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Original

Early determinants of overweight and obesity at 5 years old in preschoolers from inner of Minas Gerais, Brazil

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Abstract

Introduction: **Brazil is experiencing a nutritional transition characterized by a reduction in the prevalence of nutritional deficits and an increase in overweight and obesity, not only in adults but also in children and adolescents.**

Objectives: **This study was designed to evaluate the factors associated with overweight and obesity in Brazilian 5-year-old preschoolers.**

Methods: **A cross-sectional study of a cohort of 232 preschoolers born in Diamantina/Minas Gerais, Brazil, was undertaken. The data, including socioeconomic status, anthropometry, diet, previous history of the preschoolers and family history, were collected between July of 2009 and July of 2010. To identify the factors associated with overweight and obesity, a logistic regression and a hierarchical model were undertaken.**

Results: **Overweight and obesity occurred in 17.2% of the preschoolers. After adjusting for mother's obesity, per capita income, protective food intake, weight gain at age 0-4 months and time spent playing, the factors associated with overweight and obesity that reached statistical significance were mother's obesity [OR = 3.12 (95% CI 1.41-6.91), P = 0.01], weight gain of more than 0.85 kg/month in the first four months of life [OR = 2.16 (95% CI 1.01-4.64), P = 0.04] and lower per capita income [OR = 0.32 (95% CI 0.13-0.79), P = 0.01].**

Conclusion: **The results show that more weight gain during the first four months of life and being born of mothers with obesity increased the odds of overweight/obesity in the preschoolers, while lower per capita income was a protective factor.**

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Key words: *Preschool. Overweight. Obesity. Income.*

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LOS PRIMEROS DETERMINANTES DEL SOBREPESO Y LA OBESIDAD A LOS 5 AÑOS DE EDAD EN PREESCOLARES DEL INTERIOR DE MINAS GERAIS, BRASIL

Resumen

Introducción: **Brasil está experimentando una transición nutricional caracterizada por una reducción en la prevalencia de deficiencias nutricionales y un aumento del sobrepeso y la obesidad, no sólo en los adultos sino también en los niños y los adolescentes.**

Objetivos: **Este estudio se diseñó para evaluar los factores asociados con el sobrepeso y la obesidad en preescolares brasileños de 5 años de edad.**

Métodos: **Se realizó un estudio transversal de una cohorte de 232 preescolares nacidos en Diamantina/Minas Gerais, Brasil. Los datos, que incluían situación socioeconómica, antropometría, dieta, antecedentes de los preescolares y familiares, se recogieron entre julio de 2009 y julio de 2010. Para identificar los factores asociados con sobrepeso y obesidad, se realizaron una regresión logística y un modelo jerárquico.**

Resultados: **El sobrepeso y la obesidad ocurrieron en el 17,2 % de los preescolares. Tras ajustar para obesidad materna, la renta per cápita, la ingesta de alimentos, la ganancia de peso entre los 0-4 meses de edad y el tiempo dedicado al juego, los factores asociados con el sobrepeso y la obesidad que alcanzaban una significación estadística fueron la obesidad materna [OR = 3,12 (IC al 95 % 1,41-6,91), P = 0,01], la ganancia de peso de más de 0,85 kg/mes en los primeros 4 meses de vida [OR = 2,16 (IC al 95 % 1,01-4,64), P = 0,04] y una menor renta per cápita [OR = 0,32 (IC al 95 % 0,13-0,79), P = 0,01].**

Conclusión: **Los resultados muestran que la mayor ganancia de peso durante los 4 primeros meses de vida y tener una madre obesa aumentan las probabilidades de sobrepeso/obesidad en los preescolares, mientras que una menor renta per cápita es un factor de protección.**

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Palabras clave: *Preescolares. Sobrepeso. Obesidad. Renta.*

Abbreviations

HDI: Human development index.

FUVJM: Federal University of Vales of Jequitinhonha and Mucuri.

BMI: Body mass index.

FFQ: Food frequency questionnaire.

EER: Estimated energy requirement.

TEV: Total energy value.

AMDR: Acceptable Macronutrients Distribution Range.

EI: Energy intake.

TV: Television.

FAPEMIG: Foundation for Research Support of Minas Gerais.

Introduction

Brazil is experiencing a nutritional transition characterized by a reduction in the prevalence of nutritional deficits and an increase in overweight and obesity, not only in adults but also in children and adolescents.[1]

The prevalence of overweight and obesity in childhood differs among countries, and overweight is more prevalent than obesity. This prevalence varies from 0.2% to 32.8% for overweight and from 0.2% to 16.2% for obesity.[1-4] Recent reports of the global prevalence of childhood overweight and obesity trends cite alarming data: in 2010, 43 million children, 35 million in developing countries and 8.1 million in developed countries, were overweight or obese. The worldwide prevalence for such disorders increased from 4.2% to 6.7%, and the prediction for 2020 is 9.1%, or 60 million[5] unhealthy dietary practices.

The increased prevalence of childhood obesity is believed to be due to a combination of genetic causes, pre- and post-natal factors such as increasingly sedentary lifestyles and unhealthy dietary practices,[6-8] gender,[9-12] more weight gain during the first months of life,[10,12,13-16] lowest duration of breastfeeding,[7,12,17,18] maternal overweight/obesity,[9,10] low levels of maternal education,[7,11,12] smoking during pregnancy and low per capita family income.[4,10]

The association of pre and post-natal factors with overweight and obesity in childhood has been extensively explored among children globally; however, most studies were conducted in developed countries and literature in this regard is scarce for studies of preschoolers in developing countries, especially with prospective cohort design. In light of these considerations, this study aimed to contribute to the identification of factors that are associated with overweight and obesity in preschoolers from a Brazilian-born cohort from Diamantina/Minas Gerais.

Methods

Subjects and study setting

The subjects of this study were 5-year-old (± 5 months) children of both genders from a cohort born in, and residents of the city of, Diamantina/Minas Gerais/Brazil. These children were evaluated and monitored previously by Lessa[19] in a study cohort of children born between September 2004 and July 2005, who studied growth and development in the first years of life. During the period of September 2004 and July 2005, 310 children were born in Diamantina and 281 were eligible for the cohort and were monitored in their first year of life.

Diamantina is a municipality located in the Jequitinhonha Valley in Minas Gerais, Brazil. At present, the mortality rate among children younger than 1 year is 32.8/1.000, the literacy rate is 83.4%, the human development index (HDI) is 0.748 and the HDI income is 0.752. Among the households, 90.76% are supplied with treated water, 70.7% with a sewage system and 69.67% with garbage collection.[20]

The data collection for this study occurred during the period of July 2009 through July 2010. The data were collected by four nutritionists and one student in a Nutrition Course of the Federal University of Vales do Jequitinhonha and Mucuri- FUVJM. Before the start of the study, the researchers were trained in data collection to avoid measurement errors. Each preschooler was visited at his home. The interviews and data collection started only after the parents signed the informed consent that allowed their child to participate in the study.

Anthropometry, dietary and other evaluations

The nutritional status of the children was assessed using weight and height to obtain the body mass index (BMI). Subjects were weighed on a digital and portable scale with a maximum capacity of 150 kg and with divisions of 50 g. Height was measured with a portable stadiometer, with a scale accuracy of 0.1. The procedures were according to the protocols recommended by Jelliffe.[21]

The z-score < + 1 identified children with deficit/eutrophy and ≥ +1 identified those with overweight/obesity, according to the BMI/age.[24] To identify the score-z of the children, we used the Software WHO Anthro and WHO Anthro plus versions 3.0.1 and 1.0.3 respectively (WHO, Geneva).

The mothers of the children also underwent anthropometric assessments. Their weights and heights were evaluated to obtain their BMIs. These measures were performed according to Lohman et al.[23]. Values for BMI ≥ 30 kg/m^2 were classified as obesity.[24]

These assessments occurred in the morning. The measurements of preschoolers and their mothers were

performed on a single occasion and took place at the FUVJM during the period of July 2009 through July 2010.

To better evaluation of dietary intake and identify the portion of food consumed by children was using a quantitative food-frequency questionnaire (FFQQ).[25] This FFQQ had besides the frequency of consumption, different size of food portions. An album containing photos of food portions was also used. This album was produced by the authors of the FFQQ[25] for use together with a questionnaire. The FFQQ has shown good agreement with multiple recalls and biomarkers in preschoolers and their outcome has not been compromised when reported by parents.[26]

The FFQQ was adapted to this study. Before its implementation, a pilot test was conducted to assess its adequacy for this research. The foods not mentioned by the families of preschoolers were excluded, and others were added to the FFQQ. The nutrient composition was analyzed by the software Diet PRO (version 5i).

The food items of the FFQQ were grouped into two categories: risk (cakes, sweets, sodas, frying, candy and stuffed cookies) and protective (milk, dairy products, vegetables and fruits) for overweight/obesity. Although milk has been associated with obesity, some research[27] has found that the calcium present in milk exerts a protective effect against obesity, so milk and dairy products were included in the protective foods group for overweight/obesity.

The frequency of the food intake of the groups was summarized in a single value (summary measure) for each preschooler according to the methodology used by Neumann et al.,[28] which is represented by the following formula:

$$\frac{(\Sigma \text{ frequency of intake of food contained in the group})}{\text{N}^{\text{o}} \text{ of the food of the group} * \text{maximum frequency of consumption of the FFQQ}}$$

For example, for a given individual, the sum of the frequencies coded for the group protective foods was 268. In this food group, the maximum consumption would be 350 (the group contains 50 foods, that number was multiplied by 7). Thus, the score intake of protective foods for the individual in question was 268/350 = 0.7. In this way, summary-measures for each individual were obtained.

The food groups are presented as a discrete variable, which was obtained by the sum of the frequencies of the intake of the foods contained in each group. After they were categorized into a dichotomous variable (0 and 1), we used the category of high (1) or low (0) frequency of intake for the values above or below the first quartile, respectively.

The evaluation of energy intake was performed using the estimated energy requirement (EER), which is the energy needed to meet the energy balance compatible with good health.[29] The physical activity factor used was 1.16 for the girls and 1.13 for the boys. A decision was made to utilize a low activity factor because the children spent an average of 3 hours/day playing, and only nine participated in scheduled physical activities (e.g., swimming, soccer, and ballet). The adequacy of the relative distribution of macronutrients in the diet compared to the total energy value (TEV) was evaluated using as reference values the recommended Acceptable Macronutrients Distribution Range (AMDR): carbohydrates, 45% to 65%; proteins, 10% to 30%; and lipids, 25% to 35% of TEV.[29]

Considering the possibility of under-/over-reporting of the dietary intake, we also assessed the occurrence of this problem in our sample. For this assessment, we used the methodology proposed by Burrows et al.,[30] in which the value for energy intake (EI) was divided by EER (EI/EER). An EI/EER less than 0.84 indicates under-reporting, an IE/EER greater than 1.16 indicates over-reporting and an IE/EER between 0.85 to 1.16 indicates accurate reporting.

Additional information about the determinants of overweight and obesity was obtained through a questionnaire that was administered to the mother or caregiver in the home of the child. Data were collected on information surrounding the family's monthly income, maternal education, and the time spent by children on games and television (TV). Information about whether the mother smoked during pregnancy, duration of breastfeeding, and weight at birth and during the first four months of life was obtained through the database of the researcher responsible for the cohort study cited above.

Statistical analysis

Simple frequencies of variables such as socioeconomic, maternal, and previous and current data on preschoolers were used to characterize the studied population.

A analysis was performed using multiple logistic regression. This analysis followed an approach determining hierarchy[31] (fig. 1), which means that the more distal variables determined the group of intermediate variables and outcome. Only variables with a p-value < 0.2 in the bivariate analysis were used in the adjusted analysis. Once included in the model and reaching a p-value < 0.10, the variables were maintained until the end, independent of the p-value in the successive stages. In the final model, variables associated with overweight/obesity with p-value < 0.05 were considered significant.

The sample power was calculated post-hoc using the parameter risk difference for being overweight/obese in relation to weight gain in the first 4 months of life obtained by a logistic regression, which was 2.41. The power obtained was 99% using the statistical software "G*Power".[32]

Ethics approval (ref. nº ETIC 545/08) was obtained from the Federal University of Minas Gerais. Statis-

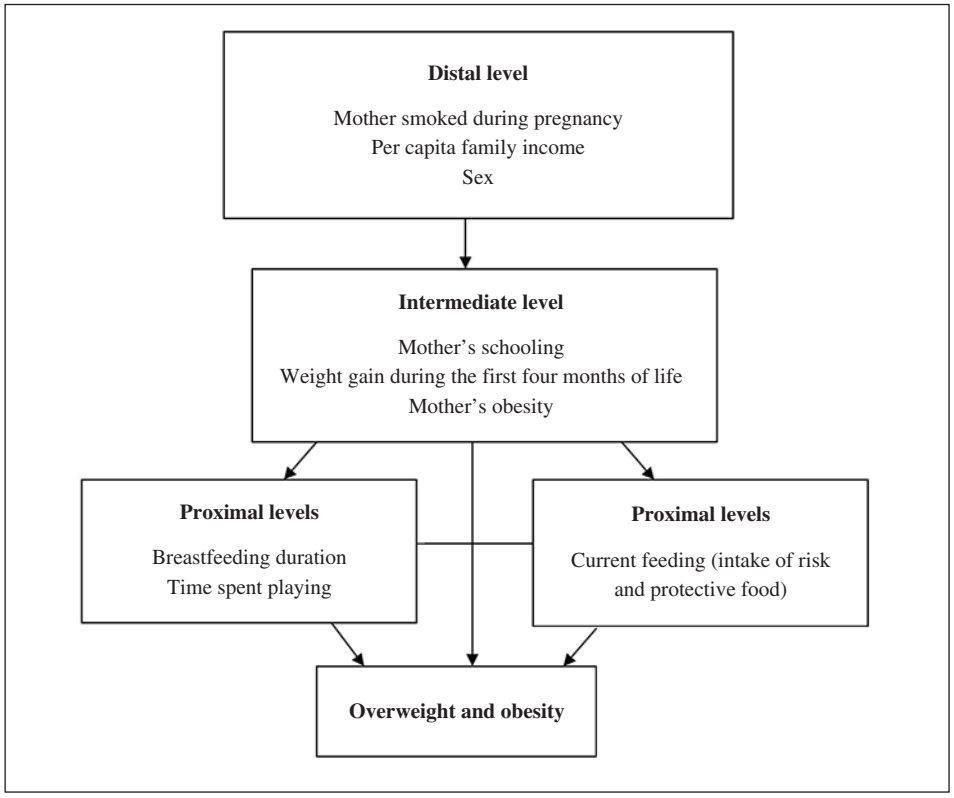

Fig. 1.—Hierarchical framework of factors associated with overweight and obesity in preschoolers.

tical analysis was performed using the Statistical Package for Social Sciences - PASW- version 19.0 for Windows system (SPSS Inc., Chicago, IL, USA).

Results

Weight and height data were obtained for 232 children of the 281member birth cohort, including 142 boys (61.2%) and 90 girls (38.79%). The distribution of normal weight, overweight and obesity was 192 (82.8%), 38 (16.4%) and 2 (0.9%), respectively. We included the underweight children in the normal weight group because of the small number of individuals involved (n = 7). Overweight and obese children were also combined into one group in the analysis. The prevalence of overweight/obesity was 17.3%, with 16.2% (n = 23) in boys and 18.9% (n = 17) in girls.

A majority of the preschoolers, who are overweight/obese, live in a household with more than half the minimum wage per capita, spend more than two hours per day watching TV, had a body weight gain in the first four months of life greater than 0.85 g/month and have obese mothers (table I). About the estimation of dietary intake among the eutrophic, the under-reporting, true reporting and over-reporting was similar, while in the overweight/obesity group, under-reporting was more prevalent (table I).

The evaluation of the percentage of energy intake provided by macronutrients found that for preschoolers, on average, there was an adequate energy distribution, with 60.9% provided from carbohydrates, 26.8% from lipids and 12.3% from protein (data not shown).

Table II shows the results of the bivariate and adjusted analyses for factors associated with overweight/obesity. In the bivariate analysis, maternal obesity, average weight gain from 0 to 4 months, per capita family income, intake of protective food groups and time spent playing were associated with overweight/obesity.

By the adjusted analysis, the preschoolers of obese mothers had a three times greater chance of being overweight/obese (OR = 3.17; p = 0.01) when compared with children of non-obese mothers. Children who had a higher average weight gain in the first four months of life had a greater than double chance of being overweight/obese at 5 years old (OR = 2.41; p = 0.02), and those with lower per capita family income had a 68% (OR = 0.32; p = 0.01) lower chance of being overweight/obese (table II).

Of the 281 children in the original cohort, 232 (82.56%) were included in the present study. The loss of 17.33% during follow-up was due to families moving away from the area (n = 37; 75.51%), incorrect addresses (n = 8, 16.33%) and family refusal to participate (n = 4; 8.16%).

Discussion

The results of this research are consistent with previous studies, in which researchers found an

Table I
Socioeconomic, maternal, previous and current characteristics of preeschoolers according to nutritional status. Diamantina, Minas Gerais, Brazil

Variables	Overall (n = 232)		Eutrophic (n = 192)		Overweight/obesity Obesity (n = 40)	
	n	%	n	%	n	%
Per capita income (US$)[1]						
< 144.1	85	36.6	65	33.9	20	50.0
≥ 144.1	147	63.4	127	66.1	20	50.0
Mother's schooling (full years)						
< 9	115	49.6	95	49.5	20	50.0
≥ 9	117	50.4	97	50.5	20	50.0
Mother smoked in pregnancy						
Yes	43.0	18.5	38	19.8	5	12.5
No	189	81.5	154	80.2	35	87.5
Mother's obesity						
Yes	40	17.6	66	13.9	14	35.0
No	187	82.4	161	86.1	26	65.0
Time spent playing (hours/day)						
< 3	73	31.5	57	29.2	16	40.0
≥ 3	159	68.5	135	70.8	24	60.0
Sex						
Female	90	38.79	73	29.7	16	40.0
Male	142	61.2	119	0.3	24	60.0
Breastfeeding duration						
< 6 months	61	26.3	48	25.0	13	32.5
≥ 6 months	171	73.7	144	75.0	27	67.5
Weight gain 0 to 4 months						
< 0.85 kg/month	107	48.2	95	51.9	12	30.8
≥ 0.85 kg/month	115	51.8	88	48.1	27	69.2
Risk food[b]						
< 0.54	56	24.1	47	24.5	9	22.5
≥ 0.54	176	75.9	145	75.5	31	77.5
Protective food[2]						
> 0.57	174	75.0	140	72.9	34	85.0
≤ 0.57	58	25.0	52	27.1	6	15.0
Estimation of dietary intake						
Under-reporting (IE/EER < 0.84)[3]	72	31.0	64	33.3	19	47.5
True reporting (IE/EER 0.84-1.16)	83	35.8	62	32.3	10	25.0
Over-reporting (IE/EER > 1.16)	77	33.2	66	34.4	11	27.5

[1]Value refers to the minimum wage of US$ 288.1.
[2]Value refers to the first quartile of frequencies of the intake of the foods contained in each group.
[3]IE = Energy intake; EER = Estimated energy requirement.

increased prevalence of overweight and obesity in the pediatric population, both in Brazil[1-4] and in other countries.[7,8,11,15]

It is important to highlight that the prevalence of overweight/obesity found in this study is in agreement with the national statistics,[2-4] which show rates of overweight and obesity ranging from 9.5 to 32.8, but these results are much lower than those reported by the national surveys cited earlier.[1]

Considering the high prevalence of the under-reporting of energy intake among those in the overweight/obese group, our dietary data from this group cannot be considered valid because the total under-reporting was not cancelled out by the total over-reporting. Thus, for that group, our intake results can be considered biased according to Black and Cole.[33]

In the present investigation, only three variables were associated with overweight/obesity in preschoolers studied, after the model adjustment: maternal obesity, more average weight gain during the first four months of life and lower per capita family income. These results are in agreement with research that has found

Table II
Crude and adjusted odds ratio with confidence intervals (95% CI), according to the variables associated with overweight and obesity of preschoolers. Diamantina, Minas Gerais, Brazil

Variables	*OR crude*	*P-value*	*95% CI*	*OR adjusted*[5]	*P-value*	*95% CI*
Mother's schooling (full years)						
< 9	1.02	0.95	0.52-2.02	–	–	
≥ 9	1					
Mother's obesity						
Yes	3.33	**0.01**	1.54-7.21	3.17	**0.01**	1.42-7.08
No	1			1		
Mother smoked in pregnancy						
Yes	0.58	0.28	0.21-1.78	–	–	
No	1					
Per capita family income[1]						
< 144.1	0.51	**0.05**	0.26-1.02	0.32	**0.01**	0.13-0.79
≥ 144.1	1					
Risk food[2]						
≥ 0.54	1.12	0.79	0.49-2.51	–	–	
< 0.54	1					
Protective food[2]						
< 0.57	0.47	**0.11**	0.19-1.19	–	–	
≥ 0.57	1					
Breastfeeding duration						
≤ 6 months	1.44	0.33	0.69-3.02	–	–	
> 6 months	1					
Weight gain 0 to 4 months[3]						
≥ 0.85 kg/month	2.43	**0.02**	1.16-5.09	2.41	**0.02**	1.10-5.27
< 0.85 kg/month	1			1		
Time spent playing[4]						
< 3	1.58	**0.20**	0.78-3.19	–	–	
≥ 3	1					
Sex						
Female	1.20	0.59	0.60-2.41	–	–	
Male	1					

[1]Value refers to the minimum wage of US$ 288.1.
[2]Value refers to the first quartile of frequencies of the intake of the foods contained in each group.
[3]Value refers to the median of time (hours/day) spent playing.
[4]Value refers to the median of weight gain 0 to 4 months.
[5]Ajusted analyses for mother's obesity, per capita income, protective food intake, weight gain between 0 to 4 months and time spent playing.

that overweight and obesity in children is associated with maternal obesity,[9,10] with a high weight gain during the first months of life[10,12-16] and low family income.[1,4,34]

The familial characteristic of obesity, determined by the co-occurrence of obesity in schoolchildren and their parents, has been documented in the literature.[9,10] Thus, mothers/parents who have this problem must be more attentive when feeding and providing physical activity for their children. Johanssen et al.[35] cite that the feeding of children involves intense interactions between parents and children, which might contribute to the formation of the child's feeding habits. Usually, parents select the feeding method for their newborn baby and determine, along with their economic resources and cultural background, which foods will be made available.

It is important to elucidate that feeding habits in an environment where people are obese tend to be inadequate. It is common to have a high intake of foods rich in fat and simple carbohydrates as well a low intake of fruits and vegetables. Thus, when genetic predisposition coexists with a sedentary lifestyle and dietary errors, the chance of becoming overweight during childhood is great.

Rapid weight gain in the first months of life has been associated in several studies with overweight/obesity in childhood.[10,12-16] One possible biological mechanism that could explain this relationship is that the prenatal period, infancy, and early childhood are stages of

particular vulnerability because they are critical periods for cellular differentiation and development; therefore, over-nutrition in infancy could adversely program the components of the metabolic syndrome and the way that energy is stored.[36]

Mihrshahi et al.[16] cite that rapid weight gain in early life is associated with formula milk feeding; this occurs possibly due to actual content of formula milk (e.g., higher protein intake) or differences in feeding styles, such as feeding to schedule, which increase the risk of overfeeding. Infant weight gain might be associated not only with type of milk consumed but also with mode of milk delivery. Regardless of the milk type in the bottle, bottle-feeding might be distinct from feeding at the breast in its effect on infants' weight gain.[37]

In the present study, a low per capita family income was a protective factor for overweight/obesity. This result is in agreement with results reported by Gabriel et al.[4] and with national survey[1] who evaluated overweight/obesity in schoolchildren and observed that in recent years this problem increased in the lower income population, however, the highest prevalence remains in the higher income population. And is in agreement also with observation was made by Dinsa et al.[34] who found in a systematic review of obesity and socioeconomic status in developing countries that obesity in children appears to be predominantly a problem of the rich in low- and middle-income countries.

The relationship between poverty and obesity appears to differ between rich countries and poor. Children born in the Canadian province of Quebec being raised in middle-income or in poor families presented more than double the odds of being overweight at 4.5 years.[10] One explanation for this difference is possibly that the epidemiological transition has not occurred completely yet in the poor countries, while in rich countries had already experienced the full transition.

It is important to elucidate the limitations of the present study. The most important limitations are related to the cross-sectional design, which in some circumstances could be considered inappropriate for investigating the frequency of food intake and anthropometric characteristics. In this type of study, reverse causality can occur, in which mothers of children with excess weight could be offering healthier foods to their children compared to their usual offerings. The food frequency questionnaire used in the present study registered dietary intakes for less than a month; thus, this limited range could be more sensitive to the effect of reverse causality.[38] Nevertheless, when assessing the intake frequency of risk and protection groups for overweight and obesity, a higher mean intake of protective foods occurred among preschool-aged children who were overweight/obese, which can characterize the effect of reverse causality.

This study showed that high weight gain during the first four months of life and being born to a mother with obesity increase the odds of being overweight/obesity among preschoolers. These results indicate the need for good prenatal care and monitoring in the first years of childhood aimed at advising mothers about breastfeeding and adequate nutrition for their children. This scenario could also help to demystify the notion that a healthy baby is the one with the highest rate of weight gain per month. Encouragement of physical activity at school and the advisement of mothers/families in choosing healthy foods as early in life as possible can contribute to the prevention of overweight/obesity in childhood and later life.

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Referencias

1. Instituto Brasileiro de Geografia e Estatística (IBGE). Pesquisa de orçamentos familiares, 2008-2009 (POF): Antropometria e análise do estado nutricional de crianças, adolescentes e adultos no Brasil; 2010.
2. Ribeiro RQC, Lotufo PA, Lamounier JA, Oliveira RG, Soares JF, Botter DA. Additional Cardiovascular Risk Factors Associated with Excess Weigth in Children and Adolescents. The Belo Horizonte Heart Study. *Arq Bras Cardiol* 2006; 86 (6): 408-18.
3. Vitolo MR, Gama CM, Bortolini GA. Alguns fatores associados a excesso de peso, baixa estatura e déficit de peso em menores de 5 anos. *J Pediatr* 2008; 84 (3): 251-7.
4. Gabriel CG, Corso ACT, Caldeira GV, Gimeno SG, Schmitz B de A, de Vasconcelos F de A. Overweight and obesity related factors in schoolchildren in Santa Catarina State, Brazil. *Arch Latinoam Nutr* 2010; 60 (4): 332-9.
5. Onis M, Blösner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. *Am J Clin Nutr* 2010; 92 (5): 1257-64.
6. Siqueira PP, Alves JGB, Figueiroa JN. Fatores associados ao excesso de peso em crianças de uma favela do Nordeste brasileiro. *Rev Paul Pediatr* 2009; 27 (3): 251-7.
7. Jiménez-Cruz A, Bacardí-Gascón M, Pichardo-Osuna A, Mandujano-Trujillo Z, Castillo-Ruiz O. Infant and toddlers' feeding practices and obesity amongst low-income families in Mexico. *Asia Pac J Clin Nutr* 2010; 19 (3): 316-23.
8. Mushtaq MU, Gull S, Mushtaq K, Shahid U, Shad MA, Akram J. Dietary behaviors, physical activity and sedentary lifestyle associated with overweight and obesity, and their socio-demographic correlates, among Pakistani primary school children. *IJBNPA* 2011; 8 (1): 130-43.
9. Giugliano R, Carneiro EC. Fatores associados à obesidade em escolares. *J Pediatr* 2004; 80 (1): 17-22.
10. Dubois L, Girard M. Early determinants of overweight at 4.5 years in a population-based longitudinal study. *Int J Obes* 2006; 30 (4): 610-7.
11. Nakano T, Sei M, Ewis AA, Munakata H, Onischi C, Nakahori Y. Tracking overweight and obesity in Japanese children; a six years longitudinal study. *J Med Invest* 2010; 57 (1-2): 114-23.
12. Lamb MM, Dabelea D, Yin X, Ogden LG, Klingensmith GJ, Rewers M, Norris JM. Early-Life Predictors of Higher Body Mass Index in Healthy Children. *Ann Nutr Metab* 2010; 56 (1): 16-22.
13. Wells JCK, Hallal PC, Wright A, Singhal A, Victora CG. Fetal, infant and childhood growth: relationships with body composition in Brazilian boys aged 9 years. *Int J Obes* 2005; 29 (10): 1192-8.

14. Monteiro PO, Victora CG. Rapid growth in infancy and childhood and obesity in later life-a systematic review. *Obes Rev* 2005; 6 (2): 143-54.
15. Goodell LS, Wakefield DB, Ferris AM. Rapid Weight Gain During the First Year of Life Predicts Obesity in 2-3 Year Olds from a Low-income, Minority Population. *J Community Health.* 2009; 34 (5): 370-5.
16. Mihrshahi S, Battistutta D, Magarey A, Daniels LA. Determinants of rapid weight gain during infancy: baseline results from the NOURISH randomised controlled Trial. *BMC Pediatr* 2011; 11: 99-107.
17. Simon VGN, Souza JMP, Souza SB. Aleitamento materno, alimentação complementar, sobrepeso e obesidade em pré-escolares. *Rev Saúde Pública* 2009; 43 (1): 60-9.
18. Gubbels JS, Thijs C, Stafleu A, van Buuren S, Kremers SP. Association of breast-feeding and feeding on demand with child weight status up to 4 years. *Int J Pediatr Obes* 2011; 6 (22): e515-22.
19. Lessa AC. Alimentação e crescimento no primeiro ano de vida: um estudo de coorte. [Tese] Salvador: Universidade Federal da Bahia. Programa de Pós-Graduação em Saúde Pública. 2010; p. 122.
20. Wikipédia [internet]. Diamantina. Acesso: 27/08/12. Disponível em: http://pt.wikipedia.org/wiki/Diamantina.
21. Jelliffe DB. Evaluación del estado de nutrición de la comunidad. Ginebra: Organización Mundial de La Salud; 1968.
22. World Health Organization. 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**.** Geneva: World Health Organization. Department of Nutrition for Health and Development, 2006.
23. Lohman, TG, Roche AF, Martorell R, editors. Antropometric standerdization reference manual. Abrigged edition, Champaign, IL: Human Kinetics Books. 90 p. 1991.
24. World Health Organization – WHO. Obesity: prevening and managing the global epidemic. Geneva: Report of a WHO Consultation on Obesity; 1998.
25. Sales RL, Silva MMS, Costa NMB, Euclydes MP, Eckhardt VF, Rodrigues CMA, Tinôco ALA. Desenvolvimento de um inquérito para avaliação da ingestão alimentar de grupos populacionais. *Rev Nutr* 2006; 19 (5): 539-52.
26. Parrish LA, Marshall JA, Krebs NF, Rewers M, Norris JM. Validation of a Food Frequency Questionnaire in Preschool Children. *Epidemiology* 2003; 14 (2): 213-7.
27. Tylavsky F, Cowan PA, Terrell S, Hutson M, Velasquez-Mieyer P. Calcium Intake and Body Composition in African-American Children and Adolescents at Risk for Overweight and Obesity. *Nutrients* 2010; 2 (9): 950-64.
28. Neumann AICP, Martins IS, Marcopito LF, Araujo EAC. Padrões alimentares associados a fatores de risco para doenças cardiovasculares entre residentes de um município brasileiro. *Rev. Panam. Salud Pública* 2007; 22 (5): 329-39.
29. National Research Council. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (macronutrients). Washington (DC): National Academy Press. 2002.
30. Burrows TL, Martin RJ, Collins CE. A systematic review of the validity of dietary assessment methods in children when compared with the method of doubly labeled water. *J Am Diet Assoc.* 2010; 110 (10): 1501-10.
31. Victora CG, Hutty SR, Fuchs SC, Olinto MTA. The role of conceptual frameworks in epidemiological analysis: A hierarchical approach. *Int J Epidemiol* 1997; 26: 224-7.
32. Portney LG, Watkins, MP. Foundations of Clinical Research: Applications to Practice. (3rd Edition), Prentice Hall. 2008.
33. Black AE, Cole TJ. Biased over- or under-reporting is characteristic of individuals whether over time or by different assessment methods. *J Am Diet Assoc* 2001; 101 (1):70-80.
34. Dinsa GD, Goryakin Y, Fumagalli E, Suhrcke M. Obesity and socioeconomic status in developing countries: a systematic review. *Obes Rev* 2012; 13 (11): 1067-79.
35. Johanssen DL, Johanssen NM, Specker BL. Influence of parent's eating behaviors and child-feeding practices on children's weight status. *Obesity* 2006; 14 (3): 431-9.
36. Lederman SA, Akabas SR, Moore BJ. Editors' Overview of the Conference on Preventing Childhood Obesity. *Pediatrics* 2004; 114 (4): 1139 -45.
37. Li R, Magadia J, Fein SB, Grummer-Strawn LM. Risk of Bottle-feeding for Rapid Weight Gain During the First Year of Life. *Arch Pediatr Adolesc Med* 2012; 166 (5): 431-6.
38. Perozzo G, Olinto MTA, Dias-da-Costa JS, Henn RL, Sarriera J, Pattussi MP. Associação dos padrões alimentares com obesidade geral e abdominal em mulheres residentes no Sul do Brasil. *Cad. Saúde Pública* 2008; 24 (10): 2427-39.