

Relationship between overweight at 6 years of age and socioeconomic conditions at birth, breastfeeding, initial feeding practices and birth weight

Relação entre excesso de peso aos 6 anos de idade e condições socioeconômicas ao nascimento, amamentação, práticas iniciais de alimentação e peso ao nascer

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ABSTRACT

Objective

To review the relationship between overweight at 6 years of age and socioeconomic conditions at birth, breastfeeding, early feeding practices and birth weight.

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Methods

A cross-sectional study was carried out involving 473 six-year-old schoolchildren from public and private schools living in a municipality in Southern Brazil. Sociodemographic and breastfeeding data and other initial feeding practices were obtained through interviews with the mothers at home. Birth weight and gestational age were obtained from the child's health card. Anthropometric data of the schoolchildren were collected during school visits. Bivariate and multivariate analyzes were performed using the Poisson Regression between the independent variables and overweight.

Results

The prevalence of overweight was 33.2%; 83.2% of the children were breastfed and out of these, 48.4% were breastfed only in the first six months. Non-breastfed children exhibited a 20% higher overweight prevalence (PR=1.20; 95%CI 1.13; 1.28). Children with exclusive breastfeeding for six months exhibited a lower overweight prevalence (PR=0.94; 95%CI 0.89; 0.99).

Conclusion

In this study, breastfeeding showed to be a protective factor for overweight.

Keywords: Breast feeding. Birth weight. Child. Obesity. Overweight.

RESUMO

Objetivo

Analisar a relação entre excesso de peso aos 6 anos de idade e condições socioeconômicas ao nascimento, amamentação, práticas iniciais de alimentação e peso ao nascer.

Métodos

Foi realizado um estudo transversal, envolvendo 473 escolares de 6 anos de idade de escolas públicas e privadas, residentes em um município do sul do Brasil. Dados sócio-demográficos e referentes à amamentação e outras práticas iniciais de alimentação foram obtidos por meio de entrevistas com as mães nos domicílios. O peso ao nascer e a idade gestacional foram obtidos por meio de consulta à carteira de saúde. Dados antropométricos dos escolares foram coletados em visitas às escolas. Foram realizadas análises bivariadas e multivariadas por meio da Regressão de Poisson entre as variáveis independentes e o excesso de peso.

Resultados

A prevalência de excesso de peso foi de 33,2%; 83,2% das crianças foram amamentadas e desses, 48,4% tiveram amamentação exclusiva nos primeiros seis meses. Crianças não amamentadas apresentaram prevalência 20% maior (RP=1,20; IC95% 1,13; 1,28) de excesso de peso. Crianças com amamentação exclusiva por seis meses apresentaram menor prevalência de excesso de peso (RP=0,94; IC95% 0,89; 0,99).

Conclusão

O aleitamento materno neste estudo mostrou-se como um fator protetor para o excesso de peso.

Palavras-chave: Aleitamento materno. Peso ao nascer. Criança. Obesidade. Sobrepeso.

INTRODUCTION

The number of children reaching overweight levels is increasing globally. Although the prevalence of overweight in high-income countries is more than double that of middle- and low-income countries, three-quarters of the world total overweight children live in economically poorer countries [1].

According to data from the *Pesquisa de Orçamento Familiar* (Family Budget Survey) carried out in Brazil in 2008 and 2009 [2], which is the latest large-scale survey in this country, overweight shows high prevalence rates, which have been increasing over the years. Interpretation of these data reveals that among children aged 5 to 9 years, 43.8% of the girls were above an ideal weight. Among boys of the same age group, the rates were even higher, 51.4%.

In *Florianópolis*, SC, Brazil, prevalence of overweight is similar to that shown in national data. In a survey that used the protocol proposed by the European Childhood Obesity Group involving a representative sample of 7 to 10 year olds who attended the first four years of elementary school, the prevalence of overweight was 22.1% [3]. In contrast, in another study conducted with third and fourth grade's students of public and private institutions also in *Florianópolis*, the overall prevalence of overweight was similar, 21.9% [4]. More recently, in a study with schoolchildren aged 7 to 10 years, overweight rates were 36.2% in boys and 32.7% in girls [5]. Thus, the data show that the prevalence rates of overweight in childhood have never been as high as today in this locality.

Weight gain in childhood is a consequence of behavioral changes that have occurred in recent decades [1]. Such changes are due to social and environmental factors, including interpersonal (family, colleagues and social networks), community (school, workplace and institutions) and governmental (local, state and national policies) factors. These observations enhance the need for effective interventions and the implementation of programs for a fast reversal of these trends [1].

In a study on the health effects of overweight in Latin America [6], it was pointed out that identifying the determining factors is critical for developing well-informed health policies, actions, laws and regulations, *i.e.*, measures based on scientific evidence. This is of great relevance because the high prevalence of overweight leads to an increase in associated morbidities such as diabetes, high blood pressure, dyslipidemia, hypercholesterolemia, cardiovascular diseases and development of the metabolic syndrome, which decreases quality of life and elevates the cost of health care [6,7] Ward *et al.* [8] developing a simulation model to estimate the risk of obesity at age 35 for the United States (US) child population found that those individuals severely obese at 2 years of age have only one chance in 5 of not being obese at 35 years of age. They also estimated that at 5 years this chance is halved and concluded that persistent obesity dramatically increases the risk of overweight in adulthood.

In 2014 the Pan American Health Organization presented an action plan for obesity prevention proposing the implementation of a series of actions that include the promotion of breastfeeding and healthy eating. In addition, they proposed improvement of nutrition environments and school physical activity; fiscal policies and regulation of food marketing and labeling; ongoing surveillance, investigation and evaluation, as well as other multisectoral actions [9].

Many studies show that the duration of breastfeeding, exclusive breastfeeding until 6 months of age and the period of introduction of cow's milk and dairy products are associated with children's excess weight [1,10-14] pointing to the hypothesis of breast milk having a protection effect against excessive weight gain. Victora *et al.* [15] presented the beneficial effects of long-term breastfeeding through a meta-analysis. They concluded about the protective effect against overweight, infections, malocclusions and improvement in intelligence indicators and diabetes.

Possible biological explanations for breastfeeding being protective for overweight include better development of self-regulation of food intake, the participation of breast milk in metabolic programming, changing fat cells both morphologically and in number or even inducing the phenomenon of metabolic differentiation [15,16], among others.

Since overweight has a complex etiology and lasts a long time, it is important to study the influence of early life in the individuals' health-disease process. Thus, the objective of this study is to review possible associations between socioeconomic conditions at birth, breastfeeding, initial feeding practices and birth weight and overweight in 6-year-old schoolchildren.

METHODS

This is a cross-sectional study nested in a cohort called *Coorte Brasil Sul* (Brazil South Cohort) [17] involving schoolchildren born in 2009 and their families enrolled in public and private schools in the Municipality of *Palhoça*, SC. The children were enrolled in their large majority in the first year of elementary school. *Palhoça* is located in the Greater *Florianópolis* metropolitan region, with an estimated 164,927 inhabitants in 2017. The Human Development Index (HDI) is 0.757, (43rd municipality in the *Santa Catarina* State and 420th in the country) [18].

The total population of children born in 2009 resident in *Palhoça* and enrolled in the municipality's schools was 1,670 [17]. The minimum sample number with 80% power to detect a difference in the prevalence of overweight in children who were 20% exposed to an independent variable studied (in this case, non-breastfed children) and among 10% unexposed, which generates a Prevalence *Ratio* of 2.0 at a significance level of 95%, totaled 398 schoolchildren. Assuming 20% potential losses and refusals, the total sample was accrued accordingly and set at 477 students. The sample size was calculated using the OpenEpi program. The sample units were randomly selected from the database of the *Coorte Brasil Sul* [17], guaranteeing the conditions of concurrent existence of data from two investigation instruments: questionnaire and anthropometric form. The inclusion criteria in the cohort were children born in the year 2009, coming from families living in *Palhoça*, SC and enrolled in the Municipality schools. Children whose mothers or guardians were not found at home in three visits, including one on the weekend, were considered lost.

The dependent variable of the study was overweight (Body Mass Index [BMI] z-score >+1). The independent variables were: gender; ethnicity/skin color reported by mother (categorized as white and non-white); father's and mother's occupation at birth (categorized as being with and without income); father and mother's education at birth (categorized as 0 to 8 years of study completed or more than 8 years); birth weight in relation to gestational age (appropriate for gestational age: 10-90 percentile; large for gestational age: >90 percentile); breastfeeding (if the child was breastfed during the first 2 years of life: yes and no); exclusive breastfeeding for 6 months (yes and no); period of introduction of milk and dairy products (categorized as before 6 months and after 6 months); use of flours to supplement a baby bottle up to 2 years of age (yes and no); use of sugar, honey or molasses in the bottle until 2 years of age (yes and no) and use of fruits before sixth month of life (yes and no).

Data collection was performed through interviews (ethnicity/skin color reported by the mother, father's and mother's occupation at birth; father's and mother's education at birth; breastfeeding; time duration of exclusive breastfeeding; period of introduction of milk and dairy products; use of flours to supplement a feeding bottle up to 2 years of age; use of sugar, honey or molasses in the bottle up to 2 years of age and use of fresh or processed fruits), document data (birth weight; gestational age) and anthropometric measurements (children's weight and height). The interview was conducted with the mother or, in her absence, with the child's main caregiver, at home, by teams composed of nurses, nutritionists and community health agents, all trained in a 30-hour activity program. Document data were obtained from the child's health card at the time of the interview. The anthropometric evaluation was performed in the schools. An interview script and an anthropometric evaluation form were specially designed for this study.

The anthropometric evaluation of the students was performed based on the BMI, obtained by calculating the weight over squared height according to the World Health Organization Standards.

Children's weight and height were collected in schools by the method recommended by the Brazilian Ministry of Health for this purpose [19,20]. The collection team consisted of nurses and nutritionists properly trained for this purpose.

Anthropometric data were collected in duplicate in 5% of the study population, selected at random, in order to allow monitoring of diagnostic reproducibility. A lack of the parents' signature of the Free and Informed Consent Form or of the children's consent was considered a loss. A pilot study was carried out with students not included in the study, with about 5% of all children aiming to test the proposed methodology, which proved to be feasible.

The anthropometric data obtained were entered into Excel spreadsheets and later imported by the Anthroplus Program (Geneze, Switzerland, 2009) [21] where the nutritional diagnosis classifications of the population involved were performed. Birth weight and gestational age were entered into Excel spreadsheets and later imported by the Intergrowth-21st Program [22] where children were classified as appropriate or big for their gestational age.

Subsequently, all data were imported by the IBM® SPSS® 18.0 Statistics Program (New York, United States), where they were reviewed. Bivariate analyzes were performed to test proportions homogeneity by means of chi-square, with significance level lower than or equal to 0.05. Multivariate analysis was performed using Poisson Regression with robust estimator to estimate the effects of any confounding variables, estimating the Prevalence Ratios (PR) and their relevant confidence intervals. Therefore, variables with $p < 0.25$ in the bivariate analysis were included in a model using the stepwise backward method so that all significant variables had their effect adjusted. In the final model variables with significance level lower than or equal to 0.05 were maintained.

This study was approved by the Research Ethics Committee of the *Universidade do Sul de Santa Catarina* according to the CAAE opinion 38240114.0.0000.5369.

RESULTS

A total of 473 6-year-old schoolchildren and their families participated in the study, providing a response rate of 99.1%. However, this number was different between the variables, since in some of them the information was unknown or was unavailable.

Most participants were male (53.1%), Caucasian (83.2%). These and other data on parent's education and occupation at birth can be found in Table 1. The prevalence of thinness was 1.7%, eutrophy 64.9%, overweight 21.2% and obesity 12.0%. The prevalence of overweight (sum of overweight and obesity percentages) was 33.2% (95%CI 28.9; 37.5). No socio-demographic variable was associated with overweight (Table 1). Regarding breastfeeding, the results showed that 91.1% of children were breastfed at some point in time in their lives. Out of these, 48.4% were under exclusive breastfeeding in the first 6 months of their life. Regarding other feeding practices, 14.2% of the sample had milk and dairy products introduced before 6 months of age. Overweight was associated with non-breastfeeding ($p=0.006$); in children who were not exclusively breastfed for six months, the prevalence of overweight was higher ($p=0.031$) (Table 2). However, the smaller number of respondents in the variable "exclusive breastfeeding for 6 months" ($n=353$) should be pointed out. This was due to the failure to remember in many cases whether breastfeeding had in fact been exclusive until the sixth month, although the respondents knew whether or not they had breastfed their offspring ($n=470$).

The results of the multivariate analysis are presented in Table 3. Non-breastfed children had a 20% higher overweight prevalence (PR=1.20; 95%CI 1.13; 1.28) ($p<0.001$), compared to those children who had been breastfed independently of the other variables studied. In addition, children exclusively breastfed for six months exhibited a lower overweight prevalence (PR=0.94; 95%CI 0.89; 0.99) ($p<0.037$) also independently of the other variables studied.

Table 1. Sociodemographic characteristics of the studied sample. *Palhoça* (SC), 2015.

Variables	Overweight						<i>p</i>
	Yes		No		Total		
	n	%	n	%	n	%	
<i>Gender (n=473)</i>							0.162
Male	91	31.5	160	63.7	251	53.1	
Female	67	30.2	155	69.8	222	46.9	
<i>Ethnicity/Skin Color (n=473)</i>							0.674
Caucasian	130	33.0	264	67.0	394	83.2	
Other	28	35.4	51	64.6	79	16.8	
<i>Father's Occupation at Birth (n=445)</i>							0.605
With income	141	33.0	286	67.0	427	92.0	
Without income	7	38.9	11	61.1	18	8.0	
<i>Mother's Occupation at Birth (n=464)</i>							0.237
With income	82	36.3	144	63.7	226	48.7	
Without income	74	31.1	164	68.9	238	51.3	
<i>Father's Education at Birth (n=371)</i>							0.567
0 to 8 years completed	73	33.8	143	66.2	216	58.2	
Over 8 years completed	48	31.0	107	69.0	155	41.8	
<i>Mother's Education at Birth (n=436)</i>							0.687
0 to 8 years completed	67	32.5	139	67.5	206	47.2	
Over 8 years completed	79	34.3	151	65.7	230	52.8	

DISCUSSION

The present study found a prevalence of overweight at 6 years of age associated with breastfeeding, but not with family socioeconomic conditions at birth, birth weight and some initial feeding practices. At 6 years of age non-breastfed children exhibited a higher overweight prevalence and those with exclusive breastfeeding for 6 months had a lower overweight prevalence.

Many international studies indicate a growing childhood obesity [1,6,23,24]. In Brazil, it is not different. In this investigation, the rate of overweight and obesity was quite high (33.2%) comparable to another study conducted also in the Greater *Florianópolis* metropolitan region where the rate found was 34.5% among schoolchildren aged 7 to 10 years [5].

In the present study, there was no statistically significant association between overweight, gender and ethnicity of the schoolchildren. Ogden *et al.* [25] investigating obesity prevalence trends in US children and adolescents, found a significant increase of obesity prevalence in boys, but not in girls. As for ethnicity, in another North American study, the prevalence of obesity was higher among Hispanic children compared to non-Hispanic white children of all ages [26].

Table 2. Birth weight, breastfeeding and feeding characteristics of the studied sample. *Palhoça* (SC), 2015.

Variables	Overweight						p
	Yes		No		Total		
	n	%	n	%	n	%	
<i>Birth weight in connection with Gestational Age (n=378)</i>							0.981
Adequate to the Gestational Age (≥Percentile 10-90)	107	34.6	202	65.4	309	81.7	
Big for Gestational Age (>Percentile 90)	24	34.8	45	65.2	69	18.3	
<i>Breastfeeding (n=470)</i>							0.006
Yes	135	31.5	293	68.5	428	91.1	
No	22	52.4	20	47.6	42	8.9	
<i>Exclusive breastfeeding during 6 months (n=353)</i>							0.031
Yes	43	25.1	128	74.9	171	48.4	
No	65	35.7	117	64.3	182	51.6	
<i>Milk and dairy products period of introduction (n=464)</i>							0.538
Before 6 months	20	30.3	46	69.7	66	14.2	
After 6 months	136	34.2	262	65.8	398	85.8	
<i>Flour use added to Baby Bottle up to 2 Years (n=461)</i>							0.500
Yes	93	31.8	199	68.2	292	63.3	
No	59	34.9	110	65.1	169	36.7	
<i>Use of sugar, honey or molasses in the bottle until 2 years (n=466)</i>							0.741
Yes	44	32.4	92	67.6	136	29.2	
No	112	33.9	218	66.1	330	70.8	
<i>Fruits use before 6 months (n=465)</i>							0.081
Yes	52	39.4	80	60.6	132	28.4	
No	103	30.9	230	69.1	333	71.6	

Table 3. Association between overweight and sociodemographic variables, breastfeeding and fruit consumption. *Palhoça* (SC), 2015.

Variables	Overweight					
	PR _c	95%CI	p	PR _a	95%CI	p
<i>Gender</i>			0.162	#		
Male	1.00					
Female	0.96	0.91; 1.01				
<i>Mother's Occupation at Birth</i>			0.237	#		
With income	1.00					
Without income	0.97	0.92; 1.02				
<i>Breastfeeding</i>			0.006			<0.001
Yes	1.00			1.00		
No	1.14	1.03; 1.27		1.20	1.13; 1.28	
<i>Exclusive breastfeeding up to 6 months</i>			0.031			0.037
Yes	1.00			1.00		
No	0.94	0.89; 0.99		0.94	0.89; 0.99	
<i>Fruits use before 6 months</i>			0.081	*		
Yes	1.00					
No	0.95	0.89; 1.01				

*Not included in the model because it presents collinearity with the variable "Exclusive breastfeeding up to the sixth month" (p<0,001); #: No Statistical Significance; PR_c: Crude Prevalence Ratio; PR_a: Adjusted Prevalence Ratio.

The significant association between overweight and socioeconomic conditions is shown in many papers [1,6,26]. However, the non-association found here corroborates the findings of another study performed in the same region where no statistical association was found between family income and overweight in children [5]. Rivera *et al.* [6] claim that prevalence of overweight at 5 years of age is higher in Latin America than elsewhere in the world, due to existing socioeconomic differences and low purchasing power of the population, leading to a higher consumption of affordable food, but mostly hypercaloric. The authors conclude that diets called obesogenic, because they are based on foods rich in sugar and dense energy, but poor in nutrients, are often the only foods within reach of this portion of the population.

Still in the same line of reasoning, parents' education at birth was not associated with the prevalence of overweight at 6 years. These results differ from a European study in which the prevalence of obesity was twice as high in Danish children and adolescents with low-educated parents as compared to parents with higher education. The authors add that those data are consistent with many other studies in that country that relate children overweight to this aspect [27].

Also, the present study found no statistically significant association between birth weight and overweight at 6 years. However, Goergen *et al.* [28] when reviewing the relationship between birth weight and time of breastfeeding with the nutritional status of children aged 2 to 6 years, obtained different results. They pointed out that birth weight was positively associated with current weight. They also found that in children born weighing more than 4,000g the probability of becoming overweight was higher.

In the present investigation, a statistically significant association was observed between breastfeeding and overweight. Non-breastfed children had a 20% higher prevalence of being overweight at 6 years of age compared to those who were breastfed. In addition, children who had been exclusively breastfed for 6 months had a lower prevalence of overweight at 6 years of age compared to those who were not breastfed for the same period. Offering other foods before 6 months, besides being unnecessary, can be harmful because it increases the risk of the child becoming ill, and may impair the absorption of important nutrients available in breast milk, such as iron and zinc [13]. Weaning should occur naturally and begin only after 2 years of age [15,29-31].

The Brazilian Ministry of Health [32] in the latest review of its Child Health-related *Cadernos de Atenção Básica* (Primary Care Notes) reiterates that breastfeeding reduces the chance of obesity. In a systematic review assessed by the Ministry of Health on evidence of long-term effect of breastfeeding, breastfed individuals were 22% less likely to become overweight [32,33]. Thus, it is possible that there is a dose/response relationship with the period of breastfeeding, *i.e.*, the longer the individual was breastfed, the lower the chance of becoming overweight. Possible mechanisms involved in this protection include better development of self-regulation of food intake in breastfed children; the unique composition of breast milk that participates in the metabolic programming process, for example changing the number and/or size of fat cells or inducing the phenomenon of metabolic differentiation. Moreover, it has been found that cow's milk may alter the metabolic rate during sleep of breastfed children, which may be associated with metabolic programming and the development of overweight [15,34]. Further, associating the protective effect of breastfeeding to overweight, the WHO, based on a systematic review published in 2013, emphasizes that protein intake as well as energy metabolism are lower among breastfed individuals [34]. Still, Scholtens *et al.* [35] suggest that

differences in dietary preferences could be related to such an association. The authors report that at 7 years of age, Dutch children who were breastfed for more than 16 weeks exhibited a higher intake of fruits and vegetables compared to those who had never been breastfed. Those children were also less likely to consume white bread, soda, chocolate, and fried snacks [35].

On the other hand, in the present study, when the nutritional status at 6 years of age was referred to the period of introduction of other milks and dairy products, the use of flours as feed bottle complements and the use of sugar, honey or molasses in the bottle until 2 years of age no significant differences between no overweight and overweight groups were observed. However, studies have shown evidence that these factors are associated with a higher prevalence of obesity and a higher BMI in children [29,36-38]. The Ministry of Health [31] pointed out that among formula-fed infants, the introduction of solid food before four months of age was associated with a six-fold increase in the chance of obesity at 3 years of age.

In the first 2 years of the child's life, the choice of food deserves special attention, because that is the time when eating habits are being formed. Studies [30,32,34] show that sweeteners, sugar, and products with these ingredients should not be offered to children. Eating sweets increases the chance of excessive weight gain and other diseases such as tooth decay, diabetes, hypertension, and cancer. Honey, despite being a natural product, is not recommended for children under 2 years of age as it contains many components of sugar and increases the risk of bacterial contamination associated with botulism in children under one year of age [31,33].

Limitations of this study include the fact that the questionnaire used required answers in connection with what happened in the past in the children's and family's life, which may have generated a potential memory bias. However, many investigations have shown that the technique can be used because it presents acceptable levels of information validity and is used in population-based surveys conducted in Brazil [2]. Still regarding the questionnaire, one could think about very broad questions used about the age of infant feeding, since there are specific recommendations for the first year of life. However, the use of this questionnaire is justified by the fact that the present work is nested in a larger study [17] with other broader objectives. Even so, caution is recommended in interpreting the results given here, since comparing breastfed children during different time durations may also lead to potentially different effects on the outcome assessed.

Based on the results of the present study, further investigations are recommended to better understand the determinants of childhood overweight. In addition, knowing the difficulty in treating overweight in adulthood, especially due to its association with other chronic diseases, health promotion and prevention starting in childhood seem to be the most effective means of reducing the incidence and prevalence of overweight. Moreover, awareness of the epidemiological situation is of fundamental importance to yield proper inferences about overweight among schoolchildren of the age group studied, which can support the planning of appropriate interventions at local level for such important public health issue.

CONCLUSION

Breastfeeding in this study proved to be a protective factor for overweight at 6 years of age. Socioeconomic conditions, other initial feeding practices, and birth weight were not associated with overweight.

CONTRIBUTORS

LCD ROSA, contributed to study conception and design, data collections, data analysis and interpretation, review and approval of the final version. E TRAEBERT, RD NUNES and J GHIZZO FILHO, contributed to data analysis and interpretation, review and approval of the final version. J TRAEBERT, contributed to study conception and design, data analysis and interpretation, review and approval of the final version.

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