

Prolonged Breastfeeding and Dental Caries In Children In the Third Year of Life

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Purpose: To assess the association between long-term breastfeeding and dental caries in children during the third year of life. **Study design:** This retrospective longitudinal study consisted of children who were followed-up by the Maternal and Child Public Oral Health Program. Information regarding socio-economic class, demographic status, daily frequency of sucrose intake, breastfeeding duration and oral hygiene were collected with the aid of a questionnaire. Information on dental caries in the children was collected from dental records. Negative binomial regression models were used to assess the association between breastfeeding duration and dental caries. **Results:** We included a total of 325 children in the study. The incidence of dental caries was found to be 12.92%. Even after adjustments, children who were breastfed for a period ≥ 24 months were more likely to have dental caries, when compared with children who were not breastfed or were breastfed for less than 6 months. Children who had a higher frequency of sucrose intake and those with dental plaque were more likely to have dental caries. **Conclusion:** In this study, a greater incidence of dental caries was found in children who were breastfed for a period ≥ 24 months..

Keywords: dental caries; dietary sucrose; food habits; mother-child relations.

INTRODUCTION

Dental caries remains the most common chronic disease among children.¹ Early childhood caries (ECC) has been on the rise in many countries. The prevalence of ECC in most developed countries is between 1% and 12%, and as high as 70% in lesser developed countries.² Dental caries has a significant impact on the general health, nutrition, growth, and body weight^{3,4} of the children, thus causing discomfort, pain, sleeping problems, absence from school, learning disorders, communication and psychosocial problems, which affects quality of life.^{5,6} There are many well established factors associated with dental caries.⁷⁻⁹ However, pragmatically, it should be considered as a dental biofilm-sugar-dependent condition,¹⁰ as dietary behavior is a crucial element in causing this disease.¹¹ Some studies have shown that the amount and frequency

of sugar as well as the time of consumption are significantly related to childhood dental caries.^{11,12} Recently, the World Health Organization¹³ has published guidelines on restriction of sugar intake over the course of a lifetime, based on evidence that links sugar to a higher risk of non-communicable diseases such as diabetes, obesity, and dental caries.

A nutritional factor that has been questioned is the association between breastfeeding duration and dental caries in young children.¹⁴ Exclusive breastfeeding is recommended by the World Health Organization¹ up to six months of age, and breastfeeding complemented with appropriate food intake is suggested up to two years of age or beyond. The benefits of breastfeeding extend far beyond its nutritional value. Studies have shown that breastfeeding can reduce risk for mortality, infectious diseases, obesity, and diabetes in children.¹⁵ Furthermore, it has long-term consequences on the individual and society; a cohort study has suggested that breastfeeding improves intelligence quotient till adulthood, and thus, it might have an important effect in real life, as improved intelligence quotient would further lead to higher education and income levels.¹⁶

Despite all the benefits of breastfeeding, the relationship between breastfeeding and caries development has been controversial. Some studies have suggested that prolonged breastfeeding could have a significant impact on the development of dental caries.^{5,17} *In vitro* studies have shown that human milk is relatively cariogenic¹⁸, and its cariogenic potential is enhanced when supplemented with sugar.¹⁹ In a cohort study, Chaffee et al.⁷ also showed that long-duration breastfeeding, particularly if frequent, was associated with severe ECC. However, other studies have not found this association.²⁰⁻²³ Therefore, given the importance of both breastfeeding and dental

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caries prevention, the aim of this study was to assess the association between long-term breastfeeding and ECC in 3 year-old children followed-up by a public oral health program.

MATERIALS AND METHOD

For this retrospective longitudinal study, data were obtained from all the attendants of the Federal University of Pelotas Prenatal Oral Health Program, a spinoff of a program promoting oral health in infants, in which the dental treatment is focused on expectant mothers as well.

The study was approved by the Research Ethics Committee, School of Dentistry, Federal University of Pelotas (UFPel), Brazil (protocol no 57/2013), and all mothers in the study provided written informed consent.

The program provides clinical dental treatment, preventive care, and risk assessment for women in all stages of pregnancy and their infants up to 3 years of age; in addition, education on preventive health care is provided to the women. The service is being offered since 2000 and has education and prevention as its key features. The dental visits were carried out according to the needs of the individual, but at least one visit per year was scheduled.

During the dental visits, the mothers received oral health guidance with the help of an interactive discussion. The aim was to encourage parents/caregivers to establish regular dental care (a “dental home”) for the child and for themselves. The main topics covered during the visits were importance of the child’s primary dentition, oral hygiene, benefits of fluoride, and dietary and feeding counseling (warning of the risks of frequent consumption of sucrose and adding sugar in baby bottles or natural juices).

The oral health care and examination was provided by a trained team comprising an experienced dentist (a specialist in pediatric dentistry) and one dental student. To standardize the examination, a training process was performed with the students in each new work team, twice per year. The examiners and assistants received approximately six-hours of theoretical training through a presentation, in which the indexes and protocols used in the program were explained. All the information obtained at each infant visit was registered on specific records and collected in a standardized way following predefined criteria by a single researcher.

Clinical examination was performed at the dental office of the School of Dentistry under artificial light using a dental mirror and dental probe, which enabled them to remove residual dental plaque. Cotton rolls and gauze were used to control moisture.

The study population was determined by utilizing the dental clinical records of children evaluated by the program over the last 15 years. Children who had their first dental appointment before the first year of life and at least one visit per year during their first 3 years of life were included. Children for whom information about breastfeeding duration was not available were excluded. A total of 325 children were included in the study.

Variables (Data collection)

The independent variables used in this study were obtained from anamnesis, clinical examination, and treatment performed, data on which were available from the Oral Health Program. Demographics (sex), socioeconomic, diet, and oral health variables were collected. Family income was determined in Brazilian Minimum Wages

(which corresponded to approximately US\$ 212) and divided in tiers. Data on maternal schooling was collected in years of study and dichotomized into ≤ 8 years (elementary school) and > 8 years (middle school or higher). Breastfeeding duration was categorized into < 6 months, 6–11 months, 12–23 months, and ≥ 24 months.²⁴

The sucrose frequency intake variable was constructed with data from a frequency food questionnaire collected during various periods of the child’s follow-up, but for this study, the record nearest the period of 2 years of age was used. Mothers were questioned in relation to sucrose containing food and drinks consumed by their children. Sucrose intake was counted when sweet food, sugar-sweetened beverages, or a spoonful of sugar added was reported. The questions were related to 12 foods: vegetables, fruits, water, sugar in tea, soft drink, sugar in coffee, sugar in milk, yogurts, artificially sweetened juices/gelatin juice, cake/sweet cookie, bread/crackers, and candies/lollipops. Then mothers were questioned on how many times a day the child consumed that food or drink. The sum of sucrose intake by day was used as a continuous variable named “sucrose frequency.” A high frequency of sucrose intake was considered when consumption of sweet food, sugar-sweetened beverages, or a spoonful of sugar added was reported ≥ 7 times/day.⁸ Oral hygiene reports were also collected and dichotomized by median value (≤ 6 months and > 6 months).

For this study, we used caries incidence recorded between the first and the last dental examination during the child’s third year of life. Early childhood caries (ECC) is an independent variable, and is defined as the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces (dmfs) in any primary tooth in a child under the age of six years.²⁵ In addition, initial lesions (white spots) were also detected in dental surfaces.²⁶ The presence of dental plaque was examined in all primary teeth, and the variable was dichotomized as “present” (at least one surface with dental plaque was detected) and “absent” (dental plaque not visible on any surface). For this study, we used the record of dental plaque examination during the dental examination in the child’s second year of life.

Statistical analysis

The data were double-typed and the consistency of information was assessed. Data were analyzed using Stata software version 12.0 (Stata Corporation, College Station, TX, USA). Descriptive analyses were conducted for assessing relative frequencies and means. To compare mean incidence of dental caries according to the independent variables, we used Mann-Whitney test for dichotomous variables and Kruskal Wallis test for countable variables. For the multivariate analysis, negative binomial regression models were used to assess the association between breastfeeding duration and dental caries, allowing the estimation of rate ratios (RR) and the respective 95% confidence intervals (CI). The P-value for a variable to be included in the multiple regression model was 0.250. Thus, covariates used in the models for adjustment included frequency of sucrose intake and presence of dental plaque.

RESULTS

A total of 325 children were included in this study. The incidence of dental caries was 12.92%. The mean dental caries incidence was greater in children who were breastfed for a longer duration (greater than 24 months), who had greater frequency of sucrose, and who presented with dental plaque during the oral examination in the second year of life (Table 1).

Table 1. Characteristics of participants and dental caries measured by sum decayed, missed and filled surfaces (dmfs) and white spot lesions surfaces according to demographic, socioeconomic, duration of breastfeeding, sucrose frequency and oral hygiene (n=325).

Variables	n	%	Mean dmfs + white spot	(SD)	P-value
Sex					0.419**
Male	165	50.8	0.60	2.31	
Female	160	49.2	0.71	2.03	
Familiar income (BMW) †					0.3769*
3 ^o Tertile (>3BMW)	64	20.9	0.63	1.69	
2 ^o Tertile (2.1-3 BMW)	138	44.9	0.46	1.65	
1 ^o Tertile (≤2BMW)	105	34.2	0.91	2.93	
Maternal schooling †					0.178**
>8 years	194	60.2	0.57	1.87	
≤8 years	128	39.8	0.79	2.59	
Breastfeeding					<0.001*
<6 months or non-use	146	44.9	0.32	1.39	
6-11 months	80	24.6	0.66	1.88	
12-23 months	62	19.1	0.68	3.15	
≥ 24 months	37	11.4	1.95	2.83	
Sucrose frequency †	319	100.0			0.005*
Oral hygiene begins					0.927**
≤6 months	204	62.8	0.63	1.92	
>6 months	121	37.2	0.70	2.55	<0.001**
Dental plaque †					
Absent	139	43.6	0.09	0.74	
Present	180	56.4	0.96	2.60	

* Kruskal Wallis test; ** Mann-Whitney test; † Missed data; dmfs=decayed, missed or filled surface; SD= standard deviation; BMW=Brazilian Minimum Wage

In multivariate analysis, after adjustments, children who were breastfed for a period ≥24 months (RR 8.29; CI 1.82–37.72) were more likely to have a greater incidence of dental caries in comparison with children who were not breastfed or were breastfed for less than 6 months (Table 2). Furthermore, the results showed that children who had a higher frequency of sucrose intake (RR 1.36; CI 1.12–1.65), and those who presented with dental plaque (RR 9.38; CI 3.22–27.35) were more likely to have a greater incidence of dental caries.

DISCUSSION

The findings of this study show an increase in ECC risk with breastfeeding for 24 months or more in a child population evaluated by a public oral health program. The magnitude of the effect is an important issue; children who were breastfed for a longer time presented 8.29 times greater risk of ECC compared to children who were breastfed for a lesser time (<6 months).

A recent systematic review examined the association between breastfeeding and dental caries.²⁷ According to the review, children breastfed beyond 12 months had an increased risk of dental caries. Since the analysis presented a high heterogeneity due to combined primary studies that differed substantially from each other and had a high risk of bias, the result of the meta-analysis seems inconclusive.

Although some studies have been conducted on this topic, the findings are difficult to evaluate and compare. First, there has been no standardization of cut-off point for breastfeeding duration. For example, some studies that have investigated the association between dental caries and breastfeeding duration used cut-off points for prolonged breastfeeding as equal or lesser than 12 months.^{23,28} In contrast, some authors define prolonged breastfeeding with cut-off points above 18 months.²⁹⁻³¹ However, according to the World Health Organization, children should be breastfed up to 24 months or beyond, with this age also being used as a cut-off point by other studies, such as ours.^{5,24,32,33}

Our data are consistent with previous studies that applied the same cut-off point of breastfeeding duration used in this study and used a reference group of children that were breastfed for <6 months. A cross-sectional study of Canadian healthy urban children aged 1 to 6 years, which used parental report of dental caries as the outcome, identified an increase in odds of caries with total breast-feeding duration of 24 months or longer relative to total breastfeeding duration of 0 to 5 months.³⁴ Data from a Brazilian birth cohort study from low-income families showed that breastfeeding for 24 months or beyond was associated with the highest average prevalence of severe ECC compared with breastfeeding for <6 months.²⁴

Our results found that prolonged breastfeeding (>24 months) is associated with increased incidence of ECC. A possible explanation of this finding is that children who have received prolonged breastfeeding have some similar characteristics. Mothers of these children usually practice bed-sharing, where children sleep in the same bed, facilitating breastfeeding. Thus, for these children, nocturnal breastfeeding on demand is available, with a higher frequency of breastfeeding and presence of human milk in their mouth for longer periods when salivary flow is decreased. This practice has been related to the development of dental caries.^{24,27}

It is worth noting that our study adjusted the analysis for sugar intake. Most of the studies assessing the relationship between breastfeeding and ECC were not controlled for key confounding factors.²⁷ In the statistical analysis, we have controlled for possible confounding factors such as frequency of sucrose intake, and even after adjustments, breastfeeding beyond 24 months remained associated with a higher incidence of dental caries. This result corroborates with a recent birth cohort study of 5-year-old children, which showed that children breastfed up to 24 months of age or beyond have an increased risk of dental caries, and this risk is notably independent of lifetime sugar consumption.³³

Table 2. Unadjusted and adjusted association between duration of breastfeeding and dental caries measured by decayed, missed and filled surfaces (dmfs) and white spot lesions in preschoolers (n=325)

Variables	RR [*]	95% CI	P-value	RR ^{**}	95% CI	P-value
Sex			0.726	†		
Male	1.00					
Female	1.19	0.45-3.10				
Familiar income (BMW) [†]			0.457	†		
3 ^o Tertile (>3BMW)	1.00					
2 ^o Tertile (2.1-3 BMW)	0.74	0.20-2.77				
1 ^o Tertile (≤2BMW)	1.46	0.37-5.74				
Maternal schooling [†]			0.505	†		
>8 years	1.00					
≤8 years	1.39	0.53-3.69				
Breastfeeding			0.014			0.006
<6 months or non-use	1.00			1.00		
6-11 months	2.10	0.66-6.67		2.24	0.69-7.20	
12-23 months	2.15	0.61-7.53		2.77	0.68-11.28	
≥ 24 months	6.18	1.40-27.17		8.29	1.82-37.72	
Sucrose frequency	1.20	1.04-1.38	0.013	1.36	1.12-1.65	0.002
Oral hygiene begins			0.823	†		
≤6 months	1.00					
>6 months	1.12	0.42-3.02				
Dental plaque [†]			<0.001			<0.001
Absent	1.00			1.00		
Present	10.22	3.69-28.33		9.38	3.22-27.35	

^{*}Crude analysis; ^{**}Adjusted analysis ; † Variable did not included in the multiple analysis

Children > 24 months of age have almost all the deciduous teeth in their mouth and are exposed to several foods and drinks to complement their diet; thus, cariogenic foods/drinks introduced in the children’s diet should be carefully controlled to demonstrate the effect of breastfeeding on dental caries. The method used to collect data on frequency of sucrose intake involved using the Food Frequency Questionnaire (FFQ); this tool enables the assessment of long-term dietary intake in a relatively simple, cost-effective, and time-efficient manner.³⁵ In addition, if a range of different nutrients and energy values are required, the list of foods may comprise more than 150 food items. However, the FFQ contains only a few food items, since the major sources of the nutrients of interest are found in relatively few food types. We have not used a validated FFQ to collect data on frequency of sucrose intake, and the questionnaire contains only 12 food items. Although there are difficulties implicit in calculating the absolute nutrient intake of individuals from FFQ, they are useful for gathering information on groups of individuals as well as for evaluating habitual intake of a range of foods in the epidemiological practice.³⁵

The methods used to collect information on sucrose intake have some limitations that should be taken into consideration. A potential limitation is related to answers about sucrose intake; mothers may have concealed some sugar intake after the program after the importance of this topic was reinforced to the mothers through multiple

visits. Thus, the answers may have been influenced by social desirability bias, and an underestimation of sugar consumption reported by mothers is expected.

Another important point to be discussed is the oral hygiene of deciduous teeth. We have used the presence of visible plaque and age of starting oral hygiene practices as possible confounding factors. However, only the presence of visible plaque was associated with dental caries, in agreement with other investigations.^{28,36} Presence of visible plaque was considered as a risk indicator for dental caries and a mediator of tooth mineral loss.³⁶

In this study, the age of start oral hygiene practices was not linked to dental caries. The guidelines for implementing oral hygiene measures no later than the time of eruption of the first primary tooth was recommended by the program in the first dental visit²⁵ preferably from 4 months of age, even if no tooth had erupted by that age, to favor a good maternal habit. Mechanical removal of dental plaque can have a protective effect with regard to dental caries, but the evidence on effective reduction of caries risk is related to the use of fluoridated dentifrice in oral hygiene practices.³⁷ In this study, information on introduction of fluoride toothpaste was not collected. This oral health program started 15 years ago; however, the recommendation of American Academy of Pediatric Dentistry to implement oral hygiene measures no later than the time of eruption of the first primary tooth, with

fluoridated toothpaste, is recent.²⁵ In Brazil, this recommendation was strengthened around four years ago. Thus, this guideline has been advised and data on this recommendation recorded by the program only recently. Therefore, daily use of fluoride is another factor that should be controlled in future studies.

According to literature, breastfeeding is a characteristic of families with healthier lifestyles and is associated with introduction of healthy complementary food.³⁸ In our study, although no statistically significant differences were found when comparing dental caries in children who were not breastfed or breastfed for less than 6 months with children who were breastfed between 6 months and 23 months, some studies have shown a higher risk of dental caries in children who were not breastfed or who had stopped breastfeeding early (<6 months) compared to children who were breastfed more than 6 months or during their first two years of life.⁵ According to these authors, this could be due to the fact that children who were not breastfed or were breastfed for less than six months might start bottle-feeding early, thus being exposed to sugar in formula, with accelerated introduction of complementary foods, which may be related with caries development depending on the amount and frequency of sugar intake.⁸ It is worth noting that our findings were congruent with other studies worldwide.^{5,17,31}

Human milk has been identified as the ideal food for infants and recommended throughout the first year of life.¹ The cariogenicity of human milk has not been studied in depth under *in vivo* conditions. *In vitro* researches on this topic report controversial findings.³⁹ However, most of the *in vitro* studies showed that a higher cariogenic potential of human milk was observed after combining with sugars.^{18,19} An *in situ* study showed that human milk has the potential to induce demineralization of primary enamel, and this effect was increased with the addition of sucrose.⁴⁰

Another factor that we have not assessed is the daily frequency of breastfeeding. Besides the duration, the frequency of breastfeeding should also be studied. According to a study, there was a stronger association between long-duration breastfeeding and caries when high frequency breastfeeding was present.²⁴

It is important to note that our sample was not representative of the whole population; we have used a convenience sample. In addition, although pediatric dentistry specialists carried-out the dental examination, there is no calibration process to determine reliability of dental caries diagnosis. Thus, more studies are needed to confirm the association between prolonged breastfeeding and ECC.

It is necessary to emphasize the importance of controlling other factors that may be associated with increased risk of caries development when combined with breastfeeding. Frequency of sucrose intake and oral hygiene habits, such as fluoride intake, should be further analyzed to better understand this issue. Therefore, the limitations of the study design should be taken into account when interpreting our data.

An important strength of this study was the retrospective longitudinal design allowing data collection of feeding information, which has been updated regularly, reducing the information bias. Furthermore, regular dental visits by the children allowed collection of data on increment of dental caries.

CONCLUSION

In children followed-up by a public oral health program, a greater incidence of dental caries was found when they were breastfed for a period ≥ 24 months. Despite the results of this study, breastfeeding has undeniable benefits for children, mothers, and the community. Thus, we clearly state that we do not discourage breastfeeding.

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