



# Preterm Birth, Pacifier use and Breastfeeding: is there a Relationship?

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The immaturity of born to preterm infants may predispose to sucking difficulties. This research aimed to evaluate if pacifier use is associated with preterm birth and influenced in type of infant feeding. This comparative cross-sectional study was conducted in Belo Horizonte, Brazil and evaluated 250 children aged 3 to 5 years. As a sample, two groups were established: the normal term children group (n=125) was selected at a day-care centre and the group of preterm children (125) was identified at a public university hospital with a preterm care project from birth to seven years of age. To collect data, a pre-tested questionnaire regarding information on gestational age, infant development, infant feeding and non-nutritive sucking habits was used for both groups. Bivariate and multivariate Poisson regression was used for the statistical analysis. Pacifier use was more prevalent in the preterm group (PR=1.20, 95% CI=1.02-1.42) who used the bottle (PR=1.38, 95% CI=1.15-1.64) and were breastfed for less than six months (PR=1.19, 95% CI=1.01-1.41). The majority of breastfed infants were of normal term birth (PR=1.14, 95% CI=1.04-1.20) and had monthly family income greater than USD 450.28 (RP= 1.10, 95% CI=1.01-1.20). In this study, pacifier use was more prevalent among preterm infants and associated with less than six months of breastfeeding and used of bottle. Monthly family income was associated with a prevalence of breastfeeding.

Key Words: breastfeeding, bottle-feeding, oral habits, pacifier, prematurity.

## Introduction

The World Health Organization (WHO) defines premature infants as all births before the 37th full week of pregnancy or before 259 days from the first day of the last period of the menstrual cycle (1). Globally, nearly 15 million infants are born prematurely each year, representing 11.1% of all of all newborns (2).

Limitations are very common in preterm infants, due to immaturity of suckling, swallowing and breathing functions, which may hinder breastfeeding (3,4,5). The WHO recommends immediate breastfeeding (within the first hour of life), exclusively and without adding any liquid, solid or semi-solid foods until six months of age (6). Human milk is a rich source of nutrients that helps to develop the immune system of the infant, to prevent allergies and respiratory problems, fill psychosocial needs and prevent non-nutritive suckling habits (7-9).

The WHO and the United Nations Children's Fund (UNICEF) do not recommend pacifiers and bottle-feeding, in order to prevent early weaning (WHO, 1998). Suckling habits and bottle-feeding can hinder bone growth and jeopardize the development of dental positions and respiratory and speech processes (10,11).

Several studies of different designs, systematic review, clinical trial, longitudinal and cross-sectional studies have associated non-nutritive suckling habits with early weaning, malocclusions and socioeconomic factors in children (12-19). One case-control study observed that children aged 3 to

6 years who were born prematurely had a 3.3-fold greater chance of developing non-nutritive sucking habits (20). However, studies in the literature evaluating the association between pacifier-sucking habits and prematurity remain scarce. In fact, it was hypothesized that premature children may be more prone to difficulties with breastfeeding and consequently vulnerable to the introduction of pacifiers and/or bottles in their daily lives. The introduction of pacifiers and bottles may lead to disharmonies of the dental arches. Therefore, the aim of this study was to evaluate whether preterm infants are more likely to use pacifiers and whether there is an influence by the type of infant feeding. The results can contribute to stimulate educational campaigns to stimulate the practice of breastfeeding and discourage the use of pacifiers and bottles, deserving special attention to preterm babies.

## Material and Methods

The study was a retrospective comparative cross-sectional epidemiological study of 250 children aged 3 to 5 years. Due to the specificity of this study, a convenience sample was divided into two groups: preterm infants in a public hospital (n=125) and normal term birth preschool enrolled in a public day-care centre (n=125) in Belo Horizonte, southwest Brazil. Participants from the two groups were children in the same age group at the time of data collection.

The sample calculation was based on a prevalence

of 43% of the pacifier sucking habit (17) and a 95% confidence level, the power 90%, resulting in a sample of 208 participants, being: 104 premature children and 104 normal term births. The sample size using the proportion estimation formula based also on the prevalence of breastfeeding of our study (81.2%), power 95% and a 5.0% stand error was done. The minimum need for 76 participants in each group was observed. Therefore, the sample size based on the pacifier prevalence was adopted. The minimum participants required for breastfeeding assessment were included within the number of participants based on the pacifier prevalence.

Predicting possible losses, a 20% excess was added to the total, resulting in a final sample size of 250 children (21), 125 premature and 125 normal term birth children.

Children from 3 to 5 years of age were included, without neurological changes and with good general health. Children with cleft palate, presence of syndromes and children whose parents did not consent to participation were excluded from the study.

The study was authorized by the Human Research Ethics Committee of the Federal University of Minas Gerais (protocol #49803115.4.0000.5149). The parents/guardians voluntarily agreed to participate and signed a consent form.

### Data Collection

To recruit the preterm group, information was sought from the medical records of the university public hospital. In order to recruit the normal term group, we contacted a public day-care center. The two groups had the same age range at the time of data collection. The same questionnaire was used for both groups, obtaining information on gestational age (preterm or normal term), socio-demographic aspects (mother's age, mother's profession, monthly family income, child's sex, child's age), unplanned pregnancy, birth normal or cesarean, infant development (diseases, medication use, hospitalization and weight), infant feeding (time of breastfeeding and time of use of the bottle) and use of pacifier based on parent/guardian reporting. This questionnaire was previously tested with 20 children in order to evaluate the methodology proposed for the study. No change in methodology was required. Participants in the pilot study were not included in the main study. Medical records of the group of preterm mothers were used to access families who had children in the age range necessary for the study. The participating university hospital has an project that accompanies premature infants from birth until they turn seven. Therefore, it was necessary to consult the records to select the families that had children who were born prematurely and that at the time of collection they had the age group between 3 and 5 years of age. Mothers of a public day care center was

contact and those mothers who had children between the ages of 3-5 years and those who had been born full term was invited.

The minimum wage in Brazil was the reference for the categorization of monthly family income. Household income was categorized in terms of the Brazilian Monthly Minimum Wage (BMMW), which corresponded to USD 450.28 at the time of the study and was established as the monthly income of all economically-active members of the family. For statistical analysis, household income was categorized as follows: parents/caregivers of children whose families have a monthly income  $\leq 1$  BMMW or  $> 1$  BMMW (<http://agenciabrasil.ebc.com.br/en/economia/noticia/2017-02/brazils-national-average-household-income-capita-40016-2016>).

Data organization and statistical analyses were performed using Statistical Package for Social Science (SPSS) software, version 21.0. Two models of bivariate Poisson regression were constructed; one for the pacifier variable and another for the breastfeeding variable. The independent variables were "sex", "child's age", "gestational age", "family income", "unplanned pregnancy", "type of birth" and "bottle-feeding and breastfeeding time". The estimation of the effect of the numerous independent variables on the dependent variables was calculated using a Poisson regression. The "breastfeeding" variable did not fit the multivariate regression model of the pacifier variable and was therefore excluded. The "breastfeeding times" variable did not fit the bivariate regression model of the breastfeeding variable and was excluded. The independent variables that were associated with the dependent variables in the bivariate analysis ( $p \leq 0.20$ ) were inserted into the multivariate Poisson regression based on the conceptual model.

### Results

Of the 250 children, 113 were boys (45.2%) and 137 were girls (54.8%). A large number of the children were five years old (117,46.8%) and belonged to families with income greater than USD 450.28 (121,48.4%). The majority of unplanned pregnancies were reported and equalled 136 cases (54.4%), a large proportion of the children were born by caesarean section (65.6%) and breastfed after hospital discharge (80.8%). A total of 120 children were born at less than 34 weeks gestation and five between 35 and 37 weeks. A large percentage the children used pacifiers (167,66.8%), a bottle (198,79.5%) and had a breastfeeding period of six months or greater (123,61.1%).

In the bivariate analysis, the pacifier variable had a statistically significant association with gestational age ( $p < 0.001$ ), sex ( $p = 0.019$ ), breastfeeding ( $p < 0.001$ ), bottle-feeding ( $p < 0.001$ ) and duration of breastfeeding ( $p < 0.001$ ).

Table 1. Bivariate Poisson Regression Model for independent variables in relation to the dependent variable pacifier

	n	(%)	Pacifier Use				PR (95% CI)	p
			Yes		No			
			n(%)	n(%)	n(%)	n(%)		
<b>Gestational age</b>								
Preterm birth	125	(50.0)	100	(80.0)	25	(20.0)	1.49 (1.22-1.76)	<0.001
Normal term	125	(50.0)	67	(53.6)	58	(46.4)	1	
<b>Sex</b>								
Male	113	(45.2)	66	(58.4)	47	(41.6)	0.80 (0.70-0.96)	0.019
Female	137	(54.8)	101	(73.7)	36	(26.3)	1	
<b>Age</b>								
3 years	63	(25.2)	43	(68.3)	20	(31.7)	1	
4 years	70	(28.0)	47	(67.1)	23	(32.9)	0.98 (0.77-1.24)	0.891
5 years	117	(46.8)	77	(65.8)	40	(34.2)	0.96 (0.79-1.20)	0.827
<b>Family income</b>								
Up to USD 450.28	77	(30.8)	55	(71.4)	22	(28.6)	1.18 (0.96-1.44)	0.101
Greater than USD 450.28	121	(48.4)	73	(60.3)	48	(39.7)	1	
<b>Unplanned pregnancy</b>								
Yes	136	(54.4)	87	(64.0)	49	(36.0)	0.91 (0.76-1.09)	0.339
No	109	(43.6)	76	(69.7)	33	(30.3)	1	
<b>Birth</b>								
Normal	83	(33.2)	54	(65.1)	29	(34.9)	0.97 (0.86-1.10)	0.681
Cesarean	164	(65.6)	110	(67.1)	54	(32.9)	1	
<b>Feeding a patient discharge</b>								
Breastfeeding	201	(80.8)	129	(64.2)	72	(35.8)	1.24 (0.99-1.55)	0.054
Bottle-feeding	25	(10.0)	20	(80.0)	5	(20.0)	1	
<b>Breastfeeding</b>								
No	47	(18.8)	42	(89.4)	5	(10.6)	1.44 (1.24-1.66)	<0.001
Yes	203	(81.2)	126	(62.1)	77	(37.9)	1	
<b>Bottle-feeding</b>								
Used	198	(79.5)	147	(74.2)	51	(25.8)	1.89 (1.33-2.69)	<0.001
Not used	51	(20.5)	20	(39.2)	31	(60.8)	1	
<b>Duration of breastfeeding</b>								
Less than 6 months	78	(38.8)	61	(78.2)	17	(21.8)	1.53 (1.22-1.84)	<0.001
Longer than 6 months	123	(61.1)	64	(51.0)	59	(48.0)	1	

PR= Prevalence Ratio; p= probability value; Bold values represent statistically significant values.

(Table 1). In the bivariate analysis, the breastfeeding variable was significantly associated with gestational age (p<0.001), sex (p=0.002), family income (p<0.001), feeding at patient discharge (p<0.001), pacifiers (p<0.001) and bottle-feeding (p<0.001) (Table 2).

The multivariate Poisson regression model showed that gestational age, bottle-feeding and duration of breastfeeding remained associated with the pacifier variable. The likelihood of remaining in the group that uses pacifiers was higher in preterm infants (PR=1.20, 95% CI=1.02-1.42) who used a bottle (PR=1.38, 95% CI=1.15-1.64) and who were breastfed for fewer than six months (PR=1.19, 95% CI=1.01-1.41) (Table 3). It is also observed that the multivariate Poisson regression model showed that the likelihood of remaining with the breastfed infants group of was higher for normal term birth (PR=1.14 CI=1.04-1.120), the use of bottle (PR=1.76 95% CI=1.52-2.03) and family income greater than USD 450.28 (PR=1.10 95% CI=1.01-1,20) (Table 3).

## Discussion

The most important results of this study are associated with gestational age, bottle use, family income and the use of pacifiers as a discouraging breastfeeding, and the results among preterm birth infants are important. These results will be discussed below. The child is part of a family and wider society. Individual customs and customs of the country of origin can influence habits. Thus, pacifier use is subject to cultural influences. The high prevalence

of pacifier use is worrying considering the possible consequences, including early weaning and the occurrence of malocclusions (10,11). Related work developed in Brazil evaluated 278 premature babies. In this study, 45.7% of preterm infants used pacifiers (22). The prevalence of pacifier use in the current study may be associated with the difficulty in initiating breastfeeding for preterm infants, thus making them more vulnerable to bottle-feeding (7,8). The replacement of breastfeeding by bottle-feeding may be responsible for the appearance of unfortunate oral habits (7,8). The high prevalence of pacifiers among preemies emphasizes the importance of the overall view of the child during the interview, relating the gestational age to the presence of non-nutritive sucking habits.

Pacifier use was associated with less than six months of breastfeeding. Children who use pacifiers early have generally had shorter breastfeeding times (6,9). The mother's need to return to work when the baby reaches 4 to 6 months old can be a barrier to the practice of breastfeeding and contribute to early weaning. The pacifier may be an alternative for the mother to reassure and fill the need for gratification of the child's oral phase. The WHO recommends exclusive breastfeeding up to six months of age, therefore, children who breastfed for less than six months experienced early weaning (6). Breastfeeding has the ability to satisfy both the baby's suckling needs and his or her psychological needs. Thus, the practice of breastfeeding prevents the appearance of non-nutritive suckling habits (8,23).

The results here in also demonstrated that bottle-feeding is associated with pacifier use. Bottle-fed children can breastfeed less frequently and the pacifier may be an option to meet their need to suckle. The WHO and UNICEF recommend that pacifiers or bottle-feeding (artificial nipples) should not be used by breastfed infants (6). Children who are bottle-fed may have greater difficulty in obtaining milk from the breast due to "confusion of nozzles", caused by differences in the technique of suctioning between the bottle and the breast, which can lead to weaning (24). In turn, early weaning and

bottle-feeding may potentiate pacifier use (8).

Table 2. Bivariate Poisson Regression Model for independent variables in relation to the dependent variable breastfeeding

	Breastfeeding				PR (95% CI)	p
	Yes		No			
	n(%)	n(%)	n(%)	n(%)		
<b>Gestational age</b>						
Normal term	117	(93.6)	8	(06.4)	1.36 (1.19-1.54)	<0.001
Preterm birth	86	(68.8)	39	(31.2)	1	
<b>Sex</b>						
Male	101	(89.4)	12	(10.6)	1.20 (1.06-1.34)	0.002
Female	102	(74.5)	35	(25.5)	1	
<b>Age</b>						
3 years	49	(77.8)	14	(22.2)	1	
4 years	56	(80.0)	14	(20.0)	1.02 (0.86-1.22)	0.754
5 years	98	(84.2)	19	(15.8)	1.07 (0.92-1.25)	0.338
<b>Family Income</b>						
Greater than USD 450.28	112	(92.6)	9	(7.4)	1.22 (1.07-1.41)	0.003
Up to USD 450.28	58	(75.3)	19	(24.7)	1	
<b>Unplanned pregnancy</b>						
Yes	113	(83.1)	23	(16.9)	1.04 (0.92-1.17)	0.514
No	87	(79.8)	22	(20.2)	1	
<b>Birth</b>						
Normal	67	(80.7)	16	(19.3)	0.98 (0.87-1.12)	0.852
Cesarean	134	(81.7)	30	(18.3)	1	
<b>Feeding a patient discharge</b>						
Breastfeeding	182	(90.1)	20	(9.9)	3.75 (1.86-7.55)	<0.001
Bottle-feeding	6	(24.0)	19	(76%)	1	
<b>Pacifiers</b>						
Not used	78	(94.0)	5	(06.0)	1.25 (1.12-1.38)	<0.001
Used	125	(74.9)	42	(25.1)	1	
<b>Bottle-feeding</b>						
Not used	49	(96.1)	2	(03.9)	1.24 (1.13-1.36)	<0.001
Used	153	(77.3)	45	(22.7)	1	

\* The time of breastfeeding variable did not fit the model and was therefore excluded. PR= Prevalence Ratio; p= probability value; Bold values represent statistically significant values.

There was a significant association between the "breastfeeding" and "normal term" variables, indicating that breastfeeding was more prevalent for full-term infants. While the mother waits for the development of her premature child in the hospital, she does not receive the stimulus of breast suction. Lack of sucking on the breast can lead to decreased milk production by the mother, making it difficult to breastfeed. This has been verified by a similar result in a longitudinal study conducted in Australia (25). The study examined children of a gestational age between 37 and 39 weeks (92.0%) and between 35 and 36 weeks. Fewer of the younger group (88.2%) started breastfeeding and only 41.2% maintained it for a total period of six months. Those born at 37-39 weeks (54.5%) breastfed for six months (25). In most instances, premature infants required feeding tubes, presenting relative difficulty for the initiation of breastfeeding (4).

The practice of breastfeeding was associated with monthly family income greater than USD 450.28. Mothers with low family income probably had difficulties obtaining

access to adequate information and regular prenatal care because of the difficulty of scheduling consultations in the public health system. The lack of orientation of these mothers may have influenced the frequency and duration of breastfeeding. A study conducted with pregnant women from Myanmar observed that socioeconomic indicators such as medium- and high-income women and with higher levels of education had more intent to breastfeed their babies than women with lower incomes and lower educational levels (26). Such findings may indicate a relationship with the sample site profile. The public hospital where the preterm infant data was collected provides free care for disadvantaged families and part of the sample of full-term students was collected from a private school whose parents pay a monthly fee. Therefore, children born at normal term had a higher family income. In addition, these children were more likely to initiate breastfeeding compared to preterm infants, who show immaturity in coordinating suckling, swallowing, and breathing (3).

A study was conducted in seven countries of different socioeconomic levels (Brazil, Japan, Norway, Turkey, the United States, Sweden and Mexico) and found that the prevalence of breastfeeding was high in all countries, varying from 78.0% to 98.0% (27).

Natural breastfeeding at the time of hospital discharge was associated with the existence of breastfeeding. In this study, 47 children left the hospital being breastfed and only 22 were able to continue breastfeeding after leaving the hospital. Despite the limitations of preterm births, most of the children were able to breastfeed, only 25 children never breastfed. This result underscores the importance of breastfeeding guidance at the time when mothers are vulnerable and open to information while awaiting the preterm baby's discharge from hospital.

Maintaining exclusive breastfeeding for six months without introducing pacifiers and bottle-feeding can be a challenge for mothers of preterm infants. Many preterm infants need a long period of hospitalization and may face several sequelae throughout their lives. A pacifier may be an alternative for mothers to calm and reassure their babies.

The strength of this work is the presentation of new perspectives in the study of the aetiology of non-nutritive sucking habits (even in the face of WHO campaigns discouraging the use of pacifiers and bottles) with the opportunity to compare two age-matched groups in different environments (one hospital and one day-care centre). The results demonstrate that educational and multidisciplinary campaigns with the partnership of doctors, nurses, dentists, speech therapists, pedagogues and psychologists should be encouraged. In addition, public health programs need to be implemented to support low-income families and promote the health of pregnant

Table 3. Multivariate Poisson Regression

Pacifier Use	PR adjusted	95% CI	P
Gestational age			
Preterm birth	1.20	1.02-1.42	0.026
Normal term	1		
Bottle-feeding			
Used	1.38	1.15-1.64	<0.001
Not used	1		
Duration of breastfeeding			
Less than 6 months	1.19	1.01-1.41	0.031
Longer than 6 months	1		
Breastfeed			
	PR adjusted	95% CI	p
Gestational age			
Normal term	1.14	1.04-1.20	0.003
Preterm birth	1		
Feeding at patient discharge			
Breastfeeding	1.76	1.52-2.03	<0.001
Bottle-feeding	1		
Family Income			
Greater than USD 450.28	1.10	1.01-1.20	0.024
Up to USD 450.28	1		

\* The breastfeeding variable did not fit the model and was therefore excluded. -PR= Prevalence Ratio; p= probability value; CI=confidence interval. Bold values represent statistically significant values

women.

This study presents some limitations that merit reflection. The population studied was limited to a local sample, which does not guarantee its reproducibility in other socioeconomic and cultural situations. The possibility of memory bias is likely, although the information collected occurred either during or shortly after exposure. This detail can be observed by the small increase in the prevalence of pacifier use among 3-year-olds compared to 5-year-olds. It is important for the stimulation of other studies in this area, with different designs, both quantitative and qualitative.

In this study, preterm birth, bottle-feeding and a breastfeeding time of less than six months are factors associated with pacifier use. Full-term birth, natural breastfeeding at the time of hospital discharge and monthly family income greater than USD 450.28 are associated with breastfeeding practice in this sample studied.

In this study, pacifier use was more prevalent among preterm infants and associated with less than six months of breastfeeding and used of bottle. Monthly family income was associated with a prevalence of breastfeeding.

## Acknowledgements

This study was supported by Coordination for the Improvement of Higher Education Personnel (CAPES) and Research Support Foundation of the State of Minas Gerais (FAPEMIG).

## Resumo

A imaturidade no nascimento para pretermos pode os predispor a dificuldades de sucção. Esta pesquisa teve como objetivo avaliar se o uso de chupeta está associado ao nascimento prematuro e ao tipo de alimentação infantil. Este estudo transversal comparativo foi realizado em Belo Horizonte, Brasil e avaliou 250 crianças de 3 a 5 anos. A amostra foi composta por dois grupos: o grupo de crianças nascidas a termo ( $n = 125$ ) que foi selecionado em uma creche e o grupo de crianças pré-termo (125) que foi contatado em um hospital universitário público vinculado a um projeto de cuidados pré-termo desde o nascimento até os sete anos de idade. Para coletar dados, um questionário pretextado sobre informações da idade gestacional, desenvolvimento infantil, alimentação infantil e hábitos de sucção não nutritiva foram utilizados para ambos os grupos. Análises bivariada e Regressão de Poisson multivariada foram utilizadas para a análise estatística. O uso de chupeta foi mais prevalente no grupo pré-termo (RP = 1,20, IC95% = 1,02-1,42), que usou a mamadeira (RP = 1,38; IC95% = 1,15-1,64) e foram amamentados ao seio por menos de seis meses (RP = 1,19, 95% IC = 1,01-1,41). A maioria das crianças amamentadas ao seio nasceram a termo (RP = 1,14, 95% IC = 1,04-1,20) e com renda familiar mensal maior que USD 450,28 (RP = 1,10, 95% IC = 1,01-1,20). Neste estudo, o uso de chupeta foi mais prevalente entre os prematuros e associado com a amamentação ao seio por menos de seis meses e uso de mamadeira. A renda familiar mensal associou-se a uma prevalência de prática da amamentação ao seio.

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*Received December 21, 2017*  
*Accepted May 18, 2018*