CSP CADERNOS DE SAÚDE PÚBLICA
REPORTS IN PUBLIC HEALTH

Independent effect of type of breastfeeding on overweight and obesity in children aged 12-24 months

Efeito independente do tipo de aleitamento no risco de excesso de peso e obesidade em crianças entre 12-24 meses de idade

Efecto independiente del tipo de lactancia en el riesgo de exceso de peso y obesidad en niños entre 12-24 meses de edad

Aila Anne Pinto Farias Contarato [1]
Erika Dantas de Medeiros Rocha [2]
Sandra Ana Czarnobay [2]
Silmara Salete de Barros Silva Mastroeni [1]
Paul J. Veugelers [3]
Marco Fabio Mastroeni [1]

doi: 10.1590/0102-311X00119015

Abstract

This study aimed to analyze the effect of type of breastfeeding on the nutritional status of children between 12-24 months of age. This cohort study included 435 children born in 2012 in a public hospital in Joinville, Santa Catarina State, Brazil. Two years after delivery the mothers and their children were contacted in their homes for a new investigation of demographic, economic, nutritional, and anthropometric data. In the unadjusted analysis, children who were not exclusively breastfed were more likely to be overweight (including obesity) at 2 years of age (OR = 1.6; p = 0.049) than exclusively breastfed children. After adjusting for several covariates, children who were not exclusively breastfed had a 12% higher risk of overweight including obesity compared to unadjusted analysis (OR = 2.6 vs. OR = 1.8; p = 0.043). In addition, birthweight was also an independent determinant of overweight including obesity (OR = 2.5; p = 0.002). The practice of exclusive breastfeeding can reduce the risk of overweight in children from developing countries such as Brazil.

Breast Feeding; Overweight; Nutritional Status

[1] *Universidade da Região de Joinville, Joinville, Brasil.*
[2] *Departamento de Nutrição, Associação Educacional Luterana Bom Jesus, Joinville, Brasil.*
[3] *School of Public Health, University of Alberta, Alberta, Canada.*

Correspondence
M. F. Mastroeni
Universidade da Região de Joinville.
Rua Paulo Malschitzki 10, Joinville, SC
89219-710, Brasil.
marco.mastroeni@univille.br

Introduction

Recommended for the first 6 months of an infant's life [1], exclusive breastfeeding (EBF) protects children against infectious diseases such as diarrhea, lower respiratory tract infections and acute otitis media [2], reduces neonatal morbidity and mortality in low- and middle-income countries [3], and improves cognitive development [4]. Some studies have also demonstrated a protective effect of EBF on the risk of overweight and obesity in childhood and adulthood [5,6,7,8]. However, despite the benefits of EBF for the growth and development of newborns and children, the global prevalence of EBF is still low [9]. According to data from the United Nations Children's Fund (UNICEF) published in 2013, the global prevalence of EBF increased from 38% in 2000 to 41% in 2012, with this increase being more expressive in developed countries (from 38% in 2000 to 50% in 2012) [9].

In Brazil, data from the *Brazilian National Demographic and Health Survey of Children and Women* (PNDS 2006) revealed a prevalence of high weight-for-height of 5 to 7% in children younger than 5 years of age and of 6% in children aged 12 to 23 months [10], thus rendering this condition an important public health problem. Since overweight and obesity are difficult to treat, preventing and identifying modifiable or protective risk factors are fundamental for the control of this epidemic [11]. In this respect, EBF seems to exert an important lifelong effect on this control [5,6,7,8,12].

The association between the protective effect of breastfeeding and overweight throughout life has been extracted mainly from observational studies [12]. To our knowledge, no longitudinal or prospective studies have so far evaluated the independent effect of type of breastfeeding on the risk of overweight including obesity in Brazilian children at 2 years of age. The objective of the present study was to evaluate the independent effect of type of breastfeeding on the risk of overweight including obesity in children between 12-24 months of age.

Methods

Subjects and study design

This was a cohort study involving mothers and their infants seen at the Darcy Vargas Public Maternity Hospital of the Municipality of Joinville, Santa Catarina, Brazil. The data are part of a project started in 2012 that was designed to evaluate the determinants and consequences of children born large for gestational age (LGA) and has been described previously [13].

In summary, the first data collection (1st investigation) occurred at Darcy Vargas Public Maternity Hospital in January/February 2012 and included demographic, economic, anthropometric, obstetric, reproductive, and biochemical data. All parturients admitted to Darcy Vargas Public Maternity Hospital with age 18 or older, a gestational age classified as 37 to 42 weeks and a singleton live birth were included in the study. During this phase, exclusion criteria were women diagnosed with pre-eclampsia or infectious-contagious diseases (acquired immunodeficiency syndrome, hepatitis, syphilis, and toxoplasmosis) and newborns with some type of anomaly and those referred for adoption immediately after birth. Of the 529 eligible mother-child pairs, 58 did not meet the inclusion criteria and 36 (7.6%) were considered losses (two mothers refused to participate in the study, 29 mother-child pairs exhibited problems during blood sample collection, one mother provided incomplete data, and four deliveries were performed before the mother arrived at the maternity), totaling 435 mother-child pairs [13].

The second data collection (2nd investigation) started 12 months after birth. The data were collected in the participant's home between March 2013 and March 2014 and included demographic, economic, anthropometric and breastfeeding data. Children aged 25 months or older and those with some type of anomaly that could interfere with anthropometric assessment were excluded from the study. Of the 435 mother-child pairs that participated in the 1st investigation, 11 (2.5%) did not meet the inclusion criteria and 121 (27.8%) were considered losses (23 mothers refused to participate in the study and 98 were not located), resulting in 303 (69.7%) mother-child pairs.

Data collection

The data were collected using pre-tested questionnaires that were administered by trained researchers. In the 1st investigation, newborn weight, length and Apgar score were obtained from the Maternity Register on the same day as the birth of the child. Birthweight was classified into three categories by adjusting weight for gestational age and sex: small for gestational age (SGA) defined as a birthweight < 10th percentile; adequate for gestational age (AGA) defined as a birthweight between 10th and 90th percentile, and large for gestational age (LGA) defined as a birthweight > 90th percentile [14]. A 1-minute Apgar score ≥ 7 was classified as adequate and < 7 as

inadequate. Maternal anthropometric measures were obtained immediately after delivery, still in the maternity unit, using the method of Gordon et al. [15]. Maternal weight was measured with a portable digital scale (Cardiomed, Curitiba, Brazil; capacity of 150kg) to the nearest 0.1kg, and height was measured with a portable stadiometer (Cardiomed, measuring length of up to 220cm) to the nearest 0.1cm.

In the 2nd investigation, infant weight was measured with a portable pediatric digital scale (Beurer, Ulm, Germany; model BY20) with a capacity of up to 20kg to the nearest 10g. Length was measured with a pediatric ruler (measuring capacity of up to 100cm) with a precision of 0.1cm. Weight and height were used to calculate the body mass index (BMI = weight [kg]/length [m^2]). The nutritional status of the children was evaluated based on BMI according to age and sex using the growth charts of the World Health Organization (WHO) [16], which classify children below the 3rd percentile as lean; ≥ 3rd and ≤ 85th percentile as eutrophic; > 85th and ≤ 97th percentile as risk of overweight; > 97th and ≤ 99.9th as overweight, and > 99.9th as obese. The anthropometric measures of the mothers were obtained using the same equipment and procedures as employed in the 1st investigation. Maternal nutritional status was evaluated based on BMI and classified according to the cut-off points of the WHO [17]: normal, BMI between 18 and 24.9kg/m^2; overweight, between 25.0 and 29.9kg/m^2; obese, ≥ 30.0kg/m^2.

Monthly household income (in BRL) was reported by the participants and classified into three categories: < 3, 3-5, and ≥ 5 minimum wages (MW). One MW corresponded to US$306.00 at the time of the study. Marital status was classified as "married/consensual union" when the participant reported to be formally married or lived together with her partner in the same residence, and as "other" when the participant reported any other type of marital status. The participants were also asked whether they returned to working or studying in the first month after pregnancy.

The pregestational BMI was calculated using the report of pregestational weight and the measurement of height obtained immediately after delivery, still in the maternity unit. All anthropometric measurements were obtained in duplicate and the arithmetic mean was used as the final measure.

Breastfeeding was classified according to WHO indicators [18], which define EBF when the infant receives only breast milk or expressed milk and no other liquid or solid, except for drops or syrups of vitamins, minerals and/or medications, for a period of 6 months; predominant breastfeeding (PB) when the infant receives breast milk or expressed milk, as well as water and water-based drinks such as fruit juice and tea; complementary feeding (CF) when the infant receives breast milk or expressed milk, as well as solid or semi-solid foods, non-human milk and special formula; breastfeeding (B) when the infant receives breast milk or expressed milk, as well as non-human milk and special formula; artificial feeding (AF) when the infant receives any type of liquid or semi-solid food in a bottle, including breast milk, non-human milk and special formula [18]. For this study, PB, CF, B and AF were grouped as non-exclusive breastfeeding (NEBF).

Statistical analysis

The data were analyzed using the IBM SPSS, version 22.0 (IBM Corp., Armonk, U.S.A). The chi-squared test was used to compare the prevalence of maternal and child categorical variables according to type of breastfeeding (EBF *vs.* NEBF).

Odds ratios (OR) and 95% confidence intervals (95%CI) were calculated by logistic regression to verify the association of children with overweight including obesity (> 85th percentile) with type of breastfeeding and other risk factors. In unadjusted analysis (Model 1), the crude effects of each risk factor were estimated for children > 85th percentile (compared to children ≤ 85th percentile). Using the Enter method which forces all variables to be included in the model, risk factors with p-value < 0.05 were selected, in addition to age and sex of the child to construct the first adjusted model (Model 2). The second adjusted model (Model 3) was developed including all risk factors of Model 1 in order to verify the independent effect of each factor on the outcome investigated (> 85th percentile). A theoretical model with only one hierarchical level was used for adjusted analysis, with introduction of the variables in the following order: maternal age, maternal education level, marital status, household income, current maternal BMI, and birthweight, 1-minute Apgar score, sex and age of the child. To control for potential confounding factors, the variables were included in the model using a stepwise procedure and adjustment was performed for variables that were significant ($p < 0.05$) in Model 2. The effect of each variable on the outcome (risk of overweight including obesity) and on the exposure (type of breastfeeding) was also analyzed individually.

The reference categories were determined based on the results of other studies, which showed that (1) children born to mothers of lower age and BMI, (2) with higher education level and household income, (3) who lived with a part-

ner, (4) children that received EBF, (5) were born SGA or AGA, and (6) had a 1-minute Apgar score < 7 at birth were less likely to be overweight in the future [19,20,21,22,23,24,25].

The chi-squared test was applied to determine differences in age, education level, birthweight and sex between the group of mother-child pairs that participated in the 1st investigation (N = 435) and the group of pairs that participated in the 2nd investigation (N = 303). All tests were considered significant when p-value < 0.05.

The study was approved by the Ethics Research Committee of the University of Joinville Region (Univille, process 107/2011).

Results

The chi-squared test for proportionality revealed no significant difference in age (p = 0.148), education level (p = 0.874), birthweight (p = 0.103) or sex (p = 0.666) between the groups of the 1st and 2nd investigation.

Table 1 shows the general characteristics of the mothers and their children 2 years after delivery. The proportion of mothers who reported working/studying after pregnancy and who had a BMI > 25mg/kg² was significantly higher among mothers who did not exclusively breastfeed compared to those who did (67.3% *vs.* 47.6% and 53.1% *vs.* 40.8%, respectively). The nutritional status of the children was also significantly associated with type of breastfeeding. The proportion of children > 85th percentile was higher among NEBF children compared to EBF children (45.7% *vs.* 34%; p = 0.048).

The analysis of risk factors for overweight including obesity at 2 years of age is shown in Table 2. When compared to EBF children, those who were not exclusively breastfed were more likely to develop overweight including obesity (OR = 1.6; p = 0.049) after 2 years of follow-up. Children of currently obese mothers (BMI ≥ 30kg/m²) had an increased risk of overweight including obesity when compared to children of mothers with a BMI < 25kg/m² (OR = 2.1; p = 0.012). Children born LGA and with a 1-minute Apgar score < 7 were also more likely to be overweight than SGA/AGA children (OR = 2.3; p = 0.001) and children with a 1-minute Apgar score ≥ 7 at birth (OR = 2.5; p = 0.033), respectively (Table 2).

After adjusting for the covariates child age and sex and for those that were significant (p < 0.05) in unadjusted analysis (Model 1), the risk of NEBF children being overweight (including obesity) after 2 years of follow-up increased from 1.6 to 1.7 times (Model 2; OR = 1.1; p = 0.038). In the third model (Model 3), even after adjusting for all covariates of Model 1, NEBF children were more likely to be overweight (including obesity) when compared to unadjusted analysis (OR = 1.8 *vs.* OR = 1.6; p = 0.043) (Table 2). Additionally, birthweight was found to exert an independent effect on the child's risk of overweight including obesity (OR = 2.5; p = 0.002).

Discussion

To our knowledge, this is the first longitudinal and prospective study involving Brazilian children that demonstrated the practice of NEBF to be associated with an increased risk of overweight including obesity in children at 2 years of age. We showed that EBF exerted an independent effect on the risk of overweight including obesity even after controlling for different confounders of the mother and child. Additionally, children born LGA were also more likely to be overweight (including obesity) at 2 years of age.

Our results are consistent with the findings of other prospective studies conducted in Brazil but that involved different age groups [8,19]. Moreira et al. [19], studying children younger than 5 years of age, demonstrated an association between EBF < 6 months and the risk of overweight (OR = 1.82; 95%CI: 1.31-2.51). Scanferla de Siqueira & Monteiro [8] showed that children aged 6 to 14 years who had never been breastfed were also more likely to be overweight (OR = 2.06; 95%CI: 1.02-4.16).

Several authors have evaluated the relationship between EBF and late overweight, but the results are conflicting. Longitudinal and prospective studies involving children from other countries found results similar to those of the present study [20,26,7,28,29]. Rossiter et al. [26] observed that Canadian children who were combination fed in the first 6 months of life were more likely to be overweight (OR = 1.27; 95%CI: 1.02-1.58). In a prospective cohort study, Jwa et al. [27] investigated the effect of breastfeeding on the nutritional stats of Japanese children between 5.5 and 8 years of age. When compared to children receiving infant formula, children exposed to EBF were less likely to be overweight both at 5.5 years (boys – OR = 0.64; 95%CI: 0.50-0.82 and girls – OR = 0.70; 95%CI: 0.55-0.89) and 8 years of age (boys – OR = 0.61; 95%CI: 0.48-0.76 and girls – OR = 0.60; 95%CI: 0.47-0.77) 27. Rzehak et al. [28] evaluated children monthly until 2 years of age and observed that those exposed to EBF gained less weight than children fed infant formula, but showed a similar growth in length. Zhang et al. [29] observed that EBF reduced the risk of overweight including obesity by 47% in Chinese children

Table 1

Characteristics of mothers and their children according to type of breastfeeding 2 years after delivery. Joinville, Santa Catarina State, Brazil, 2013-2014.

Characteristics	Type of breastfeeding (N = 303)			p-value
	EBF	NEBF	Total	
	n (%)	n (%)	n (%)	
Mothers				
Age (years)				0.741
< 20	3 (2.8)	7 (3.6)	10 (3.3)	
20-30	63 (59.4)	124 (62.9)	187 (61.7)	
≥ 30	40 (37.8)	66 (33.5)	106 (35.0)	
Education (years)				0.472
< 9	35 (33.0)	56 (28.4)	91 (30.0)	
9-12	46 (43.4)	100 (50.8)	146 (48.2)	
≥ 12	25 (23.6)	41 (20.8)	66 (21.8)	
Marital status				0.079
Married/Consensual union	99 (93.4)	171 (86.8)	270 (89.1)	
Others	7 (6.6)	26 (13.2)	33 (10.9)	
Monthly household income (MW) *,**				0.468
< 3	58 (54.7)	117 (60.3)	175 (58.3)	
3-5	29 (27.4)	41 (21.1)	70 (23.3)	
≥ 5	19 (17.9)	36 (18.6)	55 (18.4)	
Worked/Studied after pregnancy ***				0.001
No	55 (52.4)	64 (32.7)	119 (39.5)	
Yes	50 (47.6)	132 (67.3)	182 (60.5)	
Pre-pregnancy BMI (kg/m^2)				0.546
< 25	69 (65.1)	120 (60.9)	189 (62.4)	
25-30	23 (21.7)	54 (27.4)	77 (25.4)	
≥ 30	14 (13.2)	23 (11.7)	37 (12.2)	
BMI (kg/m^2) #				0.043
< 25	61 (59.2)	92 (46.9)	153 (51.2)	
≥ 25	42 (40.8)	104 (53.1)	146 (48.8)	
Children				
Age (months)				0.628
12-17	67 (63.2)	130 (66.0)	197 (65.0)	
18-25	39 (36.8)	67 (34.0)	106 (35.0)	
Sex				0.909
Male	54 (50.9)	99 (50.3)	153 (50.5)	
Female	52 (49.1)	98 (49.7)	150 (49.5)	
Birthweight				0.708
SGA/AGA	77 (72.6)	147 (74.6)	224 (73.9)	
LGA	29 (27.4)	50 (25.4)	79 (26.1)	
1-minute Apgar				0.637
≥ 7	98 (92.5)	179 (90.9)	277 (91.4)	
< 7	8 (7.5)	18 (9.1)	26 (8.6)	
BMI (percentile)				0.048
≤ 85th	70 (66.0)	107 (54.3)	177 (58.4)	
> 85th	36 (34.0)	90 (45.7)	126 (41.6)	

"AGA: adequate for gestational age; BMI: body mass index; EBF: exclusive breastfeeding; LGA: large for gestational age; MW: minimum wage; NEBF: non-exclusive breastfeeding; SGA: small for gestational age.

* MW at the time of the study: US$306.00;

** n = 300, three participants did not know the monthly household income;

*** n = 301, two participants did not answer this question;

n = 299, four participants refused to provide their anthropometric measurements.

Table 2

Logistic regression results of children at risk of overweight including obesity 2 years after birth. Joinville, Santa Catarina State, Brazil, 2013-2014.

Characteristics	Model 1		Model 2		Model 3	
	OR * (95%CI)	p-value	OR ** (95%CI)	p-value	OR *** (95%CI)	p-value
Type of breastfeeding						
Exclusive	Reference	-	Reference	-	Reference	-
Non-exclusive	1.6 (1.0-2.7)	0.049	1.7 (1.0-2.9)	0.038	1.8 (1.0-3.0)	0.043
Age (years)						
< 30	Reference	-	-	-	Reference	-
≥ 30	1.0 (0.6-1.6)	0.973	-	-	1.0 (0.6-1.7)	0.989
Education (years)						
≥ 12	Reference	-	-	-	Reference	-
9-12	1.4 (0.7-2.5)	0.307	-	-	1.2 (0.6-2.4)	0.944
< 9	1.2 (0.6-2.3)	0.567	-	-	0.9 (0.4-2.0)	0.779
Marital status						
Married/Consensual union	Reference	-	-	-	Reference	-
Others	1.0 (0.5-2.2)	0.891	-	-	0.8 (0.3-1.8)	0.553
Monthly household income (MW) #						
≥ 5	Reference	-	-	-	Reference	-
3-5	1.2 (0.5-2.3)	0.764	-	-	1.4 (0.6-3.3)	0.368
< 3	1.5 (0.8-2.9)	0.165	-	-	1.9 (0.9-3.9)	0.097
Current maternal BMI (kg/m^2)						
< 25	Reference	-	Reference	-	Reference	-
25-30	1.6 (0.9-2.7)	0.083	1.3 (0.7-2.3)	0.310	1.4 (0.8-2.5)	0.293
≥ 30	2.1 (1.2-3.9)	0.012	1.8 (0.9-3.2)	0.082	1.8 (0.9-3.4)	0.092
Birthweight						
SGA/AGA	Reference	-	Reference	-	Reference	-
LGA	2.3 (1.4-3.8)	0.001	2.6 (1.5-4.6)	0.001	2.5 (1.4-4.5)	0.002
1-minute Apgar score						
≥ 7	Reference	-	Reference	-	Reference	-
< 7	2.5 (1.1-5.6)	0.033	2.0 (0.8-4.7)	0.138	1.9 (0.8-4.7)	0.148

95%CI: 95% confidence interval; AGA: adequate for gestational age; BMI: body mass index; LGA: large for gestational age; MW: minimum wage; OR: odds ratio; SGA: small for gestational age.

* Unadjusted analysis;

** Analysis adjusted for significant variables ($p < 0.05$) of Model 1 + child age and sex;

*** Analysis adjusted for all variables of Model 1 + child age and sex;

MW at the time of the study: US$306.00.

at 2 years of age, and Bergamm et al. [20] found a protective effect of EBV in German children at 6 years of age (OR = 0.53; 95%CI: 0.31-0.89).

Although several studies have demonstrated a lifelong protective effect of EBF on overweight, some authors observed the opposite effect. In a cohort study involving Swedish children at 5 years of age, Huus et al. [22] found no association between EBF and the risk of overweight including obesity (OR = 1.22; 95%CI: 0.81-1.83). Durmus et al. [21] also reported no protective effect of EBF on the risk of overweight including obesity in a population-based cohort study of Dutch children at 2 years of age (OR = 1.20; 95%CI: 0.98-1.47).

Brazil is a country that has experienced a rapid nutritional transition in recent decades, which culminated in the establishment of high prevalences of overweight and obesity in children and adults similar to those found in North American countries [30,31,32]. The prevalence of the risk of overweight (> 85th percentile) of 41.6% observed in our study is alarming and higher than that reported in other national [19,23] and international studies [33,34,353,36] considering children of

the same age range. However, comparison of our results with those of other studies should be performed with caution due to the different methods and cut-off points used. Li et al. [36], studying 55,925 Chinese children younger than 3 years, found a prevalence of children above the 85th percentile of 26.6%. Hassapidou et al. [33], who investigated 1,250 Greek children aged 2 to 6 years, also used the percentile classification of the WHO and observed a prevalence of children above the 85th percentile of 32.6%. Using the classification proposed by Cole et al. [37] to evaluate the nutritional status of children between 2 and 5 years of age in the United Kingdom, van Jaarsveld et al. [34] found a prevalence of the risk of overweight including obesity (≥ 85th percentile) of 24.9% in boys and of 23.8% in girls. Moreira et al. [19], using another anthropometric index (weight/height of the WHO), reported a prevalence of 28.5% for the risk of overweight in a study involving 963 Brazilian children younger than 5 years.

Although different cut-off points and classifications have been adopted to identify the risk of overweight and obesity in children from different countries, impairing more reliable comparison, the high prevalence of the risk of infant overweight seems to be a global problem. Some authors suggest the WHO cut-off point to overestimate the prevalence of the risk of overweight [33]. However, in countries with great ethnic diversity such as Brazil, the classification of nutritional status proposed by the WHO seems to be more adequate since it was developed based on populations from different countries, including Brazil.

The explanation for the protective effect of EBF on overweight continues to be a matter of discussion in the literature. Some authors suggest the protection exerted by EBF to be related to metabolic imprinting, a phenomenon whereby an early nutritional experience acting during a critical and specific period of development can have a long-lasting effect that persists throughout the life of an individual and predisposes to certain diseases [38] such as obesity. Other authors report that NEBF, especially bottle feeding, favors the development of overweight by promoting the excessive consumption of milk and/or by compromising the development of self-regulatory mechanisms of food intake [6]. The unique composition of breast milk may therefore be implicated in the process of metabolic imprinting, for example, altering the number and/or size of adipocytes or inducing the phenomenon of metabolic differentiation [6].

Another plausible hypothesis for the negative effect of NEBF on the risk of excess body weight is the higher protein intake in the first year of life, which is associated with faster weight gain and, consequently, greater adiposity, increasing the risk of overweight in the future [39,40]. Children fed infant formula ingest a higher amount of protein than exclusively breastfed children [27] because of the higher protein content of infant formulas [28].

Finally, breastfeeding involves different factors, including the amount of food ingested, the composition of this food, the time of introduction and quality of solid foods and the development of regulatory mechanisms of food intake, as well as behavioral aspects associated with the mother-child relation and the formation of eating habits of the child [6]. Since EBF is an essential component of the child's health, the elaboration of public nutrition policies such as preventive and nutritional intervention activities is fundamental to prevent the establishment of excess body weight still during the preschool phase. The practice of EBF should be encouraged intensely since the beginning of pregnancy so that the mother does not measure efforts to practice it for as long as possible during the first 6 months of life of the child. In Brazil, the early interruption of EBF is still common and is due to different factors, especially the short period of maternity leave and the inexperience of the mother with the breastfeeding process. Although the mother needs to return to her activities after completing her maternity leave, in most cases 4 months after birth, the continuous offer of breast milk to the child, either with the bottle or by periodic visits to the daycare center/home, should be more intensely promoted in the Brazilian population by the appropriate agencies. It should also be remembered that many women in Brazil perform activities without a formal contract and therefore have no right to maternity leave, interrupting the period of EBF even earlier. According to Araújo & Lombardi [41], in 2009, about 52.1% of women held an informal activity in Brazil and most of them (57%) worked up to 39 hours per week.

Regarding the inexperience of the mother with breastfeeding her first child, increasing the frequency of contact of the mother with the health agent, pediatrician or other healthcare worker of the Basic Health Unit seems to be a simple and effective strategy to assist the mother in breastfeeding her child, and thus to increase EBF rates in the country.

This study has several strengths, including the collection of prospective data, which permits to establish the causal relationship between the exposure (EBF) and outcome (overweight including obesity of the child). In addition, the study adjusted for various important confounding factors such as socioeconomic condition, maternal nutritional status, and birth conditions of the child. All data, including the anthropometric

measurements, were collected by the same research group since the birth of the children, reducing possible bias. Finally, the losses (27.8%) that occurred in the 2nd investigation were not considered high for this type of study, a home-based cohort. In general, most home-based studies have reported losses higher than 40% [21,29]. In the present study, the fact that no significant difference was observed between the groups of the 1st and 2nd investigation (followed up and not followed up) reduced the risk of selection bias. Additionally, the probability of loss was not related to the exposure or outcome of the study but mainly to the geographic situation (incorrect address, change of address), minimizing loss to follow-up bias.

However, some important limitations of the study should be mentioned. First, data regarding education level, household income, breastfeeding and pregestational weight were reported by the mothers and may therefore be prone to memory bias. Second, aspects related to the quantity and quality of the foods offered to the children that may have influenced child development were not addressed in this study. Finally, eating and lifestyle habits of the mothers and their children were also not investigated. Characteristics such as the frequency of and how breastfeeding/food was offered may have also influenced the development of the children.

Conclusion

Although studies are controversial, our results showed that children who were not exclusively breastfed were more likely to be overweight (including obesity) at 12-24 months of age. The encouragement of EBF should be part of preventive and nutritional intervention activities, especially during the child's first 6 months of life, to prevent the development of overweight and obesity, a current global public health problem.

Contributors

A. A. F. Contarato participated in the conception, data collection and analyses, and writing the manuscript. E. D. M Rocha collaborated in the data interpretation and writing the manuscript. S. A. Czarnobay contributed to the data collection and writing the manuscript. S. S. B. S Mastroeni and M. F. Mastroeni conceived and designed the study, drafted the initial manuscript and analyses, coordinated and supervised the data collection and wrote the article. P. J. Veugelers contributed to the statistical analysis and writing the manuscript.

Acknowledgments

We thank the Darcy Vargas Maternity Hospital and the Gimenes Laboratory of Joinville, Santa Catarina, Brazil, for permitting the data collection at their facilities. We also thank John P. Ekwaru at Population Health Intervention Research Unit, School of Public Health, University of Alberta (Canada) for his statistical expertise, and Kerstin Markendorf for the English revision; to the Resarch Foundation and University of Joinville Region, Joinville, Santa Catarina (Brazil) for the financial support.

References

1. World Health Organization. The optimal duration of exclusive breastfeeding. Geneva: World Health Organization; 2001.
2. Fisk CM, Crozier SR, Inskip HM, Godfrey KM, Cooper C, Roberts GC, et al. Breastfeeding and reported morbidity during infancy: findings from the Southampton Women's Survey. Matern Child Nutr 2011; 7:61-70.
3. Debes AK, Kohli A, Walker N, Edmond K, Mullany LC. Time to initiation of breastfeeding and neonatal mortality and morbidity: a systematic review. BMC Public Health 2013; 13 Suppl 3:S19.
4. Victora CG, Horta BL, Loret de Mola C, Quevedo L, Pinheiro RT, Gigante DP, et al. Association between breastfeeding and intelligence, educational attainment, and income at 30 years of age: a prospective birth cohort study from Brazil. Lancet Glob Health 2015; 3:e199-205.
5. Marseglia L, Manti S, D'Angelo G, Cuppari C, Salpietro V, Filippelli M, et al. Obesity and breastfeeding: the strength of association. Women Birth 2015; 28:81-6.
6. Balaban G, Silva GA. Protective effect of breastfeeding against childhood obesity. J Pediatr (Rio J.) 2004; 80:7-16.

7. Simon VG, Souza JM, Souza SB. Breastfeeding, complementary feeding, overweight and obesity in pre-school children. Rev Saúde Pública 2009; 43:60-9.
8. Scanferla de Siqueira R, Monteiro CA. Breastfeeding and obesity in school-age children from families of high socioeconomic status. Rev Saúde Pública 2007; 41:5-12.
9. United Nations Children's Fund. Young child survival and development. Tematic report 2013. New York: United Nations Children's Fund; 2014.
10. Ministério da Saúde. Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher – PNDS 2006: dimensões do processo reprodutivo e da saúde da criança. Brasília: Centro Brasileiro de Análise e Planejamento, Ministério da Saúde; 2009.
11. Araújo CL, Victora CG, Hallal PC, Gigante DP. Breastfeeding and overweight in childhood: evidence from the Pelotas 1993 birth cohort study. Int J Obes (Lond) 2006; 30:500-6.
12. Scott JA, Ng SY, Cobiac L. The relationship between breastfeeding and weight status in a national sample of Australian children and adolescents. BMC Public Health 2012; 12:107.
13. Sales WB, Silleno Junior JD, Kroll C, Mastroeni SS, Silva JC, Mastroeni MF. Influence of altered maternal lipid profile on the lipid profile of the newborn. Arch Endocrinol Metab 2015; 59:123-8.
14. Lubchenco LO, Hansman C, Dressler M, Boyd E. Intrauterine growth as estimated from liveborn birth-weight data at 24 to 42 weeks of gestation. Pediatrics 1963; 32:793-800.
15. Gordon CC, Chumlea WC, Roche AF. Stature, recumbent length, and weight. In: Lohman TG, Roche AF, Martorell R, editors. Anthropometric standartization reference manual. Champaign: Human Kinetics Books; 1988. p. 3-8.
16. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ 2007; 85:660-7.
17. World Health Organization. Obesity: preventing and managing the global epidemic. Geneva: World Health Organization; 2000. (WHO Technical Report Series, 894).
18. World Health Organization; United Nations Children's Fund; United States Agency for International Development; Food and Nutrition Technical Assistance; University of California, Davis; International Food Policy Research Institute. Indicators for assessing infant and young child feeding practices. Geneva: World Health Organization; 2008.
19. Moreira MA, Cabral PC, Ferreira HS, Lira PI. Overweight and associated factors in children from northeastern Brazil. J Pediatr (Rio J.) 2012; 88: 347-52.
20. Bergmann KE, Bergmann RL, Von Kries R, Böhm O, Richter R, Dudenhausen JW, et al. Early determinants of childhood overweight and adiposity in a birth cohort study: role of breast-feeding. Int J Obes Relat Metab Disord 2003; 27:162-72.
21. Durmus B, van Rossem L, Duijts L, Arends LR, Raat H, Moll HA, et al. Breast-feeding and growth in children until the age of 3 years: the Generation R Study. Br J Nutr 2011; 105:1704-11.
22. Huus K, Ludvigsson JF, Enskar K, Ludvigsson J. Exclusive breastfeeding of Swedish children and its possible influence on the development of obesity: a prospective cohort study. BMC Pediatr 2008; 8:42.
23. Cocetti M, Taddei JA, Konstantyner T, Konstantyner TC, Barros Filho AA. Prevalence and factors associated with overweight among Brazilian children younger than 2 years. J Pediatr (Rio J.) 2012; 88:503-8.
24. Caminha MF, Azevedo PT, Sampaio BB, Acioly VM, Belo MP, Lira PI, et al. Breastfeeding in children from 0 to 59 months in the state of Pernambuco, Brazil, in accordance with weight at birth. Ciênc Saúde Coletiva 2014; 19:2021-32.
25. Minsart AF, Buekens P, De Spiegelaere M, Englert Y. Neonatal outcomes in obese mothers: a population-based analysis. BMC Pregnancy Childbirth 2013; 13:36.
26. Rossiter MD, Colapinto CK, Khan MK, McIsaac JL, Williams PL, Kirk SF, et al. Breast, formula and combination feeding in relation to childhood obesity in Nova Scotia, Canada. Matern Child Health J 2015; 19:2048-56.
27. Jwa SC, Fujiwara T, Kondo N. Latent protective effects of breastfeeding on late childhood overweight and obesity: a nationwide prospective study. Obesity (Silver Spring) 2014; 22:1527-37.
28. Rzehak P, Sausenthaler S, Koletzko S, Bauer CP, Schaaf B, von Berg A, et al. Period-specific growth, overweight and modification by breastfeeding in the GINI and LISA birth cohorts up to age 6 years. Eur J Epidemiol 2009; 24:449-67.
29. Zhang J, Himes JH, Guo Y, Jiang J, Yang L, Lu Q, et al. Birth weight, growth and feeding pattern in early infancy predict overweight/obesity status at two years of age: a birth cohort study of Chinese infants. PLoS One 2013; 8:e64542.
30. Lobstein T, Baur L, Uauy R; IASO International Obesity Task Force. Obesity in children and young people: a crisis in public health. Obes Rev 2004; 5 Suppl 1:4-104.
31. Monteiro CA, Conde WL, Popkin BM. Is obesity replacing or adding to undernutrition? Evidence from different social classes in Brazil. Public Health Nutr 2002; 5:105-12.
32. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2014; 384:766-81.
33. Hassapidou M, Daskalou E, Tsofliou F, Tziomalos K, Paschaleri A, Pagkalos I, et al. Prevalence of overweight and obesity in preschool children in Thessaloniki, Greece. Hormones (Athens) 2015; 14:615-22.

34. van Jaarsveld CH, Gulliford MC. Childhood obesity trends from primary care electronic health records in England between 1994 and 2013: population-based cohort study. Arch Dis Child 2015; 100: 214-9.
35. Gubbels JS, Kremers SP, Stafleu A, Dagnelie PC, de Vries NK, van Buuren S, et al. Child-care use and the association with body mass index and overweight in children from 7 months to 2 years of age. Int J Obes (Lond) 2010; 34:1480-6.
36. Li N, Liu E, Sun S, Guo J, Pan L, Wang P, et al. Birth weight and overweight or obesity risk in children under 3 years in China. Am J Hum Biol 2014; 26:331-6.
37. Cole TJ, Freeman JV, Preece MA. Body mass index reference curves for the UK, 1990. Arch Dis Child 1995; 73:25-9.
38. Waterland RA, Garza C. Potential mechanisms of metabolic imprinting that lead to chronic disease. Am J Clin Nutr 1999; 69:179-97.
39. Koletzko B, Broekaert I, Demmelmair H, Franke J, Hannibal I, Oberle D, et al. Protein intake in the first year of life: a risk factor for later obesity? The E.U. childhood obesity project. Adv Exp Med Biol 2005; 569:69-79.
40. Escribano J, Luque V, Ferre N, Mendez-Riera G, Koletzko B, Grote V, et al. Effect of protein intake and weight gain velocity on body fat mass at 6 months of age: the EU Childhood Obesity Programme. Int J Obes (Lond) 2012; 36:548-53.
41. Araújo AMC, Lombardi MR. Trabalho informal, gênero e raça no Brasil do início do século XXI. Cad Pesqui 2013; 43:452-77.

Resumo

Este estudo teve como objetivo avaliar a importância do tipo de aleitamento no risco de excesso de peso de crianças entre 12-24 meses de idade. Trata-se de um estudo de coorte que incluiu 435 crianças nascidas em 2012 em uma maternidade pública de Joinville, Santa Catarina, Brasil. Dois anos após o parto, as mães e seus filhos foram contatados nas residências para uma nova coleta de dados. Na análise não ajustada, crianças que não receberam aleitamento materno exclusivo apresentaram maior risco de desenvolver excesso de peso aos dois anos de idade (OR = 1,6; p = 0,049), quando comparadas às crianças amamentadas exclusivamente. Mesmo após o ajuste para diversas covariáveis, o risco das crianças não amamentadas exclusivamente apresentarem excesso de peso aumentou 12% em relação à análise não ajustada (OR = 2,6 vs. *OR = 1,8; p = 0,043). Adicionalmente, o peso ao nascer também mostrou ser um determinante independente do risco de excesso de peso (OR = 2,5; p = 0,002). A prática do aleitamento materno exclusivo pode reduzir o risco de excesso de peso em crianças de países em desenvolvimento como o Brasil.*

Aleitamento Materno; Sobrepeso; Estado Nutricional

Resumen

Este estudio tuvo como objetivo evaluar la importancia del tipo de lactancia en el riesgo de exceso de peso de niños entre 12-24 meses de edad. Se trata de un estudio de cohorte que incluyó a 435 niños nacidos en 2012, en una maternidad pública de Joinville, Santa Catarina, Brasil. Tras dos años después del parto, se contactó con las madres y sus hijos en sus residencias para una nueva recogida de datos. En el análisis no ajustado, los niños que no recibieron exclusivamente el pecho materno presentaron mayor riesgo de desarrollar exceso de peso a los dos años de edad (OR = 1,6; p = 0,049), cuando se comparan con los niños amamantados exclusivamente. Incluso tras el ajuste para diversas covariables, el riesgo de que los niños no amamantados exclusivamente presentaran exceso de peso aumentó un 12%, en relación con el análisis no ajustado (OR = 2,6 vs. *OR = 1,8; p = 0,043). Asimismo, el peso al nacer también mostró ser un determinante independiente del riesgo de exceso de peso (OR = 2,5; p = 0,002). La práctica de dar exclusivamente el pecho puede reducir el riesgo de exceso de peso en niños de países en desarrollo como Brasil.*

Lactancia Materna; Sobrepeso; Estado Nutricional

Submitted on 21/Jul/2015
Final version resubmitted on 10/Dec/2015
Approved on 11/Mar/2016