Contemporary Orofacial Sciences (2025) 3(1): 42-49
DOI: 10.61186/cofs.3.1.6

ORIGINAL RESEARCH

The association between the consumption of night milk and the prevalence of early childhood caries among children aged 1 to 3 years in Isfahan

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Received: 2024-07-19/ Accepted: 2025-02-16 / First publication date: 2025-03-05

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Abstract

Background: Several factors contribute to early childhood caries (ECC), including poor dental hygiene, frequent consumption of sugary foods and beverages, and prolonged exposure of teeth to these substances. This study aimed to investigate the relationship between nocturnal breastfeeding patterns and early childhood caries in children aged 1 to 3 years.

Materials and methods: This descriptive analytical study was conducted on 260 children aged 1 to 3 years. A pre-designed questionnaire was used to gather data on several factors, including: frequency of nocturnal breastfeeding, type of milk consumed and methods of milk consumption, duration of nocturnal breastfeeding, age at which bottled milk was first introduced, age at which nightly breastfeeding was stopped, Oral and dental hygiene habits following nocturnal breastfeeding and parental education levels. Data were analyzed by using Chi-square test ($\alpha = 0.05$).

Results: The frequency of breastfeeding, tooth brushing, and the use of fluoride-containing toothpaste did not show significant differences in relation to the prevalence of ECC ($p>0.05$). Long-term breastfeeding, frequent consumption of sugary substances throughout the day, lack of oral hygiene, absence of post-breastfeeding water, and low levels of parental education were associated with a significant increase in ECC prevalence ($p<0.05$).

Conclusion: ECC is highly prevalent among children aged 1 to 3 years in Isfahan city. Implementing preventive measures and increasing parental awareness about the relationship between ECC and nocturnal breastfeeding, as well as promoting dental cleaning during breastfeeding and regular dental examinations from the start of teething, are essential for prevention.

Key words: Dental Caries; Breast Feeding; Pediatric Dentistry

Introduction

Today, a significant problem that families face is severe dental caries among children at a very early age. This early caries most often affects anterior maxillary primary teeth, maxillary and mandibular first primary molars, and mandibular canines. Typically, the first teeth that are affected by this disease are the anterior maxillary teeth (1,2).

World Health Organization states that ECC can be associated with factors related to child, parent, and society. When it comes to parents, several critical issues should be considered. These include the parents' health, specifically their nutritional and oral health, as well as their family beliefs and behaviors regarding the nutrition of the newborn and the use of food supplements. Additionally, the family's knowledge and ability to provide a healthy diet for their child play a vital role. Developing appropriate dietary habits is essential for minimizing the risk of early childhood caries (ECC), as the nutritional patterns established in childhood can persist into adolescence (3).

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[DOI: 10.61186/cofs.3.1.6]

Breast milk is a natural food for newborns. In addition to being highly nutritious, it contains substances that help regulate the immune system and includes anti-inflammatory agents. These components can reduce the risk of mortality in both the short and long term for infants. Additionally, breast milk supports the development of the nervous system and perceptual abilities of the child (4).

Numerous studies have shown that long-term breastfeeding, nocturnal feeding, and frequent breastfeeding (more than seven times a day) can lead to early childhood caries (ECC) (5, 6). The feeding methods used during the neonatal period can significantly influence the development of dental caries in children. Research has confirmed the impact of continuous milk consumption in the later neonatal period on the occurrence of dental caries during childhood (7).

Breastfeeding, particularly during the night or for extended periods, can contribute to the development of dental caries. The American Academy of Pediatric Dentistry (AAPD) advises that nighttime and mother-directed feeding should be avoided once the first primary tooth has emerged (8). Additionally, feeding a child from the breast more than seven times after they turn 12 months old is linked to an increased risk of early childhood caries (ECC). When a child is asleep, fluids can accumulate around the teeth, and carbohydrate-containing liquids create an environment conducive to acid-producing bacteria. Furthermore, saliva production decreases during sleep, which slows down the clearance of these fluids from the mouth. (5, 6, 9).

Neonates, with ECC lesions experience limited growth as compared to those without caries. Some of these children may suffer from significant weight loss due to their reluctance to eat, which is a result of the pain associated with ECC. Additionally, ECC lesions can be linked to iron deficiency in children. (10).

A study by Carrillo-Diaz et al. (11) indicated that breastfeeding beyond the eighteenth months of age can be a risk factor for ECC. Neonates are often breastfed while their mothers are asleep, which prevents them from cleaning the child's mouth after feeding causing carious lesions to develop. Similarly, research by Chanpum et al. (12) found that the prevalence of ECC was associated with breastfeeding during sleep, as well as oral cleaning routines and the presence of dental plaque. However, there was no significant connection between the frequency of tooth brushing or the use of fluoride-containing toothpaste and the occurrence of ECC.

Given the findings from previous studies on nighttime feeding and its link to increased ECC prevalence, and considering the high levels of caries in children, it is important for dentists, parents, and public health officials to understand these dynamics for effective prevention strategies (13). This study aims to investigate the relationship between nocturnal breastfeeding patterns and early childhood caries (ECC) among 1- to 3-year-old children in Isfahan city.

Materials and methods

In this descriptive analytical cross-sectional study (ethics code: IR.IAU.KHUISF.REC.1400.024), 264 healthy 1–3-year-old children in Isfahan city referring to several pediatric specialists and pediatric dentistry clinics were chosen. The children with systemic diseases, those taking special medications, or uncooperative parents were excluded from the study.

First, the children were examined using disposable mirrors and probes via the knee-to-knee method. For ECC diagnosis, AAPD criteria were used (14). Then a questionnaire was completed by the researcher (12,15,16). A questionnaire was completed by the researcher, covering various parameters related to the child and their family. These parameters included the child's age, the education levels of both parents, their occupations, the frequency of nocturnal breastfeeding during the child's sleep, the type of milk consumed, the number of months breastfeeding occurred, night weaning, whether breastfeeding was used to help the child sleep, the frequency of sugary substance consumption throughout the day, the frequency of tooth brushing, the age when the child began dental and oral hygiene practices, and whether fluoride-containing toothpaste was used. Most of this information was provided by the mother. Finally, the presence of dental caries was assessed by examining the child (Appendix).

The obtained data were analyzed by Chi-square test and SPSS 26 software, with a significance level set at 5%.

Results

Chi-square test indicated that there was no relationship between the frequency of nocturnal breast-feeding and early childhood caries (p=0.129). There was a significant relationship between type of consumed milk and early childhood caries; the children who consumed breast milk or formula showed less dental

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caries compared to children who took cow milk. There was a significant relationship between frequency of breast-feeding and early childhood caries (p<0.001). Prolonged breastfeeding was associated with a higher percentage of dental caries. Additionally, a significant relationship was found between night weaning and early childhood caries (p<0.001), the older the weaning child the higher the percentage of dental caries (Table 1).

Table1. The relationship between dental caries and frequency, type of consumed milk and duration of breast feeding

Variable		Without caries	1-3	4-6	More than 6	P value
		No (%)	No (%)	No (%)	No (%)	
Frequency	Less than 3 times	71 (55.5)	19 (14.8)	21 (16.4)	17 (13.3)	0.129
	3 to 6 times	60 (47.6)	11 (8.7)	33 (26.2)	22 (17.5)	
	More than 3 times	4 (40)	3 (30)	1 (10)	2 (20)	
Type of consumed milk	Breast feeding	71 (44.1)	10 (11.8)	38 (23.6)	33 (20.5)	0.013
	Formula	16 (69.6)	3 (13)	2 (8.7)	2 (8.7)	
	Cow's milk	3 (30)	3 (30)	4 (40)	0 (0.0)	
	Breast feeding and Formula	42 (65.6)	8 (12.5)	8 (12.5)	6 (9.4)	
	The combination of Cow's milk and others	3 (50)	0 (0.0)	3 (50)	0 (0.0)	
Duration of breast feeding	Less than 6 month	2 (66.7)	1(33.3)	0 (0.0)	0 (0.0)	<0.001
	6-11 month	13 (68.4)	3 (15.8)	3 (15.8)	0 (0.0)	
	12-17 month	76(69.7)	8(7.3)	12(11)	13 (11.9)	
	18 month and more	44(33.1)	21 (15.8)	40 (30.1)	28 (21.1)	

There was a significant difference between breastfeeding to sleep and early childhood caries (p<0.001); as the children who were breastfed to sleep had a greater percentage of dental caries. There was also a significant correlation between drinking water after breast feeding and early childhood caries (p<0.001.. A higher percentage of caries was found in the group that did not receive water after breastfeeding.

Furthermore, a significant link existed between oral and dental cleaning of the child after nocturnal breastfeeding and early childhood caries (p=0.043). When cleaning was initiated before six months of age, a lower percentage of caries was observed (Table 2).

Table2. The relationship between dental caries and night weaning age, breast feeding to sleep, drinking water after breast feeding and age of starting oral and dental habits after nocturnal breast feeding

Variable		Without caries	1-3	4-6	More than 6	P value
		No (%)	No (%)	No (%)	No (%)	
Night weaning age	Less than 6 month	48 (85.7)	2 (3.6)	4 (7.1)	2 (3.6)	<0.001
	6-11 month	18 (66.7)	3 (11.1)	3 (11.1)	3 (11.1)	
	12-17 month	39 (59.1)	10 (25.2)	10 (15.2)	7 (10.6)	
	18 month and more	30 (26.1)	18 (25.7)	38 (33)	29 (25.2)	
Breast feeding to sleep	Yes	104 (47.3)	26(11.8)	50 (22.7)	40 (18.2)	<0.001
	No	31 (70.5)	7 (15.9)	5 (11.4)	1 (2.3)	
Drinking water after breast feeding	Yes	77 (72.6)	11 (10.4)	8 (7.5)	10 (9.4)	<0.001
	No	58 (36.7)	22 (13.9)	47 (29.7)	31 (19.6)	
	Less than 6 month	20(76.9)	1 (3.8)	2 (7.7)	3 (11.5)	0.043

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Age of starting oral and dental cleaning after nocturnal breast feeding	6 month and more	115(51.1)	32 (13.4)	22.3 (55)	38 (16)

Moreover, there was a significant difference between parental education levels and early childhood caries (p<0.001). Children whose mothers and fathers had higher education levels exhibited a lower ratio of dental caries (Table 3). A significant difference was also noted between the frequency of sugary substance consumption throughout the day and early childhood caries (p=0.001). In the group that consumed more sugary substances, a higher percentage of caries was found. However, no significant difference was detected regarding the use of fluoride-containing toothpaste and early childhood caries (p=0.252) (Table 4).

Table3. The relationship between dental caries and education of parents

Variable		Without caries	1-3	4-6	More than 6	P value
		No (%)	No (%)	No (%)	No (%)	
Mother	High school	0 (0.0)	0 (0.0)	5 (62.5)	3 (37.5)	<0.001
	Diploma	12 (29.3)	8 (19.5)	14 (34.1)	7 (17.1)	
	Associate degree	5 (19.2)	3 (11.5)	8 (30.8)	10 (38.5)	
	Bachelor degree	60 (51.3)	16 (13.7)	23 (19.7)	18 (15.4)	
	Masters	42 (79.2)	5 (9.4)	4 (7.2)	2 (3.8)	
	Doctorate	16 (84.2)	1 (5.3)	1 (5.3)	1 (5.3)	
Father	High school	2 (14.3)	3 (21.4)	5 (35.7)	4 (28.6)	<0.001
	Diploma	9 (18.8)	5 (10.4)	20 (41.7)	14 (19.2)	
	Associate degree	9 (39.1)	2 (8.7)	7 (30.4)	5 (21.7)	
	Bachelor degree	55 (53.9)	16 (15.7)	16 (15.7)	15 (14.7)	
	Masters	42 (76.4)	5 (9.1)	6 (10.9)	2 (3.6)	
	Doctorate	18 (81.8)	2 (9.1)	1 (4.5)	1 (4.5)	

Table4. The relationship between dental caries and frequency of consuming sugary substance along the day, use of fluoride-containing toothpaste and frequency of toothbrushing

Variable		Without caries	1-3	4-6	More than 6	P value
		No (%)	No (%)	No (%)	No (%)	
Frequency of consuming sugary substance along the day	To 3 times	117 (58.2)	22 (10.9)	34 (16.0)	28 (100)	<0.001
	More than 3 times	18 (28.6)	11 (17.5)	21 (33.3)	13 (20.6)	
Use of fluoride-containing toothpaste	Yes	61 (48.8)	21 (16.8)	24 (19.2)	19 (15.2)	0.252
	No	74 (53.2)	12 (8.6)	31 (22.3)	22 (15.8)	
Frequency of toothbrushing	Does not brush	10 (50)	2 (10)	5 (25)	3 (15)	0.365
	Sometimes	20 (40)	6 (12)	11 (22)	13 (26)	
	1 time a day	83 (52.2)	20 (12.6)	36 (22.6)	20 (12.6)	
	2 times or more	22 (62.9)	5 (14.3)	3 (8.6)	5 (14.3)	

Discussion

The results of this study showed that 52.6% of the children had no dental caries, while 47.4% experienced early childhood caries (ECC) to varying degrees. Most of the children investigated were breastfed. This was followed by a combination of

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breast milk and formula feeding, with the smallest percentage of children consuming cow's milk or a combination of cow's milk with other types of milk. Dental caries were present in all groups; however, children who were breastfed or fed with formula exhibited lower rates of dental caries compared to those who consumed cow's milk. A study by Perera et al. (17) noted that the duration of nocturnal milk feeding is more significant than the type of milk consumed, indicating that nighttime feeding with any type of milk increases the likelihood of dental caries in children's teeth. According to the findings of the current study, a significant proportion of children, specifically 50.4%, consumed milk for a duration exceeding 18 months. The incidence of dental caries among children who were breastfed for less than 17 months was found to be negligible. In contrast, the prevalence of caries nearly doubled when breastfeeding extended beyond 18 months. Furthermore, nocturnal milk consumption until the age of 17 months did not substantially influence the rate of dental caries. However, the prevalence of early childhood caries (ECC) was found to nearly triple when nocturnal feeding was prolonged over 17 months, a result that aligns with observations from other studies (18, 19).

In the study by Haag et al. (20), prolonged milk feeding (lasting more than 24 months) resulted in a twofold increase in the prevalence and a fourfold increase in the intensity of cavities. This indicates that milk feeding for more than 12 months, compared to just 3 to 6 months, is associated with a higher prevalence of early childhood caries (ECC). However, in the study by Olatosi and Sote (7), the frequency of breastfeeding did not show any impact on ECC. Conversely, the research by Feldens et al. (15) revealed that a high frequency of breastfeeding during the late neonatal period significantly influenced early childhood caries, which contradicts the findings of the previous studies. These conflicting results may stem from the varying effects of milk consumption at different times of the day and at night.

The results of the present study indicated that consuming milk at night for more than six months can lead to an increased prevalence of dental caries. However, there was no significant correlation between the frequency of nocturnal milk consumption and early childhood caries (ECC), which aligns with the findings of Haag et al. (20). Prolonged milk feeding especially at older ages (after 18 months) is more important than the frequency of milk consumption, and based on the WHO recommendations, the nocturnal milk consumption after six months of age should be ceased, after which solid foods and supplements should be added to the child's diet (18).

In terms of milk feeding, breastfeeding a child to sleep and offering water after feeding are crucial factors in the prevalence of early childhood caries (ECC). Many children fall asleep while nursing, which can cause milk to pool around their teeth, creating an ideal environment for acid-producing bacteria. Additionally, salivary flow decreases during sleep, slowing down the natural cleaning of the oral cavity and increasing the risk of cavities. (11). In this study, 83% of mothers reported breastfeeding their children to sleep, but only 40% provided water after feeding. It was found that breastfeeding without offering water afterward resulted in a 52.7% prevalence of ECC. In contrast, providing post-feeding water significantly lowered this prevalence. Similarly, the study by Chanpum et al. (12) indicated that breastfeeding to sleep without any oral cleaning led to a high rate of ECC. Therefore, giving water after feeding, even when a child is breastfed to sleep, is highly effective in reducing the prevalence of ECC.

Extensive research has shown that breast-feeding in the absence of other factors such as poor oral hygiene or carbohydrate-containing diet is not epidemiologically associated with caries (5). Thus, in this study other effective factors on ECC were investigated including frequency of consuming sugary substances along the day (up to three times, more than three times), frequency of toothbrushing (no toothbrushing, sometimes, once per day, twice or more), time of initiating oral cleaning (less than six months, equal to or more than six months), use of or nonuse of fluoride-containing toothpaste as well as the parental level of education.

Based on the results of the present study, the frequency of consumption of sugary substances along the day had a considerable impact on the prevalence of ECC. If sugary substances are consumed more than three times per day, doubles the prevalence of caries which aligns with results of previous studies (15,17,18). In investigating the child's toothbrushing habits, the frequency of tooth brushing did not have a significant correlation with early childhood caries (ECC). However, the timing of initiating mouth cleaning was important; if cleaning begins at six months of age, the prevalence of ECC decreases significantly.

Using fluoride-containing toothpaste had no impact on early childhood caries (ECC). This finding is

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consistent with the research conducted by Feldens et al. (15) and Chanpum et al. (12,) Very young children often struggle to cooperate during toothbrushing, which can hinder effective plaque removal. Moreover, brushing more frequently does not necessarily lead to adequate plaque removal. It is crucial to ensure that dental plaque is removed after brushing, as the quality of oral hygiene plays a more significant role in the prevalence of ECC. In older children, the benefits of using fluoride-containing toothpaste have been confirmed. However, the contradictory results in younger participants (ages 1-3 years) may stem from their age.

There was a notable association between parental education and ECC. Children whose parents had higher levels of education tend to have a lower prevalence of caries, which was consistent with findings from other studies (21, 22). As parental education, particularly that of the mother, increases, so does awareness regarding nocturnal breastfeeding, diet, and healthy habits for children. Parents become more informed about how prolonged nocturnal milk feeding can lead to early childhood caries. Additionally, practices such as avoiding breastfeeding to sleep, offering water after feedings, maintaining oral hygiene from a young age, and reducing the frequency of sugary snacks can significantly help prevent the occurrence of ECC.

Conclusion

The frequency of breastfeeding, tooth brushing, and the use of fluoride-containing toothpaste were not found to be associated with the prevalence of early childhood caries (ECC). However, prolonged breastfeeding, frequent consumption of sugary substances along the day, lack of oral hygiene, not providing water after feeding, and low parental education were linked to an increased prevalence of ECC. Prolonged milk feeding is particularly significant; delaying weaning from milk after 17 months of age is associated with nearly three times the risk of developing ECC. To address this issue, preventive measures, raising parental awareness, and conducting regular dental check-ups from the early stages of development can significantly help reduce the prevalence of ECC.

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Appendix

General information
Child's age (in months):
Mother's education level:
Highschool☐ Diploma☐ Associate Degree☐
Bachelor's Degree☐ Master's☐ Doctorate☐
Father's education level:
Highschool☐ Diploma☐ Associate Degree☐
Bachelor's Degree☐ Master's☐ Doctorate☐

Mother's occupation:
Dietary regimen
- **The number of times milk is consumed during the child's nighttime sleep:**
Less than 3 times☐ 3 to 6 times☐
More than 6 times☐
- **Type of milk consumed by the child:**
Breast feeding☐ Formula milk☐
(Type of formula:…) Cow's milk☐
2 or 3 of the mentioned items ☐
- **Duration of breastfeeding**:
Less than 6 months ☐ 6 to 11 months☐
12 to 17 months☐ 18 months and more☐
At what age was the child's night feeding stopped?
- **Is milk used to put the child to sleep?** Yes☐ No☐
- **Are the child's teeth cleaned with a damp gauze after drinking milk?** Yes☐ No☐
- **Number of times sugary substances are consumed in a day:** up to 3 times ☐
more than 3 times☐

Review of hygiene compliance
- **The number of times the child brushes their teeth:**
They don't brush their teeth☐ Sometimes☐
Once a day☐ Twice a day ☐
- **Starting to clean the child's mouth and teeth:**
less than 6 months☐
equal to or more than 6 months☐
Does the child use fluoride toothpaste?
Yes☐ No☐ From what age....
Oral and dental examination:
Caries assessment:
Free from decay ☐
1-3 teeth ☐
4-6 teeth ☐
>6 teeth☐

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