



Original / *Obesity*

## Factors associated with obesity in Brazilian children enrolled in the School Health Program: a case-control study

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### Abstract

Case-control studies evaluating the factors associated with childhood obesity are scarce in Brazil. We aimed to analyze the factors associated with obesity in Brazilian schoolchildren enrolled in the School Health Program. A case-control study was conducted on 80 schoolchildren aged 7 to 9 years, 40 of them obese and 40 of normal weight according to the cut-off points established by the World Health Organization (2007). Weight, height and waist circumference were obtained. Socioeconomic, demographic, health, eating behavior and lifestyle data were collected by applying a questionnaire to the person responsible and by determining his/her nutritional status. A binary unconditional logistic regression model (univariate and multivariate) was used for data analysis. The prevalence of obesity was 7.21%. The final model showed that duration of breast-feeding  $\geq 6$  months of age (OR 5.3; 95% CI: 1.3-22.1), excess weight of the person responsible (OR 7.1; 95% CI: 1.2-40.2), a sedentary level of physical activity (OR 4.1; 95% CI: 1.1-15.5), and fast chewing (OR 7.4; 95% CI: 2.1-26.9) were significantly associated with childhood obesity. The factors associated with obesity in schoolchildren were duration of breast-feeding  $\geq 6$  months, persons responsible with excess weight, and sedentary children who chew fast. The present study contributes information to be used for the health actions planned by the School Health Program.

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Key words: *Obesity. School health services. Chewing. Breastfeeding. Sedentary lifestyle.*

### Resumen

#### FACTORES ASOCIADOS A LA OBESIDAD EN NIÑOS BRASILEROS INSCRIPTOS EN EL PROGRAMA DE SALUD EN LA ESCUELA: UN ESTUDIO DE CASO CONTROL

La obesidad infantil es un problema creciente de salud pública mundial. Objetivamos analizar los factores asociados a la obesidad en escolares del Programa Salud en la Escuela. Se realizó un estudio caso control con 80 escolares de 7 a 9 años de edad, entre los cuales 40 obesos y 40 eutróficos de acuerdo con los puntos de corte establecidos por la World Health Organization (2007), en 2011- 2012. Se obtuvo el peso, la altura y la circunferencia de la cintura. Se colectaron datos socioeconómicos, demográficos, de salud, comportamiento alimentar y de estilo de vida con aplicación de un cuestionario al responsable, y su evaluación nutricional. Se usó un modelo de regresión logística binario incondicional para el análisis de los datos. La prevalencia de obesidad fue de 7,21%. El modelo final mostró que el período de lactancia materna  $\geq 6$  meses de edad (OR 5,3; 95% CI: 1,3 – 22,1), el exceso de peso del responsable (OR 7,1; 95% CI: 1,2- 40,2), nivel de actividad física sedentario (OR 4,1; IC 95%: 1,1-15,5) y masticación rápida (OR 7,4; IC 95%: 2,1-26,9) se asociaron significativamente con la obesidad infantil. Este fue el primer estudio a identificar los factores asociados a la obesidad en niños de 7 a 9 años de edad y el más reciente a demostrar la prevalencia de obesidad entre escolares de una ciudad brasileña. Los factores asociados con la obesidad en escolares fueron el período de lactancia materna  $\geq 6$  meses, responsables con exceso de peso, y niños sedentarios que mastican rápidamente. Este estudio contribuye con subsidios para las acciones para la salud previstas en el Programa Salud en la Escuela.

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Palabras clave: *Obesidad. Servicios de salud escolar. Masticación. Lactancia materna. Estilo de vida sedentario.*

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## Abbreviations

ESF: Family Health Strategy.  
GO: Goiás – Brazilian State.  
FSDNAF: Socioeconomic Demographic Nutritional and Physical Activity Form.  
BMI: Body Mass Index.  
INMETRO: National Institute of Metrology, Standardization and Industrial Quality.  
NHANES: National Health and Nutrition Examination Surveys.  
PAQ-C: Physical Activity Questionnaire for Older Children.  
PSE: School Health Program.  
OR: Odds Ratio.  
SPSS: Statistical Package for Social Sciences.  
WHO: World Health Organization.

## Introduction

Childhood obesity is an increasing problem worldwide, seen with alarm by public health professionals since children with excess weight tend to become obese adults, a situation representing a strong risk factor for chronic non-communicable diseases<sup>1</sup>.

In the United States, the National Health and Nutrition Examination Surveys (NHANES) estimated an increase in the prevalence of obesity from 6.5% between 1976 and 1980 to 19.6% between 2007 and 2008 in children aged 6 to 11 years<sup>2</sup>. During the next period (2009-2010) the prevalence was 18%<sup>3</sup>.

Over the last two decades, there has been a three-fold increase in excess weight among Brazilian children<sup>4</sup>. According to the Family Budget Survey (2008/2009), the weight of one in three children aged 5 to 9 years is above the recommendations of the World Health Organization (WHO) and of the Brazilian Ministry of Health<sup>5</sup>. The survey revealed that the prevalence of obesity among Brazilian children in this age range was 14.3%<sup>5</sup>.

The Brazilian Society of Pediatrics (2012) considers the age from seven to nine years to be one of the critical periods for the development of obesity, a worrisome fact due to the association of the condition with metabolic, hepatic, cardiovascular, pulmonary and orthopedic complications and with some types of cancer induced by obesity during adult age<sup>6</sup>.

Obese children may also develop immediate complications such as arterial hypertension<sup>7</sup> type 1 diabetes<sup>8</sup>, metabolic syndrome<sup>9</sup>, and non-alcoholic hepatic steatosis<sup>10</sup>, in addition to psychosocial and behavioral consequences with an impact on the health and quality of life of the child<sup>11</sup>.

A solution for the reduction of the increased prevalence of childhood obesity would be health promotion and prevention<sup>12</sup>. Thus, in order to carry out promoting and preventive actions mediated by public policies in a transdisciplinary and intersectoral manner<sup>13</sup>, it is essential to understand the factors associated with obesity.

The Family Health Strategy (ESF in the Portuguese acronym) is a program of the Brazilian Health Ministry that serves individuals and families in a complete and continuous manner by developing actions aimed at the promotion, protection and recovery of health, with emphasis on the family in its physical and social environment. On this basis, the ESF interacts with the school and is linked to other health services, thus monitoring children who need health care together with the school community and the family<sup>14</sup>.

From this perspective, the School Health Program (PSE in the Portuguese acronym) establishes a link between health, school and family, facilitating population access to health promotion and to the prevention of diseases such as childhood obesity, with a consequent improvement of health conditions<sup>14</sup>.

Few case-control studies evaluating risk factors for obesity from 7 to 9 years of age are available in Brazil. Some of these factors have already been reported to be associated with obesity among children in other age ranges. Factors not previously included such as rapid mastication and taking meals with one's siblings have also been included.

The objective of the present study was to identify the factors associated with obesity in Brazilian children by comparing the sociodemographic, health and life style profiles and the eating behavior of obese and non-obese children assisted by PSE.

## Methods

### *Study design and procedures*

An unpaired case-control study was conducted from November 2011 to May 2012 in Goiânia, the capital city of the State of Goiás (GO), Brazil, with 1,302,001 inhabitants<sup>15</sup> and with a Human Development Index of 0.832<sup>16</sup>.

The Municipal Health Secretariat divides Goiânia into seven sanitary districts with 168 Family Health teams. In 2011, 10 of these belonged to the PSE, divided into four districts (Northwest, North, Southeast and East)<sup>17</sup>.

According to the 2011 school census, Goiânia had 161 municipal schools and 107 state schools devoted to elementary education, with a total of 49,525 students enrolled in 2011, 86.4% of them belonging to the municipal network<sup>18</sup>.

### *Participants and sample*

A cross-sectional study was first carried out to estimate the prevalence of obesity in schoolchildren of both sexes aged 6 to 9 years in 2011, enrolled in eight schools covered by the PSE and located in different regions of Goiânia. Two schools were excluded because they were not frequented by children in the age range under study.

Two other schools were excluded from the case-control study, one of them because it is a school in the rural zone and the other because of a teachers' strike during the study period.

Considering that the number of children enrolled in the PSE schools was 1638, with a 7.8% prevalence<sup>19</sup>, a 95% confidence level, an 80% test power, and a 0.78% absolute error, a sample size of 1204 children was obtained. The sampling calculations were performed using the Statcalc feature of the Epi-info 6.04d software.

During the nutritional screening performed between February and October 2011, 378 children were excluded because they were outside the age range under study or had some type of physical or mental deficiency, because they were transferred or because they failed to attend two visits to the school, with a total of 1249 children thus being evaluated. The flow diagram for sample selection and data collection is illustrated in figure 1.

Of the children evaluated, 90 (7.21%) were classified as obese and 966 (77.34%) as being of normal weight. After screening, 351 low-weight (n=16, 1.28%), overweight (n=177, 14.17%) and normal-weight

children with a  $-2 \leq z$  score  $< -1$  (n=158, 12.65%) were excluded (figure 1).

The inclusion criterion for the case-control study was children of both sexes aged 7 years to 9 years, 11 months and 29 days, who were obese with a z score  $> +2$  or of normal weight with a  $-1 \leq z$  score  $\leq +1$  who frequented the six urbanas schools covered by the PSE em 2012. The children were weighted and measured once again in order to confirm the nutritional diagnosis.

The sample size for the case-control study was calculated considering the following parameters: 95% confidence interval, 80% test power, 40% expected frequency of exposure in the control group, and an Odds ratio of 4.0. On this basis, the sample size obtained was 41 cases and 41 controls at a 1:1 proportion.

However, 808 (64.69%) children with body mass index (BMI) for age between  $-1 \leq z$  score  $\leq +1$  were selected for the control group in order to avoid confounding bias between lower values with low weight.

Of the 90 cases of obesity, 35 did not satisfy the inclusion criteria and 15 were lost (figure 1). Forty of these were interviewed for assignment to the case group.

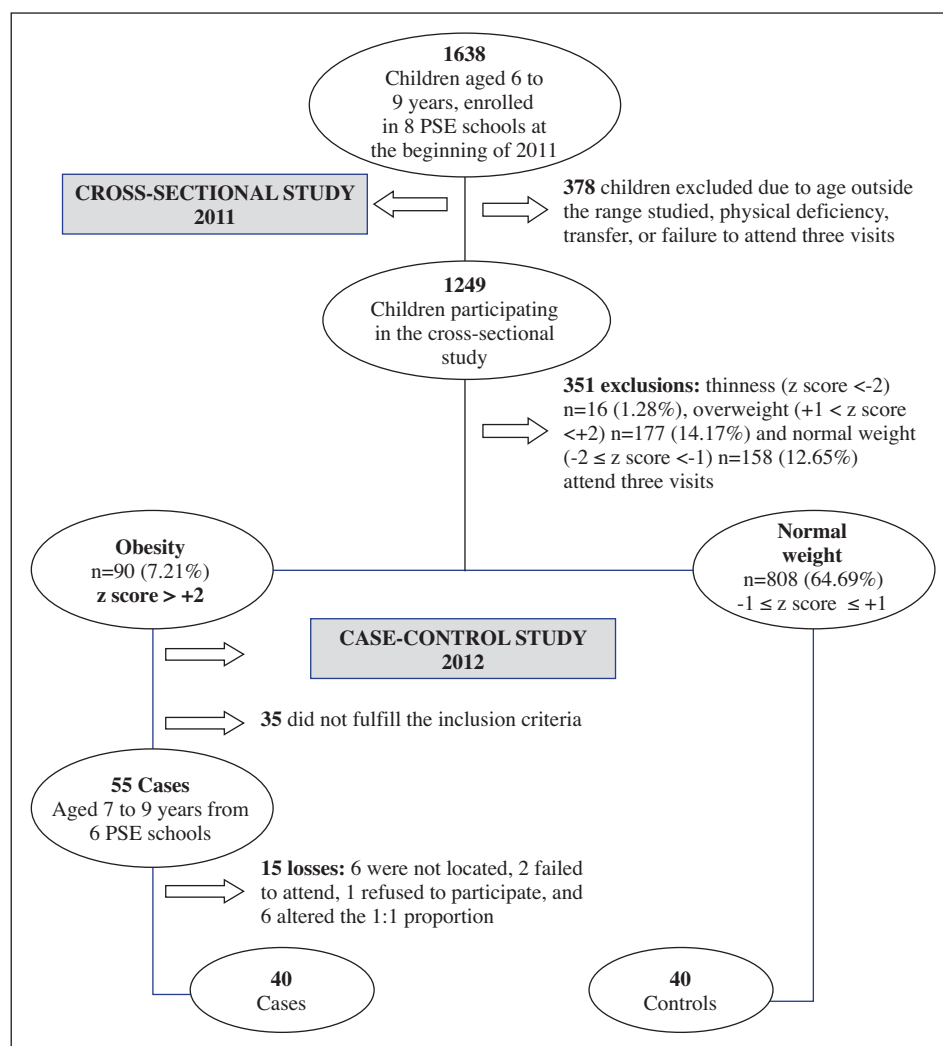


Fig. 1.—Flow diagram of the study and data collection, Goiânia, GO, Brazil, 2012. PSE, Portuguese acronym for School Health Program.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki. Survey protocols, instruments and the process for obtaining informed consent for this study were approved by Human and Animal Research Ethics (n. 204/2010). Written informed consent term was obtained from all subjects.

### *Measurements*

The children were submitted to anthropometric measurements in the schools by a trained team in order to guarantee a standardized determination of weight (kg) and height (cm) and of the prevalence of obesity based on the BMI (kg/m<sup>2</sup>), according to the cut-off points established by the World Health Organization<sup>20</sup> for sex and age. The results obtained were analyzed by calculating the Technical Error of Measurement<sup>21</sup>, which determines the inter- and intra-observer errors.

Weight (kg) was measured with a portable electronic scale (Kratos<sup>®</sup>) with a maximum capacity of 150 kg and precision of 50 g, calibrated by National Institute of Metrology, Standardization and Industrial Quality (INMETRO in the Portuguese acronym), with the child standing up with extended arms, wearing light clothing and no shoes. Height (cm) was measured with a Seca<sup>®</sup> stadiometer fixed to a wall with no baseboard using a retractable tape measure with precision of 0.1 cm, with the head of the child in the Frankfurt plane position, using standard techniques.

The data were analyzed using the WHO AnthroPlus software<sup>22</sup>. The age for nutritional evaluation was calculated as the difference between the date of data collection and the birth date.

The measurements were obtained in duplicate for each child, with care taken that the difference between evaluations would not exceed 0.5 cm, in order to guarantee precision. If this limit was exceeded, the measurement was repeated and the mean of the closest values was used.

The weight (kg) and height (m) of the persons responsible were also measured and their nutritional status was evaluated using the BMI based on the parameters defined for adults or elderly persons<sup>23,24</sup>.

The cases studied corresponded to children classified as obese whose BMI values for age were  $z$  score  $>+2$ . A randomized control classified as being of normal weight ( $z$  score  $\geq -1$  and  $z$  score  $\leq +1$ ) was selected for each case considering the same criteria for eligibility as used for the cases, such as sex, closest age, same school, and same classroom.

### *Socioeconomic-demographic, nutritional and physical activity data*

The selected children and the persons responsible for them were invited to come to the school to obtain

information about the study, to give written informed consent and to provide information in response to the survey. When coming to the school was not possible, home visits were scheduled and held.

Data were collected using a Socioeconomic Demographic Nutritional and Physical Activity Form (FSDNAF in the Portuguese acronym) elaborated by the authors and previously tested on 10 schoolchildren in order to detect possible difficulties in filling it out. The FSDNAF was used to obtain socioeconomic and demographic data, information about family structure, health history, nutritional status, eating behavior, and lifestyle of the children.

The information about masticatory function was obtained by asking the adapted question of Ochiai et al (2012): "Does the child eat his meals with rapid mastication? Yes or no". The aspect investigated for the assessment of mastication was based on a subjective criterion that depended on the perception of the person responsible<sup>(25)</sup>.

The FSDNAF includes the Physical Activity Questionnaire for Older Children (PAQ-C), translated into Portuguese, validated for the age range under investigation and adapted in order to exclude physical activities not practiced in Brazil<sup>26</sup>. This questionnaire evaluates the level of physical activity during the seven days preceding its application to the children in the presence of the persons responsible for them<sup>26-28</sup>.

### *Statistical analysis*

Data were entered in duplicate and validation was performed using the Epi-Info 6.04d software in order to exclude possible typing errors.

The Kolmogorov-Smirnov test was used to determine the normality of the variables ( $p \geq 0.05$ ). The means and standard deviations and the Student  $t$ -test were calculated for variables with normal distribution. The median, interquartile intervals and the Mann-Whitney test were calculated when the values did not show normal distribution. The chi-square, chi-square partition and Fisher exact test were applied to the categorical variables. Spearman correlation was calculated in order to determine the correlation between variables at least one of which did not show normal distribution.

A non-conditional binary logistic regression model (univariate and multivariate) based on the enter method, the crude and adjusted OR and the 95% confidence interval were applied to determine the effects of risk factors on the prevalent cases. The level of significance was set at  $p < 0.05$  in all analyses.

Block entry was performed in multivariate analysis according to sociodemographic, health, lifestyle and eating behavior data regarding the variables with  $p < 0.20$ . The variables that reduced the adjustment of the model or did not present significance were removed. The final model contained the variables with

p<0.05 adjusted for sex and age as the continuous variable and whether the child ate his meals with his siblings, which permitted a better adjustment of the model. The Hosmer and Lemeshow test (p>0.05) was used to evaluate the adjustment of the model obtained.

The statistical analyses were carried out with the aid of the Statistical Package for the Social Sciences (SPSS) version 18.0 for Windows and the STATA 12.0 software.

## Results

The prevalence of obesity among the children studied was 7.21%, overweight 14.17%, thinness 1.28% e normal ( $-2 \leq z \text{ score} \leq +1$ ) 77.34%. The socioeconomic, demographic and health characteristics of cases and controls are presented in table I.

There was association between excess weight of the person responsible and obesity of the child (p<0.001)

**Table I**  
*Socioeconomic, demographic and health characteristics of the children enrolled in the School Health Program, Goiânia, GO, Brazil, 2012*

Variables	Cases n (%)	Controls n (%)	P
<i>Sex</i>			
Male	24 (60.0)	17 (42.5)	0.12*
Female	16 (40.0)	23 (57.5)	
<i>Age (years)</i>			
7  -- 8	7 (17.5)	7 (17.5)	0.89*
8  -- 9	15 (37.5)	17 (42.5)	
9  --10	18 (45.0)	16 (40.0)	
Median and percentiles †	8.0 (8.0; 9.0)	8.0 (8.0; 9.0)	
<i>Child's schooling (years)</i>			
Median and percentiles †	3.0 (2.0; 3.0)	3.0 (2.0; 4.0)	0.17†
<i>Schooling of the person responsible (years)</i>			
Up to 5	13 (32.5)	14 (35.0)	0.92‡
5 to 10	19 (47.5)	17 (42.5)	
More than 10	8 (20.0)	9 (22.5)	
<i>Family income (minimum wages) §</i>			
Up to 2	25 (62.5)	23 (57.5)	0.33‡
2 to 4	9 (22.5)	14 (35.0)	
More than 4	6 (15.0)	3 (7.5)	
<i>Prematurity</i>			
No	34 (85.0)	36 (90.0)	0.50*
Yes	6 (15.0)	4 (10.0)	
<i>Birth weight (g)</i>			
Low (2500)	4 (10.0)	3 (7.5)	0.04‡
Adequate ( $\geq 2500 < 4000$ )	28 (70.0)	36 (90.0)	
High ( $\geq 4000$ )	8 (20.0)	1 (2.5)	
<i>Breast-feeding</i>			
Yes	37 (92.5)	37 (92.5)	0.66‡
No	3 (7.5)	3 (7.5)	
<i>Time of breast-feeding (months)</i>			
Less than 6 monthss	7 (18.9)	16 (43.2)	0.02*
$\geq 6$ months	30 (81.1)	21 (56.8)	
<i>Nutritional status of the person responsible</i>			
Normal weight	3 (7.5)	18 (45.0)	0.001*
Overweight	14 (35.0)	10 (25.0)	
Obesity	23.0 (57.5)	12 (30.0)	
<i>Level of physical activity (PAQ-C)</i>			
Active	12.0 (30.0)	20 (50.0)	0.07*
Sedentary	28.0 (70.0)	20 (50.0)	

\* Chi-square.

† Mann-Whitney: Median (25th percentile; 75th percentile).

‡ Fisher exact test.

§ Current minimum wages (2011 and 2012).

(table I). Children breast-fed for 6 months or more had a crude OR of 4.4 for obesity (95% CI:1.5-13.5) (table II).

Bivariate analysis showed that children with a high birth weight ( $\geq 4.000$  g) had a 10.3 times higher risk to become obese than those born with adequate weight (table II). A breast-feeding time  $\geq 6$  months ( $p=0.02$ ),

overweight ( $p=0.004$ ) or obesity ( $p=0.001$ ) of the person responsible, fast chewing ( $p=0.001$ ) and not taking meals in the presence of siblings ( $p=0.009$ ) were associated with childhood obesity (table II).

There was no correlation between duration of breastfeeding and per capita income ( $r=0.045$ ;  $p=0.701$ ) or schooling of the person responsible ( $r=-0.003$

**Table II**  
*Sociodemographic, health, lifestyle and eating behavior characteristics of the children enrolled in the School Health Program, Goiânia, GO, Brazil, 2012*

Variables	Cases n (%)	Controls n (%)	P	Crude OR 95% CI	P <sup>+</sup>
<i>Sex</i>					
Male	24 (60.0)	17 (42.5)	0.12*	1.00	
Female	16 (40.0)	23 (57.5)		0.49 (0.2-1.2)	0.12
<i>Age (years)</i>					
7  -- 8	7 (17.5)	7 (17.5)	0.89*	1.00	0.89
8  -- 9	15 (37.5)	17 (42.5)		1.12 (0.32-3.9)	0.85
9  --10	18 (45.0)	16 (40.0)		1.28 (0.48-3.4)	0.62
<i>Birth weight (g)</i>					
Adequate (>2500<4000)	28 (70.0)	36 (90.0)	0.04†	1.00	
Low (2500)	4 (10.0)	3 (7.5)		1.71 (0.35-8.29)	0.50
High (> 4000)	8 (20.0)	1 (2.5)		10.26 (1.21-86.72)	0.03
<i>Time of breast-feeding (months)</i>					
Less than 6 monthss	7 (18.9)	16 (43.2)	0.02*	1.00	
$\geq 6$ months	30 (81.1)	21 (56.8)		4.40 (1.5-13.5)	0.02
<i>Nutritional status of the person responsible</i>					
Normal weight	3 (7.5)	18 (45.0)	0.001*	1.00	
Overweight	14 (35.0)	10 (25.0)		8.40 (1.94-36.40)	0.004
Obesity	23.0 (57.5)	12 (30.0)		11.49 (2.81-46.95)	0.001
<i>Level of physical activity (PAQ-C)</i>					
Active	12.0 (30.0)	20 (50.0)	0.07 *	1.00	
Sedentary	28.0 (70.0)	20 (50.0)		2.33 (0.93-5.84)	0.07
<i>Smoking (passive)</i>					
No	33 (82.5)	37 (92.5)	0.18*	1.00	
Yes	7 (17.5)	3 (7.5)		2.62 (0.62-10.94)	0.19
<i>Eats every 3 hours</i>					
Yes	15 (38.5)	22 (55.0)	0.14*	1.00	
No	24 (61.5)	18 (45.0)		1.96 (0.80-4.79)	0.14
<i>Fast chewing</i>					
No	13 (32.5)	29 (72.5)	<0.0001*	1.00	
Yes	27 (67.5)	11 (27.5)		5.48 (2.10-14.30)	0.001
<i>Has a second helping</i>					
No	10 (25.0)	17 (42.5)	0.10*	1.00	
Yes	30 (75.0)	23 (57.5)		2.22 (0.86-5.74)	0.10
<i>Eats his meals with his siblings</i>					
Yes	27 (69.2)	37 (94.9)	0.003*	1.00	
No	12 (30.8)	2 (5.1)		8.22 (1.70-39.80)	0.009
<i>Eats while studying/doing a task</i>					
No	36 (90.0)	39 (97.5)	0.18†	1.00	
Yes	4 (10.0)	1 (2.5)		4.33 (0.46-40.61)	0.199

OR = Odds Ratio.

\* Chi-square.

† Fisher exact test.

‡ Bivariate logistic regression

p=0.800). There was a positive correlation between the BMI of the child and the duration of breastfeeding (r=0.413 p< 0.001), i.e., the longer the duration of breastfeeding, the higher the BMI of the child.

Regarding eating behavior, according to the perception of the persons responsible, 67.5% of the obese children chewed fast. Bivariate analysis showed that the chance of being obese was 8.2 times higher among children who did not eat their meals with their siblings. However, multivariate analysis showed that this variable continued to adjust the model although it lost significance (tables II and III).

The final model showed that the duration of breast-feeding  $\geq 6$  months of age (adjusted OR: 5.3; 95% CI: 1.3-22.1), excess weight of the person responsible (adjusted OR:7.1; 95% CI: 1.2-40.2), sedentary level of physical activity according to the PAQ-C (adjusted OR: 4.1; 95% CI: 1.1-15.5) and rapid chewing (adjusted OR: 7.4; 95% CI: 2.1-26.9) were significantly associated with the risk of childhood obesity (table III). The Hosmer and Lemeshow test showed a value of p=0.57, which confirmed the adjustment of the selected model.

## Discussion

This was the first case-control study to identify the factors associated with obesity in children aged 7 to 9 years in the Center-West region of Brazil and the

second-case control study in Brazil covering the 7-9 year age range. The prevalence of obesity detected was high, in agreement with the prevalence at the national level<sup>19</sup>.

This was a case-control study, a useful tool for the analysis of risk factors for the development of obesity, which also represents one of the most efficient types of design in terms of time, money and effort, with no risk of adverse situations for those involved in the investigation<sup>29</sup>.

The results show evidence of an association between breast-feeding time  $\geq 6$  months and the development of childhood obesity, demonstrating that prolongation of breast-feeding beyond 6 months does not protect against obesity from 7 to 9 years of age. There was also a positive correlation between duration of breastfeeding and child's BMI in this age range. Other studies also did not observe a significant protective effect of prolonged breast-feeding against childhood obesity<sup>30,31</sup>.

A progressive increase in the prevalence of breast-feeding has occurred in the United States, but the rates of childhood obesity have also increased over the last few years. These results seem to support the notion that multiple factors are involved in the maintenance of a healthy weight and that breast-feeding should not be considered to be the only preventive measure against childhood obesity<sup>23</sup>.

Thus, we may infer that prolonged breast-feeding, although important for other reasons, was unable to

**Table III**  
Risk factors for obesity among children enrolled in the School Health Program, Goiânia, GO, Brazil, 2012.

Variables	Cases n (%)	Controls n (%)	Crude OR* 95% CI	P	Adjusted OR † 95% CI	P
<b>Sex</b>						
Female	16 (40.0)	23 (57.5)	1.0		1.0	
Male	24 (60.0)	17 (42.5)	0.5 (0.2-1.2)	0.12	2.7 (0.8-9.8)	0.12
<b>Time of breast-feeding (months)</b>						
Less than 6 monthss	7 (18.9)	16 (43.2)	1.0		1.0	
$\geq 6$ months	30 (81.1)	21 (56.8)	4.4 (1.5-13.5)	0.02	5.3 (1.3-22.1)	0.02
<b>Nutritional status of the person responsible</b>						
Normal weight	3 (7.5)	18 (45.0)	1.0		1.0	
Overweight	37 (92.5)	22 (55.0)	10.1 (2.7-38.2)	0.001	7.1 (1.2-40.2)	0.03
<b>Level of physical activity (PAQ-C)</b>						
Active	12.0 (30.0)	20 (50.0)	1.0		1.0	
Sedentary	28.0 (70.0)	20 (50.0)	2.3 (0.9-5.8)	0.07	4.1 (1.1-15.5)	0.04
<b>Fast chewing</b>						
No	13 (32.5)	29 (72.5)	1.0		1.0	
Yes	27 (67.5)	11 (27.5)	5.5 (2.1-14.3)	0.001	7.4 (2.1- 26.9)	0.002
<b>Eats his meals with his siblings</b>						
Yes	27 (69.2)	37 (94.9)	1.00		1.00	
No	12 (30.8)	2 (5.1)	8.2 (1.7-39.8)	0.009	4.6 (0.7- 29.1)	0.10

OR = Odds Ratio. Hosmer and Lemeshow test, p=0.57.

\* Bivariate logistic regression.

† Adjusted for sex, age (continuous variable) and for whether he eats with his siblings.

prevent obesity among schoolchildren from a Brazilian city. We emphasize that there was no correlation between duration of breastfeeding and educational or income level of the person responsible. A recent meta-analysis detected a reduction of approximately 10% in the prevalence of overweight/obesity in children exposed to a longer duration of breastfeeding. However, it should be pointed out that confounding biases may have affected the results and that protection is not evident, since in most studies the duration of breastfeeding was longer in families whose persons responsible had higher schooling and income levels<sup>32</sup>.

We detected a larger number of obese children whose persons responsible had excess weight, in agreement with several studies demonstrating that children with one or both parents with excess weight have a higher risk to develop obesity<sup>33,34</sup>.

The level of physical activity was lower among obese children compared to children of normal weight evaluated by the PAQ-C. This finding is important because it shows that the PAQ-C can be used in this age range for the identification of sedentarism. However, a limitation of the PAQ-C is that it does not discriminate the intensity, frequency and duration of the activities and does not estimate the calorie expenditure during the period studied<sup>27</sup>.

Despite the difficulty in applying the PAQ-C, especially to younger children, the senior investigator herself filled out the questionnaire in the presence of the person responsible. These data agree with those reported by Alves et al. (2009), who observed a larger number of sedentary children among overweight and obese subjects<sup>27</sup>.

The current study indicates the presence of a significant relationship between obesity among schoolchildren and fast chewing, corroborating another study in which normal-weight children showed a better masticatory performance than obese children<sup>35</sup>. Other findings suggest that careful mastication may be a factor to be explored in the efforts to prevent childhood obesity<sup>25</sup>.

### *Strengths and limitations*

This is one of the few studies that have evaluated the association of fast chewing with childhood obesity. In Brazil, this is the first case-control study to detect that fast chewing is a risk factor for obesity in multivariable analysis.

Because this was a retrospective study, the memory bias of the person responsible and of the child represents one of its limitations. However, the present study points out prolonged breast-feeding as a risk factor for childhood obesity, demonstrating the importance of not considering breast-feeding simply as a preventive factor. Other aspects are involved, such as environmental factors represented by excess weight of the persons responsible, greater sedentarism of obese children, and fast chewing.

To our knowledge this study is the first case control in Brazil that shows that PAC-C can be used in obese children aged 7 years to 9 years for the identification of sedentarism.

### *Conclusion*

We conclude that the risk factors for obesity among schoolchildren enrolled in the School Health Program were duration of breast-feeding of more than 6 months, persons responsible with excess weight, sedentary children, and children that chew fast. Further investigations of the relationship between duration of breastfeeding and obesity are needed, regardless of income or schooling level.

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