Residência RP Pediátrica
Publicação Oficial da Sociedade Brasileira de Pediatria
ISSN-Online: 2236-6814

Submitted on: 03/28/2024
Approved on: 09/25/2024

ORIGINAL ARTICLE

Type of delivery and complementary feeding: impact on overweight in prepubertal children

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Keywords:
Natural childbirth,
Cesarean section,
Breast feeding,
Child nutrition,
Overweight
Child.

Abstract

Objectives: To evaluate association between type of delivery and nutrition in the first year of life with overweight in prepubertal children. **Methods:** Observational and cross-sectional study carried out in childhood obesity research clinic with eutrophic and over-weight children aged five to 11 years. The two groups were compared regarding variables related to birth and child nutrition in the first year of life, and the association of these vari-ables with overweight was evaluated. **Results:** 143 children were studied, 32 (22.4%) in the eutrophic group and 111 (77.6%) in the overweight group. In the comparison of groups, a significant difference (p<0.05) was found in relation to mean age, type of deliv-ery, breastfeeding in the first six hours of life and median age of introduction of solids. Multiple logistic regression showed an association between cesarean delivery and over-weight. **Conclusion:** It is observed that natural childbirth decreases by 79% the chances of a child turning overweight. The study shows the influence of type of delivery on the future health of newborns, and its protection against the development of childhood obesity.

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Resid Pediatr. 2025;15(1). DOI: 10.25060/residpediatr-2025.v15n1-1268

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INTRODUCTION

Obesity is a complex and multifactorial disease characterized by excess fat mass in an organism.[1] The growth of the disease in the world has become a serious public health problem, affecting both adults and children. In July 2023, the National Food and Nutrition Surveillance System observed that the prevalence of overweight in Brazilian children between five and ten years of age was 16.48%, obesity 9.24%, and severe obesity 4.91%.[2]

Childhood obesity is associated with worrying comorbidities that can be observed in children, such as dyslipidemia, changes in glucose metabolism and high blood pressure, which make up the so-called metabolic syndrome and are risk factors for cardiovascular diseases.[1]

The first years of life are extremely important for the proper growth of the child, as it is at this time that the first contacts with external stimuli capable of modulating the human organism occur. The way each individual responds to such stimuli can determine complications in their future health and predispose them to the development of numerous chronic diseases.[3]

Evidence suggests that the intestinal microbiota is extremely relevant in the development of childhood obesity, given its strong influence on the control of body fat, energy homeostasis and inflammatory processes.[4] Conditions such as type of delivery, breastfeeding (BF) and complementary feeding significantly impact the development of the microbiota.[5]

The literature indicates that the type of delivery is an important factor for the healthy growth of a child. It has been observed that cesarean sections negatively affect the health of newborns and can have an impact on the future development of respiratory, neurological and metabolic diseases, such as obesity.[6]

During vaginal delivery, the newborn is exposed to the mother's vaginal and fecal microbiota and colonized by bacteria that make up the gastrointestinal system. In this sense, children born by cesarean section, when compared to those born by vaginal delivery, have a lower number of beneficial bacteria in their microbiota and a higher number of bacteria that are pathogenic to the body.[7] In addition, it is reported that this type of delivery can also alter the composition of breast milk. In this regard, evidence suggests that women who gave birth by cesarean section produce milk with less diversity and abundance in their microbiota. Thus, considering the relationship between a healthy microbiota and obesity, it is clear that newborns born by cesarean section would tend to be at greater risk of childhood obesity.[8]

In this scenario, it can be stated that breast milk is the best nutrient for newborns, since, in addition to the previously mentioned, it contains an adequate amount of nutrients and hormones essential for the full development and growth of the child. The antibodies and bacterial flora present in breast milk also contribute to modulating the newborn's immune system and gastrointestinal function.[9,10] Thus, BF in the first hours of life prevents the emergence of opportunistic infections, in addition to favoring the adequate colonization of the newborn's microbiota, reducing mortality and illness rates.[9,11] Furthermore, early initiation of BF is associated with full skin-to-skin contact between mother and baby, which appears to have a strong relationship with successful breastfeeding. Studies suggest that the first hours of a newborn's life comprise a critical period of physiological changes and adaptation to the new environment, and it is the time when the newborn develops innate behaviors such as seeking and sucking. Thus, this close relationship will contribute to effective breastfeeding throughout the child's first months of life.[12]

Considering the benefits of breast milk, it is interesting to emphasize the importance of exclusive BF. Studies show that children fed with nutritional formula, compared to those who received only breast milk, have higher plasma concentrations of insulin, a hormone capable of stimulating fat deposition and early proliferation of adipocytes. In addition, breast milk contains bioactive factors that can modulate epithelial growth factors and inhibit adipocyte differentiation. From approximately the 3rd month of life, it is observed that children who are exclusively breastfed have less weight gain and lower rates of childhood obesity. It is important to try to keep the child exclusively breastfed as much as possible, so that the maximum benefit is obtained from the proteins, carbohydrates, vitamins, hormones, antibodies and growth factors offered.[13]

In this context, when there is no possibility of exclusive breastfed, it is necessary to introduce an appropriate milk formula, which is as close as possible to breast milk. The composition of the formula varies according to different brands and may have different concentrations of nutrients such as proteins and fats. Some formulas there contains between 50 and 80% more protein than breast milk. High protein consumption in the first months of life can alter the child's growth factors and increase the chances of developing obesity in the future. Furthermore, breast milk, unlike formula milk, has a higher concentration of long-chain polyunsaturated fatty acids, which are associated with lower plasma levels of pro-inflammatory cytokines and glucose in the child's skeletal muscle. Therefore, if it is necessary to introduce formula milk, it is necessary to evaluate the composition that is most beneficial to the infant.[5]

In addition, the relationship between the age of introduction of foods and introduction to the family menu and childhood obesity should be analyzed. The World Health Organization recommends exclusive breastfeeding for approximately 6 months, with the introduction of solid foods from that period onwards.[14] Studies show that early initiation of a solid diet can modulate the child's intestinal microbiota. Because bacteria have different metabolic capacities, consuming higher amounts of simple carbohydrate sources and short-chain fatty acids can alter the pattern of

gastrointestinal colonization and influence energy absorption and, consequently, the development of adipose tissue. Rapid weight gain between six and 24 months of age can result in childhood obesity in the long term.[5]

Considering the high prevalence of overweight children, this study sought to analyze variables related to birth, BF and complementary feeding to study their influence on overweight.

In this sense, based on the hypothesis that the first months of a child's life comprise a critical period of metabolic, tissue and immune formation, this study aimed to analyze the association of variables related to birth and child nutrition in the first year of life with the development of obesity in prepubertal children.

METHODS

This is a cross-sectional and observational study of children participating in an extension project carried out in a research clinic on childhood obesity. The project has a multidisciplinary nature and aims to promote teaching, research and care in childhood obesity.

The children who participated in the study were recruited from the general pediatrics outpatient clinic of a university hospital. It is an outpatient teaching clinic that is part of the Unified Health System network, where low-income children up to 11 years of age from the State of Rio de Janeiro are treated.

The study included prepubescent children, according to clinical evaluation using the Tanner criteria[15], aged five to 11 years, eutrophic, overweight or obese, healthy in other aspects and who were not being monitored by a nutritionist. The five-year cutoff considered the higher prevalence of the disease from that age onwards[16], while the 11-year cutoff was considered to exclude individuals with pubertal development.

After being informed and explained, the legal guardian of each child signed the Free and Informed Consent Form, and children over seven years of age signed the Free and Informed Assent Form.

The children selected were received on a scheduled date. During the first visit, a complete clinical evaluation was performed according to a multidisciplinary care protocol focused on monitoring growth and development, feeding, prevention and diagnosis of major childhood diseases, to ensure the health and prepubertal status of the child, as well as to understand his/her eating and social routine. In addition, the legal guardian answered a short questionnaire regarding the type of birth, BF in the first six hours of life, exclusive BF, age at which formula was introduced, use of appropriate formula in the first year of life, age at which solid foods were introduced and age at which the child was introduced to the family menu. The children were weighed without shoes and wearing light clothing, on a Filizola scale (Filizola, São Paulo, SP, Brazil), with a weight resolution of 100 g, and their heights were measured without shoes, on a Tonelli Halpender-Holtain wall-mounted stadiometer (Tonelli, Criciúma, SC, Brazil), with a resolution of 1 mm. The collected data were archived in Excel spreadsheets version 7 (MapInfo Corporation, Troy, NY, USA). Statistical analyses were performed using the statistical package R-Project version 4.2.2 (The R Foundation for Statistical Computing, Vienna, Austria). The nutritional status of the children was assessed using the Body Mass Index (BMI) reference by sex and age, according to the WHO recommendation. The following were considered to be eutrophic: z-scores greater than or equal to -2 SD and less than or equal to +1 SD; overweight: z-scores greater than +1 SD and less than or equal to +2 SD; and obesity: z-scores greater than +2 SD.[17] The BMI z-score was calculated using the WHO Anthro software (version 3.2.2, World Health Organization, Geneva, Switzerland), using data obtained through anthropometric nutritional assessments (weight and length), age in months, and sex.

The frequencies of the categorical variables of sex, type of delivery (normal or cesarean section), BF in the first six hours of life and use of appropriate formula were calculated for the group studied. The following numerical variables were accepted: age, duration of exclusive BF, age at introduction to milk formula, age at introduction of solids and age at introduction to the family menu.

The complete sample of participants was divided into two groups – a group of eutrophic children and a group of overweight children, in which children classified as overweight and obese were allocated. The frequencies of the categorical variables studied in the eutrophic and overweight groups were compared using Fisher's test. The means or medians of the continuous variables studied in the eutrophic and overweight groups were compared using ANOVA or Kurskal Wallis, respectively. Multiple logistic regression was used, with the group of overweight children as the dependent variable, and the independent variables were sex, age, type of delivery, BF in the first six hours of life, and age at introduction of solids. The objective was to evaluate the association between independent variables and overweight.

A p-value <0.05 was considered statistically significant. The odds ratios (OR) for overweight were also calculated.

This study was approved by the Ethics and Research Committee of HUPE-UERJ, where it is registered under number 173-CEP/HUPE–CAAE; 0020.0.228.000-07. The study is also registered with the National Research Ethics Committee under number 127374.

RESULTS

A total of 143 children aged five to 11 years were studied, with 32 (22.4%) children allocated to the eutrophic group and 111 (77.6%) children allocated to the overweight group. In the eutrophic group, 17 (53.1%) were female and 15 (46.9%) were male, while in the overweight group 54 (48.6%) were female and 57 (51.4%) were male. The groups

did not show significant differences in gender frequencies (p=0.69). (Table 1)

When comparing the numerical variables between the groups of eutrophic children and overweight children, a statistically significant difference (p<0.05) was found in relation to the mean age and the distribution of age quartiles at the introduction of solids. (Table 1)

When comparing the frequencies of the categorical variables between the groups of eutrophic children and overweight children, a statistically significant difference (p<0.05) was found in relation to the type of delivery and whether the children received breast milk in the first six hours of life. (Table 1)

Multiple logistic regression showed an association between the type of delivery (cesarean section) and excess weight in the group studied (p=0.03). (Table 2)

Table 2. Análise de regressão logística múltipla tendo como variável dependente crianças com excesso de peso.

	OR (IC 95%)	*p*-value
Male	1.82 (0.64-5.45)	0.27
Age (months)	1.04 (1.01-1.07)	0.03
C-Section	0.21 (0.04-0.74)	0.03
BF in the first 6h	0.46 (0.09-1.80)	0.29
Age at starting solids in the diet	1.11 (0.97-1.34)	0.21

DISCUSSION

The variables that showed statistical significance in the comparison between the groups of normal-weight and overweight children were selected for multiple logistic regression analysis. Based on the results obtained, there was no association between male gender, BF in the first 6 hours, and age at introduction of solids, and childhood obesity.

The nutrients, hormones, and antibodies present in breast milk can meet all the growth demands of a newborn, enabling their full development and ensuring protection against infectious diseases.[11,13] Although the importance of breastfeeding is known, our study found no association between BF in the first six hours of life and childhood obesity. In a cross-sectional study with 10,753 participants aged six to 16 years, Fange Liu showed that BF can significantly reduce the prevalence of overweight and obesity in this age group.[18] Although we did not find similar studies that specifically relate the first six hours of life and overweight, this possible link is believed to be important due to the decisive period of acclimatization and physiological changes of the newborn in the first hours of life.[14] Successful breastfeeding will benefit the child's immune and gastrointestinal functions, which, in the long term, may be decisive in preventing childhood obesity.[11,13]

The age at which solid foods were introduced was also not associated with overweight in the prepubertal group. The introduction of solid foods is only indicated from as of six months of age, given the changes in the gastrointestinal pattern that the greater consumption of simple carbohydrates and short-chain fatty acids can cause. Despite this, the literature is dichotomized in relation to the association with childhood obesity. The cross-sectional study by Barrera et

Table 1. Comparison between prepubertal children with normal weight and prepubertal children with excess weight in relation to the means (standard deviation), median (IQR) and prevalence of demographic characteristics and variables related to BF and complementary feeding.

		Eutrophic	Overweight	*p*-value
Sex	F	53.1% (17)	48.6% (54)	0.69
	M	46.9% (15)	51.4% (57)	
Age (months)	Mean (SD)	92.34 (14.14)	99.71 (18,07)	0.02
Type of delivery	Normal	90.6% (29)	56.8% (63)	0.0003
	C-Section	9.4% (3)	43.2% (48)	
BF in the first 6h	Yes	85.2% (23)	63.7% (65)	0.04
	No	14.8% (4)	36.3% (37)	
Time of exclusive BF	Median (1st; 3rd Q)	4 (3; 6)	4 (2; 6)	1.00
Age of introduction to milk formula	Median (1st; 3rd Q)	5 (3.5; 7)	6 (3; 8.25)	0.84
Milk formula adequate to the first year of life	Yes	28.6% (8)	30.1% (28)	1.00
	No	71.4% (20)	68.9% (65)	
Age of introduction of solids in the diet	Median (1st; 3rd Q)	6 (4; 7)	6 (5; 8)	0.03
Age of a menu introduction in the family	Median (1st; 3rd Q)	12 (10; 12)	12 (10; 12,5)	0.22

al. analyzed the age at which solid foods were introduced in 1,542 children, but, like the present study, found no association between this variable and obesity.[19] In contrast, D'Hollander et al. conducted a longitudinal study that followed 8,943 children until they were ten years old, in which it was found that the introduction of cereals at six months of age, compared with the introduction at four months, was associated with lower rates of obesity.[20] Thus, it is clear that studies with the same methodology are needed to clarify this issue.

When analyzing the groups, we found that children born through normal delivery had a 79% lower chance of being overweight between the ages of five and 11. Vaginal delivery exposes the newborn to the mother's vaginal and fecal microbiota and contributes to the adequate colonization of the gastrointestinal tract.[9] A healthy microbiota composed of beneficial bacteria reforms the human immune system and offers protection against chronic diseases and inflammatory processes, such as obesity.[5,6]

In the literature, there are studies that show the difference in the composition of the intestinal microbiota of newborns by vaginal delivery and by cesarean delivery, the latter being associated with a greater presence of pathogenic and possibly obesogenic bacteria.[9,16] Liao et al. analyzed the association between cesarean delivery and excess weight in a study carried out with 3,570 children followed from three to six years of age, in which cesarean delivery was significantly associated with a higher risk of obesity.[21]

Our findings reinforce the need for more studies that analyze the birth and supplemental nutrition of overweight children. In this context, it is worth highlighting the importance of developing strategic interventions during pregnancy and childhood, to create a healthy environment and provide effective support during labor and breastfeeding. Early interventions can be extremely important in preventing childhood obesity. Therefore, it would be interesting to conduct prospective studies with a larger sample size, which follow children until prepubertal age and have greater control over their diet.

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