DOI: http://dx.doi.org/10.12957/demetra.2014.11044

Complementary feeding and overweight among preschoolers from a vulnerable community in the city of Rio de Janeiro - Association between complementary feeding and overweight

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Abstract

Objective: To describe the introduction of foods in the first year of life and verify its association with Body Mass Index (BMI) for Age among preschool children at a daycare center in a vulnerable community in Rio de Janeiro city, Brazil. *Methods*: Cross-sectional study with 132 children aged between 2-5 years. The classification of overweight was based on BMI for age (z-score +2), as proposed by SISVAN/MS. The frequencies of anthropometric and socio-demographic variables among nutritional status were evaluated by *t*-Student's test and qui-square test. Multiple linear regression was applied to test the association of breastfeeding, introduction of food and complementary feeding score with BMI for age. Models were adjusted by age and sex of infants and mother's age. *Results*: The mean age of children was 3.3 (± 0.91) years old and 36 (28.6%) were overweight, but no significant difference was found between genders (p = 0.195). Exclusively breastfeeding was associated with lower prevalence of overweight (p = 0.028). There was positive association between BMI and consumption of porridge (β = 0.0080, 95% CI = 0003 - 0.015, p = 0.043) and negative association with complementary feeding score (β = -0.001, 95% CI -0.002 - 0.003, p = 0.016). *Conclusion*: Early introduction of foods may contribute to the risk of excess of body weight. There was association of breastfeeding and lower prevalence of overweight.

Keywords: Supplementary Feeding. Infant Nutrition. Breastfeeding. Overweight. Body Mass Index.

Introduction

Breastfeeding can be considered as a baby's first healthy eating habit.[1] Breast milk meets the nutritional needs in the first six months of life and has adequate macronutrient composition; moreover, it is easy to digest.[2] Among other benefits, breast milk protects against infections, prevents the occurrence of diarrhea episodes and protects against respiratory and allergic diseases. Brazilian[3-5] and international[6,7] studies have also pointed out the protective effect of breastfeeding against overweight in childhood.

The Ministry of Health[2] recommends exclusive breastfeeding for the first six months of life, and complemented breastfeeding up to two or three years old. According to the second Breastfeeding Prevalence Survey[8], held from 1999 to 2008, the mean duration of exclusive breastfeeding (EBF) increased from 23.4 days to 54.1 days in Brazilian capitals and the Federal District. Complemented breastfeeding (CBF) increased from 295.9 days to 341.6 days in the same period.

In Brazil, despite the improvements, to date only 41% of children benefit from EBF until six months of age.[8] Associated with a low prevalence of exclusive breastfeeding, there is early complementation with water, teas, juices, milk and other foods. According to the literature,[3,5] early complementation is associated with overweight and, when done inappropriately, it can have a negative effect on children's health in the short and long term.[9,10]

In a cross-sectional study in São Paulo, with 566 preschool children aged two to six years, Simon et al.[5] found that complementation with sugar, among other foods, is a risk factor for overweight and obesity. According to data shown by Balaban et al.,[3] in a survey with 409 preschool children of accredited daycare centers in the city of Recife, overweight was more prevalent among children who did not receive exclusive breastfeeding for up to four months.

Also, early weaning may be inadequate from a nutritional point of view.[8] Caetano et al.[11] found that, among children that were formula-fed at three months of age, only 34.7% received adequately prepared infant formula. As regards the feeding of children six to 12 months of age, the authors found low intake of micronutrients such as iron, niacin, vitamin E and zinc. In this group, there was also a high percentage of intake of processed foods, soft drinks and artificial juices.

Appropriate complementary feeding, in parallel to breastfeeding, is of paramount importance for children's growth and development, and for their health in adulthood. Nutritionists, health professionals and professionals in related fields, should promote complementation with healthy

foods and monitor the nutritional status of children in their first years of life. The objective of this study was to describe complementary feeding in the first year of life and check the association of complementary feeding and breastfeeding with body mass index for age among preschool children at a day care center in a vulnerable community in the city of Rio de Janeiro.

Method

Design and Population of the Study

A cross-sectional study was conducted with anthropometric and dietary intake data of preschool children aged between two and five years, regularly attending a day care center in the community of Santa Marta, in Botafogo, Rio de Janeiro. All 132 preschool children attending the day care center were eligible for the study. The sample consisted of 126 (95.5%) preschool children who were observed for weight and height, and 96 (72.7%) subjects who completed the questionnaire with demographic information and information about breastfeeding and complementary feeding in the first year of life.

Data Collection

The study resulted in the project called *Alimentação Saudável e Higiene Bucal: Parceria que dá Gosto* (Healthy Eating and Oral Hygiene: a successful combination of behaviors), a partnership between professionals in the Family Health Workgroup of the Santa Marta Family Clinic (FC) and the Federal University of Rio de Janeiro. Regular data collection with the preschoolers was held during the traineeship of the students enrolled in the eighth academic semester of the undergraduate Nutrition course, Josué de Castro Nutrition Institute, Federal University of Rio de Janeiro.

Anthropometric information

Anthropometric data were height (cm) and weight (kg). Height was measured with the use of a portable *Alturaexata*® stadiometer. At that time, the children were standing, with arms extended along their body and heads free of head wear. Children were weighed without shoes and coats, or any other accessories, and positioned in the center of a portable digital scale (Plena®) with 150

kg capacity and 0.1 kg precision. Both anthropometric measurements were collected according to the methodology recommended by Lohman et al.[12]

Data Analysis

Outcome

The measurements of weight and height were used for calculating body mass index [BMI = weight (kg) / height^2 (meter)]. The classification of nutritional status was based on BMI-for-age proposed by the World Health Organization[13]; excess weight (overweight and obesity) was defined as values greater than z-score +2.

Explanatory variables

During data collection, the parents of preschoolers were sent a structured questionnaire with questions about: 1) breastfeeding: received exclusive breastfeeding (yes = 0 or no = 1), the child still breastfeeds (yes or no); how long the child breastfed for (months); and 2) complementary feeding in the first year of life: juice/fruit; infant formula, vegetables, soup, porridge, homemade food, soft drinks, cookies, sweets/candies, fast-food. For each complementary food item, the mother/guardian could report the period when the food item was introduced: before 2 months; between 2 and 4 months; between 4 and 6 months; and after six months of age.

Sociodemographic covariates

The following information collected through the questionnaire was considered as sociodemographic covariates: children's age (years), maternal age (years), maternal schooling (last grade attended with passing marks), currently working (yes or no), type of work (regular, informal/self-employed or other), marital status (married/common-law marriage, single or otherwise) and number of children (number).

All guardians were informed and made aware of the research and method for collecting data on feeding of preschool children in the first year of life. Administration of the questionnaire was conditioned to voluntary participation and signing of the Informed Consent Form by the children's mothers or guardians. The study design complied with the ethical principles provided by Brazilian

law, and approved by the Research Ethics Committee of the Rio de Janeiro City Council (CEP SMSDC-RJ Protocol: Nº 125/12).

Statistical Analysis

Statistical analysis was performed in four steps: i) characterization of the sample of preschool children based on the anthropometric and sociodemographic covariates (Table 1); ii) distribution of the nutritional status of preschool children (with or without overweight) to the anthropometric and sociodemographic covariates and the explanatory variables (exclusive breastfeeding and complementary feeding in the first year of life); iii) association test of anthropometric and sociodemographic covariates with the outcome (BMI-for-age) and the explanatory variables; and iv) analysis of the effect of the explanatory variables on BMI-for-age.

Table 1. Anthropometric and sociodemographic characteristics of 126 preschool children attending a day care center in a vulnerable community in the city of Rio de Janeiro-RJ 2012.

Variables	Mean	(± SD)
Antropométricas		
Weight (*kg*)	15,9	(3,10)
Height (*cm*)	99,3	(7,82)
BMI (kg/m^2)	15,9	(3,01)
Sociodemographic		
Age (*years*)	3,3	(0,91)
Maternal age (*years*)	29,1	(6,59)
Maternal schooling (*grade*)	8,1	(3,05)
No. of children (*n*)	2,0	(1,16)
	No.	(%)
Anthropometric		
Overweight		
Yes	36	(28,6)
No	90	(71,4)

To assess the distribution of anthropometric and sociodemographic variables and the explanatory variables according to nutritional status of preschool children, Student's *t*-test and the *chi*-square test were used, respectively, to analyze continuous and categorical data (Table 2). Then, univariate linear regression analysis was used to test the association of sociodemographic covariates with the outcome, BMI-for-age (Table 3). All covariates that showed p values ≤ 0.20 were considered as adjustment variables in the analysis of subsequent multiple linear regression. Multiple linear regression analysis tested the effect of exclusive breastfeeding and complementary feeding in the first year of life on BMI-for-age.

Table 2. Anthropometric and sociodemographic characteristics, breastfeeding and complementary feeding according to nutritional status (normal weight <z-score +2 and excess weight ≥ score-z +2) of 126 preschool children attending a day care center in a vulnerable community in the city of Rio de Janeiro-RJ, 2012.

Variable	Overweight				
	No (n=90)		Yes (n=36)		
	Mean (± SD)				*p* value
Anthropometric					
Weight (*kg*)	15,1	(2,29)	17,9	(3,93)	<0,001
Height (*cm*)	99,2	(7,19)	99,5	(9,30)	0,834
Sociodemographic					
Age (*years*)	3,3	(0,90)	3,2	(0,96)	0,540
Maternal age (*years*)	28,5	(6,39)	30,6	(6,98)	0,190
Maternal schooling (*grade*)	8,1	(2,94)	8,1	(3,36)	0,898
No. of children (*n*)	2,0	(1,25)	2,0	(0,94)	0,758

	no. (%)				*p* value
Sociodemographic					
Sex of Preschooler					0,195
Male	49	(76,6)	15	(23,4)	
Female	41	(66,1)	21	(33,9)	
Type of maternal occupation					0,785
Formal	42	(75,0)	14	(25,0)	
Informal	10	(71,4)	04	(28,6)	
Maternal Marital Status					0,772
Married/Common-Law Marriage	40	(71,4)	16	(28,6)	
Single/Other	24	(68,6)	11	(31,4)	
Breastfeeding					
Exclusive					0,028
Yes	57	(75,0)	19	(25,0)	
No	07	(46,7)	08	(53,3)	
Complementary Feeding‡‡					
Fruit/Juice					1,000
< 4 months	23	(71,9)	09	(28,1)	
> 4 months	46	(71,9)	18	(28,1)	
Vegetables					0,923
< 4 months	17	(70,8)	07	(29,2)	
> 4 months	51	(71,8)	20	(28,2)	
Infant Formula					0,913
< 4 months	28	(68,3)	13	(31,7)	
> 4 months	25	(69,4)	11	(30,6)	
Porridge					0,263
< 4 months	20	(80,0)	05	(20,0)	
> 4 months	38	(67,9)	18	(32,1)	
Soup					0,678
< 4 months	16	(69,6)	07	(30,4)	
> 4 months	54	(74,0)	19	(26,0)	
Homemade food					0,715
< 4 months	06	(66,7)	03	(33,3)	
> 4 months	63	(72,4)	24	(27,6)	
Cookies					0,716
< 4 months	07	(77,8)	02	(22,2)	
> 4 months	62	(72,1)	24	(27,9)	

‡Student's *t*-test for means and Chi-square for proportion. ‡‡ Fast food was not introduced before 4 months of age. There was one case of feeding soft drinks and one case of feeding sweets before 4 months of age.

Table 3. Univariate linear regression of BMI-for-age and sociodemographic variables. Rio de Janeiro-RJ, 2012.

Variables	ß	IC95%	R^2	*p* value
Age (*years*)	0,703	0,554 – 0,852	0,413	<0,001
Maternal age (*years*)	0,040	0,014 – 0,065	0,096	0,003
Maternal schooling (*grade*)	0,019	-0,040 – 0,079	0,005	0,517
No. of children (*n*)	-0,002	-0,155 – 0,152	0,000	0,984
Sex of preschool Child	0,097	-0,257 – 0,451	0,002	0,588
Maternal Occupation	-0,117	-0,527 – 0,294	0,004	0,574
Maternal Marital Status	-0,073	-0,350 – 0,205	0,003	0,604

Breastfeeding was categorized as yes (1 = received exclusive breastfeeding) and no (zero = did not receive exclusive breastfeeding).

Complementary feeding in the first year of life was tested by the month of complementation with each of the foods contained in the structured questionnaire (juice/fruit; infant formula, vegetables, soup, porridge, homemade food, soft drinks, cookies, sweets/candies, fast-food, and by the overall complementation with these foods, based on a complementary feeding score.

For each food introduced in the first year of life, a binary variable was generated (1 = complementation before 4 months of age and 0 = complementation after 4 months of age). Since there was no complementation with fast food and there was just a case of soft drinks and sweets introduced before four months, the effect of these foods on BMI-for-age was not analyzed.

For the overall assessment of complementary feeding in the first year of life, a complementary feeding score was generated. Except for the foods mentioned above (fast food, soft drinks and sweets), a value was calculated for the month when each food item was introduced (1 = before 2 months, 2 = between 2 and 4 months, 3 = between 4 and 6 months, 4 = after 6 months). This value was multiplied by two, and the sum of all the food items was multiplied by 100, that is, the following equation was used: [(Frequency of complementation with fruit/juice*2) + (Frequency of

complementation with Vegetables*2) + (Frequency of complementation with Infant Formula*2) + (Frequency of complementation with Porridge*2) + (Frequency of complementation with Soup*2) + (Frequency of complementation with Homemade Food*2) + (Frequency of complementation with Cookies*2) *100}. The complementary feeding score could thus vary from 1,400 (minimum score: complementation with all foods before 2 months of age) to 5,600 (maximum score: complementation with all foods after 6 months). Thus, a low complementary feeding score was indicative of early complementation with the food items.

The multiple linear regression models were adjusted for the following covariates: age of preschoolers and maternal age. The covariate children's sex was introduced in the final model as an adjustment variable due to its borderline distribution between the overweight categories (p=0.195). Statistical analyses were performed using the statistical software *Statistical Analysis System* (SAS), version 8.2.[14]

Results

The evaluated preschoolers averaged 3.3 (± 0.91) years of age, 15.9 (± 3.10) kg and 99.3 (± 7.82) cm. The mothers of preschool children had an average of 29.1 (± 6.59) years of age, 8.1 (± 3.05) years of schooling and 2.0 (± 1.16) children (Table 1); 36 (28.6%) out of the 126 children evaluated anthropometrically were overweight to some extent (Table 1).

Among preschool children, 64 (50.8%) were males and 62 (49.2%) females (Table 2). Between boys and girls, respectively, 15 (23.4%) and 21 (33.9%) were overweight (Table 2), but the difference in prevalence between the sexes was not significant (p=0.195).

Table 2 shows that there are no statistically significant differences between anthropometric and sociodemographic characteristics of preschool children according to nutritional status (with and without overweight). However, the prevalence of exclusive breastfeeding differed according to nutritional status of overweight preschool children (p =0.028). As for complementation with food items (juice/fruit; infant formula, vegetables, soup, porridge, homemade food and cookies), there was no significant difference between the nutritional status categories (with and without overweight).

In the univariate linear regression analysis, the variables age of preschooler (p<0.001) and maternal age (p=0.003) were associated with BMI-for-age (Table 3). The other covariates were not associated (p>0.20) and therefore they were not considered as adjustment variables, except for the variable "sex of preschooler", which was considered confounding according to their neighboring distribution (p<0.20) between the nutritional status categories (with and without overweight).

Table 4 shows the multivariate models of BMI-for-age according to the explanatory variables: breastfeeding, complementary feeding in the first year and complementary feeding score. Among the foods listed, there was a positive association of BMI-for-age with porridge (β= 0.0080; IC95%= 0003 – 0.015; p = 0.043) and a negative association with the complementary feeding score (β= -0.001; IC95% = -0.002 – - 0003; p = 0.016).

Table 4. Multivariate linear regression‡ of body mass index and breastfeeding, complementary feeding and complementary feeding score. Rio de Janeiro-RJ, 2012.

Variables	ß	IC95%	R^2	p value
Exclusive breastfeeding	0,166	-0,215 – 0,548	0,412	0,388
Complementary feeding				
Fruit/Juice	0,012	-0,169 – 0,193	0,408	0,898
Vegetables	-0,060	-0,241 – 0,121	0,435	0,509
Infant Formula	0,0002	-0,012 – 0,013	0,395	0,977
Porridge	0,008	0,0003 – 0,015	0,386	**0,043**
Soup	-0,063	-0,241 – 0,115	0,412	0,483
Homemade Food	-0,047	-0,228 – 0,135	0,412	0,612
Cookie	-0,137	-0,313 – 0,040	0,427	0,128
Score‡‡	-0,001	-0,002 – - 0003	0,465	**0,016**

‡Models adjusted for the variables age of preschool child and maternal age.

‡‡Score of complementary feeding: (Fruit/Juice*2) + (Vegetables*2) + (Infant Formula*2) + (Porridge*2) + (Soup*2) + (Homemade Food*2) + (Cookies*2) *100.

Discussion

In this study, 28.6% of the children were overweight to some extent. The absence of exclusive breastfeeding and early complementation with porridge proved strongly associated with this outcome, as well as the negative relationship between the complementary feeding score and BMI-for-age. That is, the later complementary feeding starts, the lower the BMI-for-age is among preschool children.

The prevalence of childhood obesity has increased in recent decades throughout the world, and it is characterized as a worrying health problem.[15] In Brazil, the National Survey on Demography and Health[16], whose results were published in 2008, showed that 7.8% of children below the age of five were overweight to some degree. Reasons for this situation include early complementary feeding, intake of processed foods and a sedentary lifestyle.[17]

In the literature, there is a consensus that the early stages, especially during the first year of life, are sensitive to nutritional and metabolic changes, and that can determine effects on children's health in the short and long term.[11,18,19] As far as overweight is concerned, epidemiological findings suggest that breastfeeding can be a protective factor against obesity in childhood and adolescence.[5,18-21] In this sense, it is believed that many factors are related to the prevention against obesity, such as: the specificity of human milk and the influence of environmental and behavioral factors, e.g., socioeconomic status, maternal schooling, standard eating habits and practice of physical activity.[4]

In a meta-analysis study, in order to check the association between infant feeding practices and obesity later in life, Owen *et al.*[19] observed that breastfeeding has a protective effect against obesity when compared to bottle feeding (OR=0.87; CI 95% = 0.85 - 0.90). More recently, Messiah et al.,[22] in an American population-based study, evaluated the effect of breastfeeding, the early introduction of solid foods and smoking during pregnancy and low weight at birth as risk factors for cardiovascular disease in preschool children aged 3-6 years. Among their results, the authors showed breastfeeding as a protective factor against childhood obesity (OR 0.43, 95% CI, 0.27–0.69).

In Brazil, Siqueira & Monteiro[4] analyzed the association between exposure to breastfeeding in childhood and obesity in school-age children from upper class Brazilian families. The authors concluded that the prevalence of obesity in children who were never breastfed was twice as much as that of other children (OR = 2.06; 95% CI: 1.02; 4.16).

In the present study, other factors that influenced the nutritional status of preschool children were: maternal age, because the older mothers are, the higher children's BMI-for-age; and early complementation with porridge, which had a positive association with BMI-for-age. In addition, the complementary feeding score was negatively associated with BMI-for-age. A review study by Monte & Giugliani[9] highlights the risks of early complementary feeding and points out the few advances in complementary feeding promotion in clinical and nutritional practice.

As for maternal age, Guimarães et al.[23] also found a higher incidence of overweight among school children of older mothers. Patterson et al.[24] observed that the increased prevalence of obesity is associated with increased maternal age, accoridng to case-based data from American girls aged 9-10 years. The authors discussed the idea that older mothers tend to further protect their children and, consequently, provide them with greater amounts of food.

The results obtained in the longitudinal study by Li et al.[20] in the United States, with 1,899 infants, showed greater weight gain among formula-fed children during the first year of life. Another study, conducted with 7,798 Irish children aged nine, found that breastfeeding for a period between 13-25 weeks was associated with a 38% (p <0.05) reduction in the risk of obesity at the age of nine, while this practice for a period greater than or equal to 26 weeks was associated with a 51% reduction (p <0.01)[25] of the same risk.

In a longitudinal birth cohort study conducted with 918 children monitored until the age of six, Bergmann et al.,[6] found a greater proportion of high BMI at six months of age for infants fed with infant formula. They pointed out that obesity at least doubled from four to five and then to six years old. The study by Koletzko et al.[26] found, among children who were fed with formulas with higher protein levels, significantly higher BMI compared to those who were breastfed and received formulas with lower protein content or within the limits recommended by the *Codex Alimentarius*.

Increasing evidence points out that the early complementation with inappropriate foods such as whole cow's milk, foods with low bioavailability of micronutrients; or, the insufficient supply of fruits and vegetables, in addition to excessive intake of simple carbohydrates, lipids and sodium, lead to the formation of unhealthy eating habits[26] which have a negative effect on the nutritional status and consequently on the health of preschool children.

The World Health Organization[13] acknowledges the practice of exclusive breastfeeding in the first six months of life, and complemented breastfeeding up to two years, and timely and balanced complementary feeding as effective public health strategies to reduce the risk of non-communicable diseases.[2]

Importantly, there should be a routine monitoring of this population, both to keep track of the nutritional status of preschool children and advise children and families on the prevention of obesity, a current and important public health problem. The lack of information on birth conditions limited the observation of associations between this information and the events studied, and due to the cross-sectional design of the study, causal relationships could not be determined.

Although not significant, probably due to sample size, this study showed the very frequent practice of complementary feeding before four months of age, regardless of overweight. This competition of early complementation to breastfeeding is neither adequate nor healthy; moreover, it may contribute to the risk of future diseases, particularly cardiovascular ones, aggravated by excess weight.[15,19]

Currently, the human right to adequate food[27] is provided in the Brazilian Constitution,[28] and the promotion of adequate and healthy feeding is one of the current guidelines of the National Food and Nutrition Policy (PNAN),[1]. One of the strategies implemented by the National Policy for Health Promotion[29] is to foster quality of life and reduce health problems.

PNAN,[1] within the context of adequate and healthy feeding, recognizes breastfeeding as the earliest appropriate feeding practice, and underscores the importance of the support of health care networks, both by encouraging exclusive breastfeeding until six months and by advising on healthy complementary feeding, which should occur up to two years of age. The Food and Nutritional Surveillance (VAN), the third guideline contained in PNAN, can be used as a strategic tool for the proper monitoring of the nutritional status of preschool children.

Further prospective longitudinal studies should be conducted to assess the impact of supplementary feeding in the first year of life on the nutritional status of preschool children and the future incidence of cardiovascular diseases. Given the current evidence, there is no doubt that exclusive breastfeeding in the first six months of life as well as the development of strategies for promoting healthy complementary feeding are extremely important.

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Received: May 11, 2014
Reviewed: June 8, 2014
Approved: Sept 2, 2014