brazil, 2007.

| Variables | Total (RS and SC) | | | Rio Grande do Sul | | | Santa Catarina | | |
|---|---|---|---|---|---|---|---|---|---|
| | PR (a) | 95% CI | p | PR (a) | 95% CI | p | PR (a) | 95% CI | p |
| *Type of school* | | | | | | | | | |
| Municipal | 1 | | | | | | 1 | | |
| State | 0.94 | 0.71-1.26 | 0.712 | – | – | – | 1.32 | –0.93-1.87 | 0.117 |
| *School period* | | | | | | | | | |
| Morning | 1.31 | 0.93-1.84 | 0.121 | 1.51 | 0.96-2.37 | 0.070 | 0.85 | 0.55-1.32 | 0.478 |
| Afternoon | 1.13 | 0.79-1.62 | 0.491 | 1.30 | 0.79-2.12 | 0.290 | 0.64 | 0.43-0.96 | 0.033 |
| Full-time | 1 | | | 1 | | | 1 | | |
| *Number of household members* | | | | | | | | | |
| ≤ 3 | 1 | | | 1 | | | 1 | | |
| 4 to 5 | 0.73 | 0.50-1.06 | 0.100 | 0.95 | 0.67-1.35 | 0.764 | 0.41 | 0.20-0.82 | 0.013 |
| ≥ 6 | 0.58 | 0.35-0.97 | 0.038 | 0.61 | 0.33-1.14 | 0.122 | 0.52 | 0.21-1.29 | 0.156 |

*It continues in the next page*

**Tabela 3** *(Continuation)* Factors associated with excess weight in preschoolers according to the study variables for the total population (Rio Grande do Sul and Santa Catarina) and by state, obtained by multivariate analysis (Poisson regression). Brazil, 2007.

| Variables | Total (RS and SC) | | | Rio Grande do Sul | | | Santa Catarina | | |
|---|---|---|---|---|---|---|---|---|---|
| | PR (a) | 95% CI | p | PR (a) | 95% CI | p | PR (a) | 95% CI | p |
| *Number of rooms used for sleeping* | | | | | | | | | |
| ≤ 2 | 1 | | | 1 | | | 1 | | |
| 3 to 4 | 1.60 | 1.24-2.06 | 0.001 | 1.69 | 1.23-2.32 | 0.002 | 1.80 | 1.33-2.44 | 0.001 |
| ≥ 5 | 1.35 | 0.64-2.83 | 0.420 | 1.63 | 0.78-3.40 | 0.189 | 1.36 | 0.56-3.31 | 0.492 |
| *Maternal education* | | | | | | | | | |
| Elementary school | 1.30 | 0.91-1.85 | 0.150 | 1.68 | 1.11-2.53 | 0.015 | – | – | – |
| High school | 1.26 | 0.90-1.76 | 0.167 | 1.61 | 1.05-2.50 | 0.031 | – | – | – |
| College/university | 1 | | | 1 | | | | | |
| *Husband/partner* | | | | | | | | | |
| Yes | 1.52 | 1.20-1.93 | 0.001 | 1.44 | 1.12-1.86 | 0.005 | 2.23 | 1.12-4.43 | 0.023 |
| No | 1 | | | 1 | | | 1 | | |
| *Number of children* | | | | | | | | | |
| 1 | 1 | | | 1 | | | 1 | | |
| 2 | 0.90 | 0.66-1.22 | 0.486 | 0.74 | 0.55-1.00 | 0.048 | 1.24 | 0.64-2.44 | 0.511 |
| 3 to 4 | 0.77 | 0.53-1.11 | 0.162 | 0.66 | 0.48-0.90 | 0.009 | 1.13 | 0.49-2.60 | 0.768 |
| ≥ 5 | 0.42 | 0.18-0.99 | 0.047 | 0.31 | 0.11-0.85 | 0.025 | 0.64 | 0.16-2.52 | 0.513 |
| *Mother's age at birth of first child* | | | | | | | | | |
| ≤ 19 years | 0.88 | 0.72-1.06 | 0.181 | 0.87 | 0.66-1.14 | 0.306 | 0.72 | 0.42-1.25 | 0.238 |
| 20 to 29 years | 1 | | | | | | | | |
| ≥ 30 years | 0.86 | 0.60-1.24 | 0.415 | 0.90 | 0.58-1.40 | 0.646 | 0.64 | 0.26-1.54 | 0.315 |
| *Mother's age* | | | | | | | | | |
| ≤ 19 years | – | – | – | – | – | – | 0.92 | 0.45-1.87 | 0.817 |
| 20 to 29 years | – | – | – | – | – | – | 1 | | |
| ≥ 30 | – | – | – | – | – | – | 1.09 | 0.62-1.91 | 0.763 |
| *Gender* | | | | | | | | | |
| Male | – | – | – | | | | 1 | | |
| Female | – | – | – | – | – | – | 1.33 | 0.94-1.88 | 0.104 |
| *Ethnicity* | | | | | | | | | |
| White | 1 | | | | | | | | |
| Non-white | 1.08 | 0.81-1.43 | 0.597 | – | – | – | – | – | – |
| *Age (years)* | – | – | – | – | – | – | – | – | – |
| *Breastfeeding duration (months)* | | | | | | | | | |
| ≤ 1 | 1.22 | 0.82-1.80 | 0.317 | – | – | – | – | – | – |
| 1.01-2 | 1.17 | 0.76-1.81 | 0.466 | – | – | – | – | – | – |
| 2.01-4 | 1.05 | 0.64-1.74 | 0.828 | – | – | – | – | – | – |
| 4.01-6 | 1 | | | – | – | – | | | |
| 6.01-12 | 0.73 | 0.43-1.24 | 0.243 | – | – | – | – | – | – |
| ≥ 12 | 0.95 | 0.68-1.31 | 0.754 | – | – | – | – | – | – |
| *Birth weight g)* | | | | | | | | | |
| < 2,500 | 0.47 | 0.27-0.83 | 0.011 | 0.37 | 0.16-0.82 | 0.016 | 0.75 | 0.33-1.71 | 0.488 |
| 2,500 to 4,000 | 1 | | | | | | | | |
| > 4,000 | 1.36 | 0.91-2.05 | 0.130 | 1.50 | 1.03-2.17 | 0.034 | 0.93 | 0.42-2.10 | 0.875 |
| *Premature* | | | | | | | | | |
| Yes | 0.73 | 0.59-0.92 | 0.007 | 0.76 | 0.59-0.97 | 0.031 | 0.76 | 0.52-1.09 | 0.133 |
| No | 1 | | | 1 | | | 1 | | |

95% CI, 95% confidence interval; PR, Poisson Regression; RS, Rio Grande do Sul; SC, Santa Catarina.

## Discussion

Children enrolled in public preschools in RS presented a two-fold higher prevalence of excess weight than that identified in SC, demonstrating a significant difference in the magnitude of childhood obesity in two Brazilian states located in the same region. This finding shows the existence of distinct phases within a nutritional transition

process in contiguous areas of Brazil, determined by different representations in each state of the social factors associated with this outcome.

The present results show a differentiation of Brazil in relation to other countries regarding the prevalence of childhood obesity. Onis et al.,[17] analyzing data from 144 countries, estimated that there were 43 million overweight or obese children in 2010, and of those, 35 million were in developing countries, with an increase from 4.2% in 1990 to 6.7% in 2010.

The results of the present study indicate that social variables, together with the birth variables (birth weight and gestational age), were the most significant determinants for the higher prevalence of excess weight, being more significant for RS.

The results presented by Monteiro and Count[18] in a study of secular trends in malnutrition and obesity in children younger than 5 years from the city of São Paulo, based on data from three surveys in the years 1974, 1989, and 1996, showed a frequency of excess weight between 3% and 4% that was restricted to children from wealthier households and that was higher in those whose maternal level of schooling was also higher. The present study demonstrated a higher prevalence of excess weight in children whose mothers had a high school level of education; the prevalence was lower when maternal education was at elementary school level or at college/university level.

In a cross-sectional study nested in a cohort of children 4 years of age, in Feira de Santana, state of Bahia, the prevalence of excess weight was 12.5% and, as in the present study, there were no differences between genders, and daughters of mothers with more years of education had higher prevalence of excess weight, but the practice of breastfeeding and maternal age at the child's birth were not significantly associated with the prevalence of excess weight.[19] Vitolo et al.[12] found a prevalence of excess weight of 9.8% in children younger than 5 years of age that was associated, in addition to higher socioeconomic status, with birth weight > 2,500 g and the trend of significant association when it was an only child.

Variables such as maternal education, number of household members, and the number of children allows inference of the dependents of family income and intrafamilial division of food available for consumption and therefore, on nutritional status. The lower rates of overweight among children from families with a higher number of members and higher number of children are possibly linked to a greater division of income and food.

The discussion on the determinants of obesity is complex and, in Brazil as well as in other countries, it has emphasized the study of the social determinants of childhood obesity, such as parental education and family income. In Germany, an assessment of children aged 6 years showed that those born to mothers with no education had a three-fold greater risk of obesity, when compared to those who were born to mothers with 13 years of schooling, and that poorer children had a 3.3-fold higher risk of being obese than wealthier children.[20]

In this study, most mothers had low educational level, consistent with Brazilian official statistics, which indicate that approximately 25% of individuals aged 25 years or older have no education.[21] The educational level of parents, especially that of the mother, alters the development of obesity in children in many ways, but it can be suggested that more years of schooling reflect in higher income and the possibility of acquiring better quality food. Moreover, education provides the capacity to incorporate health recommendations and make healthy choices regarding food products, such as the inclusion of fruits and vegetables in the diet.

The present results indicate that the total duration of breastfeeding was not associated with the prevalence of excess weight in the studied children. Similarly, Durmus et al.[22] showed that the duration of breastfeeding and exclusive breastfeeding in the first six months tend to be associated with rates of growth in height, weight, and BMI in the period between 3 and 6 months of age, but not with the risk of overweight and obesity up to 3 years of age. However, it is essential to highlight the protective effect of breastfeeding against many diseases in childhood and adulthood. Lamberti et al.[23] corroborate the WHO recommendation that exclusive breastfeeding in the first 6 months of life is a key intervention for child survival.

Goldani et al.[24] studied the influence of early life factors on BMI in young adulthood and found higher BMI values among those who were born with high birth weight (> 4,000 g) and those born to families with lower socioeconomic status at the time of birth, a finding consistent with the present study, which demonstrated higher rates of excess weight in those born weighing more than 4,000 g and those born at term. Studies conducted in other regions of the world have also confirmed the association between high birth weight and development of obesity, such as the study of preschool children in Cyprus that presented odds ratios of 7.63 for birth weight > 4,000 g when compared to birth weight between 2,501 g and 3,000 g.[25] Additionally, in two recently published systematic review studies, the findings showed that high birth weight was associated with overweight and obesity in childhood, and that low birth weight had no influence on the increase of obesity in children, but those born with impaired intrauterine development would be more prone to it.[10,26]

The results of the present study show that 43% of the women had their first child during adolescence, and 20% of the assessed children were born when the mothers were aged ≤ 19 years. This is a high proportion when compared to Brazilian statistics: in 2008, the percentage of teenage mothers between 15 and 17 years old who had already had children was 6.3%, whereas in the South it was 4%.[21]

The prevalence rates of preterm birth are much higher than those found in studies carried out in Brazil and other countries. Barros et al.[27] showed, using data from cohort studies in Brazil, that in Pelotas, state of RS, prematurity rates increased from 6% in 1982 to 7.5% in 1993 and 15% in 2004; in Ribeirão Preto, state of São Paulo, the prevalence was 6% in 1978/1979 and 13.3% in 1994. According to Bettiol et al.,[28] the development of population studies in Brazil is necessary to assess the prevalence and long-term evolution of the rate of preterm infants.

Regarding the limitations of the present study, they refer specifically to the non-inclusion of important variables such as type of delivery, dietary intake, physical activity, and

family income, which would allow for a more adequate understanding of the results. The fact that the sample was selected only from public schools does not allow for a broader generalization about the prevalence of excess weight for children in this age group in the general population.

In the present study, the prevalence of excess weight occured differently in the two states, possibly related to distinct epidemiological and nutritional changes determined by socioeconomic factors. The interaction between social factors in the determination of obesity is complex, having a distinct impact in similar social groups and a sometimes similar impact in individuals from extremely divergent social groups.[29]

This study contributed to the understanding of the nutritional transition process in Brazil by demonstrating significant differences between adjacent states. Further studies, including new variables, are needed for a better interpretation of the differences observed in this study. It is possible, based on the results of this study, to draw attention to the need for greater investment in terms of public child protection policies, particularly those related to maternal and child education, health promotion,and nutritional monitoring.

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## Conflicts of interest

The authors have no conflicts of interest to declare.

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## References

1. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser. 2000;894:i-xii, 1-253.
2. Dietz WH, Bellizzi MC. Introduction: the use of body mass index to assess obesity in children. Am J Clin Nutr. 1999;70:123S-5S.
3. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000;320:1240-3.
4. Lanigan J, Singhal A. Early nutrition and long-term health: a practical approach. Proc Nutr Soc. 2009;68:422-9.
5. Brasil. Ministério da Saúde. Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher – PNDS 2006: dimensões do processo reprodutivo e da saúde da criança. Brasília: Ministério da Saúde; 2009. 300 p.
6. Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa de orçamentos familiares 2008-2009: antropometria e estado nutricional de crianças, adolescentes e adultos no Brasil. Rio de Janeiro: IBGE; 2010.
7. Danielzik S, Czerwinski-Mast M, Langnäse K, Dilba B, Müller MJ. Parental overweight, socioeconomic status and high birth weight are the major determinants of overweight and obesity in 5-7 y-old children: baseline data of the Kiel Obesity Prevention Study (KOPS). Int J Obes Relat Metab Disord. 2004; 28:1494-502.
8. Savva SC, Tornaritis M, Chadjigeorgiou C, Kourides YA, Savva ME, Panagi A, et al. Prevalence and socio-demographic associations of undernutrition and obesity among preschool children in Cyprus. Eur J Clin Nutr. 2005;59:1259-65.
9. Singh GK, Kogan MD, Van Dyck PC, Siahpush M. Racial/ethnic, socioeconomic, and behavioral determinants of childhood and adolescent obesity in the United States: analyzing independent and joint associations. Ann Epidemiol. 2008;18:682-95.
10. Rossi CE, Vasconcelos FA. Birth weight and obesity in children and adolescents: a systematic review. Rev Bras Epidemiol. 2010;13:246-58.
11. Saldiva SR, Escuder MM, Venâncio SI, Benício MH. Prevalence of obesity in preschool children from five towns in São Paulo State, Brazil. Cad Saúde Pública. 2004;20:1627-32.
12. Vitolo MR, Gama CM, Bortolini GA, Campagnolo PD, Drachler M de L. Some risk factors associated with overweight, stunting and wasting among children under 5 years old. J Pediatr (Rio J). 2008;84:251-7.
13. Post CL, Victora CG, Barros FC, Horta BL, Guimarães PR. Infant malnutrition and obesity in two population-based birth cohort studies in southern Brazil: trends and diferences. Cad Saúde Pública. 1996;12:49-57.
14. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser. 1995;854:1-452.
15. World Health Organization (WHO). WHO Child Growth Standards: length/height-for-age, weight-for age, weight-for-length, weight-for-height and body mass index-for-age. Methods and development. WHO (nonserial publication). Geneva: WHO; 2006.
16. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007;85:660-7.
17. de Onis M, Blössner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. Am J Clin Nutr. 2010;92:1257-64.
18. Monteiro CA, Conde WL. Secular trends in malnutrition and obesity among children in the city of São Paulo, Brazil (1974-1996). Rev Saúde Pública. 2000;34:52-61.
19. Jesus GM, Vieira GO, Vieira TO, Martins C da C, Mendes CM, Castelão ES. Determinants of overweight in children under 4 years of age. J Pediatr (Rio J). 2010;86:311-6.
20. Lamerz A, Kuepper-Nybelen J, Wehle C, Bruning N, Trost-Brinkhues G, Brenner H, et al. Social class, parental education, and obesity prevalence in a study of six-year-old children in Germany. Int J Obes (Lond). 2005;29:373-80.
21. Instituto Brasileiro de Geografia e Estatística (IBGE). Síntese de Indicadores Sociais: uma análise das condições de vida da população brasileira em 2008. Rio de Janeiro: IBGE; 2008. 280p.
22. Durmuş B, van Rossem L, Duijts L, Arends LR, Raat H, Moll HA, et al. Breast-feeding and growth in children until the age of 3 years: the Generation R Study. Br J Nutr. 2011;105:1704-11.

23. Lamberti LM, Fischer Walker CL, Noiman A, Victora C, Black RE. Breastfeeding and the risk for diarrhea morbidity and mortality. BMC Public Health. 2011;11:S15.
24. Goldani MZ, Haeffner LS, Agranonik M, Barbieri MA, Bettiol H, Silva AA. Do early life factors influence body mass index in adolescents? Braz J Med Biol Res. 2007;40:1231-6.
25. Savva SC, Tornaritis M, Chadjigeorgiou C, Kourides YA, Savva ME, Panagi A, et al. Prevalence and socio-demographic associations of undernutrition and obesity among preschool children in Cyprus. Eur J Clin Nutr. 2005;59:1259-65.
26. Martins EB, Carvalho MS. Birth weight and overweight in childhood: a systematic review. Cad Saúde Pública. 2006;22: 2281-300.
27. Barros FC, Diaz-Rossello JL. Redes multicêntricas e a qualidade da atenção neonatal. J Pediatr (Rio J). 2004;80:254-6.
28. Bettiol H, Barbieri MA, da Silva AA. Epidemiology of preterm birth: current trends. Rev Bras Ginecol Obstet. 2010;32: 57-60.
29. Silveira PP, Portella AK, Goldani MZ. Obesity in Latin America: similarity in the inequalities. Lancet. 2005;366:451-2.