

## Effect of breast- and bottle-feeding duration on the age of pacifier use persistence

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**Abstract:** This study evaluated the effect of breast- and bottle-feeding duration on the age of pacifier use persistence. Questionnaires (n = 723) with information on nutritive and nonnutritive sucking habits of children aged 3-6 years were assessed. The sample was divided according to breastfeeding duration: G1 – non-breastfed, G2 – up to 3 months, G3 – discontinued between 4 and 6 months, G4 – discontinued between 7 and 12 months, and G5 – longer than 12 months. The children were also assigned to 4 groups by age of pacifier use persistence, as well as by age of bottle-feeding persistence: no habits, up to 2 years, 3-4 years and 5-6 years. Associations between nutritive sucking habits and pacifier use were analyzed using logistic regression. The larger breastfeeding groups were G2 (37.9%) and G4 (19.4%). Many children discontinued pacifier use and bottle-feeding at 3-4 years of age (24.9% and 40.1%, respectively). Chances of non-breastfed children (G1) with prolonged pacifier-sucking habits, in the three age ranges, were progressively higher in comparison with group G4 (OR: 4.0-7.5,  $p < 0.01$ ). When comparing bottle-fed with non bottle-fed children, the age range at which bottle-feeding had been discontinued was significantly associated with that of pacifier use cessation: up to 2 years (OR = 6.2), 3-4 years (OR = 7.6) and 5-6 years (OR = 27.0),  $p < 0.01$ . It may be suggested that breastfeeding duration has an inversely proportional effect on the age of pacifier use persistence. Bottle-fed children who use pacifiers tend to discontinue these habits at the same period.

**Descriptors:** Breast feeding; Sucking behavior; Dentition, primary.

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## Introduction

The World Health Organization (WHO) current recommendations advise exclusive breastfeeding during the first six months of the child's life.<sup>1,2</sup> In addition, the use of artificial nipples (bottles and pacifiers) are not recommended, since it reduces suckling duration, which, in turn, causes an interference in the demand for food<sup>3</sup> along with an alteration in the oral and myofunctional dynamics.<sup>3-7</sup>

A direct relationship between short breastfeeding duration and increased prevalence of non-nutritive sucking habits, especially pacifier use, has been reported.<sup>8-15</sup> However, a possible association between breast- or bottle-feeding durations and the age of persistence of pacifier-sucking habits is not completely elucidated. Information on the age at which prolonged non-nutritive sucking behaviors cease would be more meaningful to better understand the etiology of malocclusions in the primary dentition than a simple positive registration of such habits.<sup>16</sup> Thus, the aim of the present study was to assess the effect of breast- and bottle-feeding durations on the age of pacifier use persistence. The null hypothesis stated no effect of nutritive sucking on prolonged pacifier-sucking habits.

## Materials and Methods

This study is in agreement with Resolution 196/96 from the National Health Council/Health Department (Brazil).

### Sample selection

The study sample comprised 723 structured questionnaires answered by mothers of children aged 3 to 6 years, of both genders and presumably healthy, who were attending 11 public preschools in the eastern region of the city of São Paulo, SP, Brazil. The questionnaires had information about the children's general health condition, methods and duration of infant feeding, as well as the history of non-nutritive sucking habits (pacifier use and finger-sucking habit). Before beginning this study, questionnaire interpretation consistency was investigated in a group of 18 mothers, who were asked to answer all the proposed questions twice. A six-month interval was allowed to elapse between the first and second inquiry. The

reliability of the mothers' answers was estimated by calculating the intraoperator kappa concordance index ( $\kappa$ ). All studied variables presented a high degree of reliability, with  $\kappa$  values of approximately 0.93. These questionnaires were not included in the present study sample, since the group of 18 mothers participated only in a pilot test.

In a total of 976 questionnaires collected, 73.3% mother-infant dyads were selected according to the following inclusion criteria: (1) free and informed consent terms signed by mothers; (2) questionnaires properly answered; (3) no history of traumatism, syndromes, orofacial clefts or any other developmental anomalies that could be detrimental to breastfeeding; (4) no history of finger-sucking habit; and (5) children had never undergone orthodontic treatment or speech therapy.

Demographic and socioeconomic statistical data for the areas where the preschools were located had shown that the study population was on a low-to-middle income level and consisted of a culturally homogeneous sample, as they were all under the same ethnic and sociocultural influences.

### Study groups

To analyze the effect of breastfeeding duration on the age of persistence of pacifier-sucking habits, the sample was assigned to five groups by duration, in months, of breastfeeding – without the introduction of bottles for nourishing the child or any other purpose: G1 – non-breastfed (comprised children who were never breastfed or those children who were breastfed for a period smaller than one month); G2 – children who received breastfeeding up to 3 months of age; G3 – breastfeeding was discontinued between 4 and 6 months of age; G4 – breastfeeding was discontinued between 7 and 12 months of age; and G5 – breastfeeding was performed for longer than 12 months of age.

According to WHO<sup>2</sup>, *exclusive breastfeeding* is related to nutritive sucking in the mother's breast; whenever the child receives only breast milk and no other liquids or solids. *Predominant breastfeeding*, however, is related to nutritive sucking in the mother's breast with the occasional administration of liquids/supplements by means of infant feeding

methods that preclude artificial nipples, such as cupfeeding. Breastfeeding occasional complementation may be done by offering liquids from a spoon or mug, but consists of breast milk as the infant's predominant source of nourishment.<sup>2</sup> There also might be cases in which semisolid or solid foods are gradually introduced as the child grows and the teeth erupt, but breastfeeding still continues. In this situation, the infant feeding method may be designated as *complementary breastfeeding*.<sup>9</sup> None of these categories were used in an isolated manner, considering that the study design of the present research comprised a variety of time intervals relative to breastfeeding duration, which encompassed exclusive, predominant and complementary breastfeeding phases, irrespective of the differences between categories, since the most relevant factor was the definitive avoidance of bottle-feeding.

The selected children were also distributed into four groups according to the age range up to which they persisted in using a pacifier: no habits (consisted of children who had never sucked on a pacifier); up to 2 years of age – children who had pacifier-sucking habits that persisted up to 2 years of age; from 3 to 4 years of age – children whose pacifier-sucking habits had ceased between 3 and 4 years of age; from 5 to 6 years of age – children whose pacifier-sucking habits had ceased between 5 and 6 years of age. Similarly, children were also divided into four groups by age of bottle-feeding persistence.

## Statistical analysis

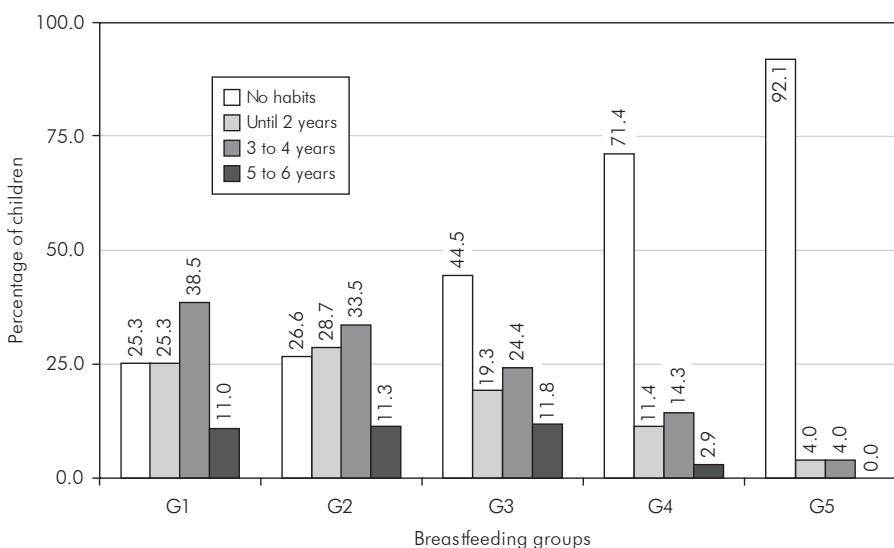
Possible effects of breastfeeding duration, gender and age range of bottle-feeding persistence on the age range of pacifier use persistence were analyzed using a logistic regression model ( $\alpha = 0.05$ ). The adjusted model provided odds ratio (OR) values, expressing the degree of association.

## Results

Based on the mothers' answers, 12.6% of the children were not breastfed (group G1). On the other hand, 87.4% of the children were breastfed without the introduction of feeding bottles for at least one month (sum of all the other breastfeeding groups). The highest percentage of children was in group G2, who were breastfed for up to 3 months of age (37.9%). The second largest group comprised children who interrupted breastfeeding between 7 and 12 months of age (19.4%), i.e. group G4.

The longer the breastfeeding practice lasted, the lower the frequency of children with history of pacifier use (Graph 1). Of the children who were breastfed for a period longer than 12 months of age (group G5), 92% did not present a history of pacifier-sucking habits. However, approximately 75% of those who had never been breastfed (G1) presented a positive history of pacifier use. Apart from the fact that many children in this study sample discontinued pacifier use between 3 and 4 years of age (24.9%), greater percentages of children with pacifier-suck-

**Graph 1** - Frequency of children categorized according to the age of pacifier use persistence in the breastfeeding groups. (G1: non-breastfed; G2: breastfeeding up to 3 months of age; G3: breastfeeding discontinued between 4 and 6 months of age; G4: breastfeeding discontinued between 7 and 12 months of age; G5: breastfeeding discontinued beyond 12 months of age).



ing habits persisting up to a period between 5 and 6 years of age were observed in groups G1, G2 and G3. The opposite situation occurred in groups G4 and G5.

According to the data shown in Graph 2, 21.4% of the total sample were never bottle-fed, whereas the highest percentage of children (40.1%) discontinued bottle-feeding between 3 and 4 years of age. The percentages of children who were never bottle-fed were progressively lower in the groups established on the basis of pacifier use history. In the study groups established by history of pacifier-sucking habits and bottle-feeding, a certain parallel distribution of children was noted. In the group of children without history of non-nutritive sucking habits (no habits), the highest frequency of children who were never bottle-fed was found. Notably, approximately 62% of the children who had discontinued pacifier use between 3 and 4 years of age also discontinued bottle-feeding at the same period.

The logistic regression analysis is shown in Table 1. The eligible reference groups for comparisons were: *G4*, considering breastfeeding duration, without the introduction of feeding bottles (group *G5* could not be used as reference because, among the children who discontinued pacifier use between 5 and 6 years of age, none of them were breastfed for longer than 12 months of age); *Male*, for gender and *Not bottle-fed*, regarding the age of bottle-feeding persistence.

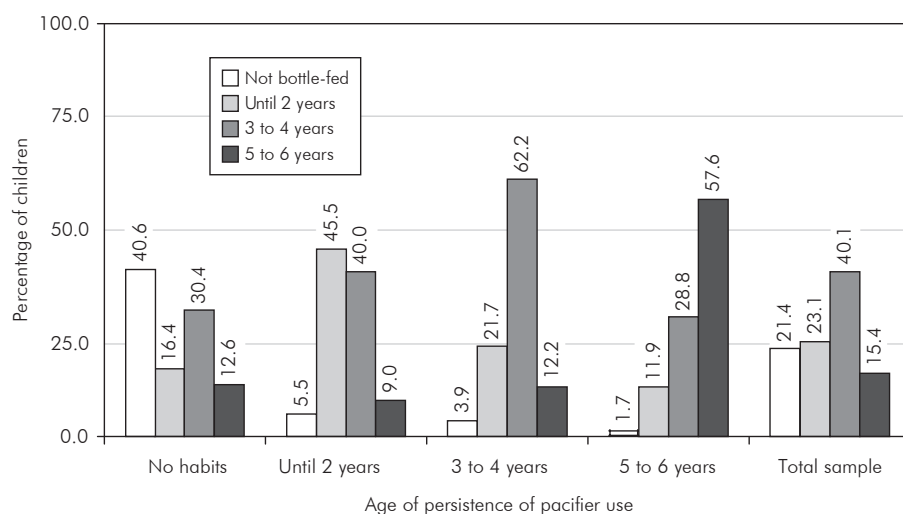
As demonstrated in Table 1, non-breastfed chil-

dren (group *G1*) would have progressively much higher chances of having pacifier-sucking habits prolonged up to the three studied periods in comparison with those who interrupted breastfeeding between 7 and 12 months of age (group *G4*); OR: 4.0-7.5,  $p < 0.01$ . Interestingly, a breastfeeding practice for very short periods of time, i.e., up to 3 months of age, appears to exert little influence on the prevention of prolonged non-nutritive sucking habits.

Considering the persistence of pacifier-sucking habits, gender was not a significant factor. Nevertheless, a correspondence between the age ranges of persistence of bottle-feeding and pacifier-sucking habits was found, with higher chances of having these two habits prolonged up to the same period, as follows: up to 2 years (OR = 6.2), 3-4 years (OR = 7.6) and 5-6 years (OR = 27.0),  $p < 0.01$  (Table 1). This finding corroborates a certain parallel development of these sucking behaviors.

## Discussion

Associations between pacifier use and increased prevalence of malocclusions in the primary dentition have been well-documented worldwide.<sup>6,10,12,16-18</sup> At the same time, there is reliable evidence of a positive influence of breastfeeding on craniofacial development.<sup>4-7,18,19</sup> Breastfeeding promotes intense exercise of the orofacial muscles, thus favorably stimulating nose breathing, proper swallowing, chewing and phonation.<sup>4,5,19</sup> Bottle-feeding, however, involves a different type of nipple and therefore a quite distinct



**Graph 2** - Sample distribution according to the age of bottle-feeding persistence in the study groups by age of pacifier use persistence.

**Table 1** - Logistic regression analysis of the association between breastfeeding duration, gender, age range of bottle-feeding cessation and age of pacifier use persistence.

Comparisons	Age of pacifier use persistence								
	Up to 2 years			3 to 4 years			5 to 6 years		
	OR	S.E.	p value	OR	S.E.	p value	OR	S.E.	p value
<b>Breastfeeding</b>									
G3/G4	1.9	0.722	0.111	1.8	0.647	0.095	3.1	1.945	0.071
G2/G4	3.9	1.330	0.000*	3.9	1.232	0.000*	6.4	3.778	0.002*
G1/G4	4.0	1.678	0.001*	5.0	1.940	0.000*	7.5	5.043	0.003*
G5/G4	0.5	0.270	0.184	0.3	0.197	0.063	-	-	-
<b>Gender</b>									
Female/Male	0.8	0.179	0.311	1.0	0.217	0.886	1.0	0.325	0.969
<b>Bottle-feeding</b>									
Up to 2 years/Not bottle-fed	6.2	2.890	0.000*	3.8	1.852	0.006*	3.0	3.390	0.321
3 to 4 years/Not bottle-fed	3.8	1.680	0.003*	7.6	3.408	0.000*	5.3	5.676	0.119
5 to 6 years/Not bottle-fed	2.2	1.144	0.146	3.9	1.956	0.008*	27.0	28.691	0.002*

OR: odds ratio. S.E.: standard error. \*: p value < 0.01 (highly significant).

sucking mechanism.<sup>4,6,19</sup> Despite attempts to design physiological rubber nipples that mimic a breast, there is little data that substantiates any benefit of one design over another.<sup>18</sup>

Although some studies have already suggested a close relationship between pacifier use and bottle-feeding,<sup>4,14,18</sup> the extent to which these two sucking habits were associated remained somewhat controversial. The present study clearly demonstrated the effects of breast- and bottle-feeding durations on the age of pacifier use persistence. The age range at which children sustain nutritive and non-nutritive sucking habits may be an important marker of malocclusion establishment. Many authors recommend that parents should be aware of the need for stopping the pacifier-sucking habit by the age of 2 years in order to reduce the risk of malocclusions.<sup>12,16,17</sup> Concerning the dummy nipple design, it seems to have no clinically significant differences between children who sucked on conventional pacifiers and those who used “orthodontic” ones, as far as the prevalence of malocclusions in the primary dentition is concerned.<sup>17</sup>

Based on the mothers’ recall, approximately 38% of the studied children had exclusive/predominant breastfeeding interrupted before the fourth month

of life. This time period is far below the one recommended by the WHO, and would certainly be too short to detect the positive influence of breastfeeding on preventing prolonged non-nutritive sucking habits and promoting adequate development of dental occlusion.<sup>8,10</sup> Durations of exclusive/predominant breastfeeding equal to or shorter than 3 months were significantly associated to higher chances of acquiring pacifier-sucking habits that may persist longer in a progressive pattern, in comparison with breastfeeding for periods equal to or longer than 7 months (Table 1). A reasonable explanation for the short duration of exclusive/predominant breastfeeding in this sample population may be related to pacifier introduction and/or routine use of bottles to supplement the baby’s nourishment.<sup>3,11</sup>

No significant differences were found between groups G5 and G4 (Table 1). Additionally, 71.4% percent of the children without history of pacifier-sucking habits were categorized in group G4 (Graph 1). Therefore, it may be suggested that breastfeeding durations, without complementary bottle-feeding, for periods equal to or longer than 7 months, may be suitable for preventing the development of prolonged pacifier-sucking habits. Nevertheless, to encourage and monitor breastfeeding

may be a major challenge in both public and private health services. Lack of mothers' compliance may be attributed to many perceived barriers, including inefficient lactation support, employment outside the home and smoking.<sup>2,11,20</sup>

In accordance with previous studies,<sup>4,18</sup> the results of the present investigation pointed out a strong association between bottle-feeding and pacifier use (Table 1 and Graph 2). A high number of children without history of non-nutritive sucking habits (40.6%) had also never used a feeding bottle. However, bottle-feeding was more frequently observed (78.6%) than pacifier use (53%), indicating that infant feeding with artificial nipples might not always be implicated in the establishment of non-nutritive sucking habits. From a clinical perspective, the most interesting finding was the parallel distribution pattern of children according to the age of bottle-feeding persistence and pacifier use.

Most pacifier users discontinued the habit between 3 and 4 years of age and, in this subgroup of children, 62.2% stopped bottle-feeding at the same age interval. In the light of the current knowledge about the association between artificial nipples and malocclusions in the primary dentition,<sup>6,10,16-18</sup> this age range may be considered a late stage of children's development to prevent some occlusal alterations.<sup>16,17</sup> During parents counseling, health care professionals should recommend that artificial nipples be curtailed beginning at 2 years of age. Other methods of soothing infants should be discussed with parents, including breastfeeding and rocking, because these comfort methods may be as effective as pacifiers in calming infants and decreasing their sucking urge. In this context, early use of a pacifier and/or feeding bottle may cause some infants to adopt a faulty

breastfeeding technique, the so-called nipple confusion, which may lead to early weaning.<sup>9,11-14</sup> Some studies suggested a relationship between pacifier use, as well as bottle-feeding, and bacteria or yeast infections, chiefly *Candida albicans*.<sup>9,12</sup> Moreover, pacifier use has also been implicated in an increased risk for acute otitis media.<sup>12</sup>

The nutritional, immunological and psychological benefits of exclusive breastfeeding for the first six months of the child's life are unequivocally recognized. However, mothers should also be provided with information about the importance of sustained breastfeeding, beyond that minimum duration proposed by the WHO, and delayed introduction as well as occasional practice of bottle-feeding to avoid the establishment of prolonged pacifier-sucking habits, which are detrimental to the satisfactory development of dental occlusion in the primary dentition.

## Conclusions

- It may be suggested that breastfeeding duration has an inversely proportional effect on the age of pacifier use persistence.
- Many children discontinued bottle-feeding and pacifier use between 3 and 4 years of age, evidencing a discontinuation of artificial nipples use in a late stage of the primary dentition development.
- Bottle-fed children who use pacifiers tend to discontinue these habits at the same period.

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