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Prolonged breastfeeding and dental caries in preschool children

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ABSTRACT

Purpose: To explore breastfeeding from 6 to 18 months of age and to study the association between breastfeeding and caries prevalence at 5 years of age.

Methods: The study included 1088 children from one Norwegian county and was based on the Norwegian Mother, Father and Child Cohort Study (MoBa). The children had clinical dental examination at 5 years of age, and parents answered a questionnaire, which included information on breastfeeding, oral health behaviour and child characteristic. Multivariate logistic regressions were performed. The study was ethically approved.

Results: Of the studied children, 77% were breastfed at 6 months of age and 16% were still breastfed at 18 months of age. Few children (6%) were breastfed during night at 18 months of age, while 11% received sugary drink during night. No association was found between breastfeeding up to 18 months of age and caries prevalence at 5 years of age ($p > .05$). Children who at 18 months of age had their teeth brushed less than twice daily (OR 2.4, CI 1.5–3.9), consumed sugary drink once a week or more often (OR 1.7, CI 1.1–2.7) and had non-Western parents (OR 3.4, CI 1.5–8.1) were more likely to have caries experience at 5 years of age than other children.

Conclusion: Breastfeeding up to 18 months of age was not associated with caries development during preschool age.

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Introduction

Early childhood caries (ECC) is a global health problem. A recent systematic review has estimated the prevalence to vary from 30% in Africa to 82% in Oceania, whereas in Europe 43% of children are affected [1]. The definition of ECC is the presence of one or more decayed, missed or filled tooth surfaces in any primary tooth in children aged 5 years or younger [2]. Development of ECC is considered multifactorial based on biological, behavioural and socioeconomically factors within family and environment. It occurs due to frequent consumption of carbohydrates and is frequently observed in upper front teeth. ECC may evolve rapidly leading to infections, toothache and influence children's well-being and quality of life [3].

One of the first sources of sugar children are exposed to and consume frequently is breastmilk. Being breastfed is highly recommended for a newborn baby and has several benefits, such as protection against infections, development of the immune system and it boosts the child's natural development [4]. Initiation of breastfeeding should start within the first hours of life and be continued exclusively as often as the child wants, day and night the first 6 months of life [5]. If there are complications with breastfeeding or the need for food exceeds what is provided by breastmilk, infant formula is recommended as substitute. After 4 months of age, children may be introduced to complementary food in addition to breastmilk or infant formula. Breastfeeding is recommended to continue up to 2 years of age in addition to complementary food [5,6].

Studies exploring the association between breastfeeding and caries development in children have shown contradictory results. Breastfeeding before 12 months of age has, in some studies shown no association with caries development, they even report a protection of being breastfed [7,8]. Others conclude that breastfeeding may lead to demineralization and caries due to frequency of breastfeeding and increased accumulation of plaque, especially during night [9–11]. A recent umbrella review concluded that breastfeeding up to 12 months of age may protect against ECC, however, breastfeeding after 12 months may increase the risk in developing ECC [12]. A direct cause and effect regarding breastfeeding and caries development has been difficult to establish and few studies include children being breastfed after 12 months of age [13–17].

The aim of the present study was to study the association between breastfeeding from 6 to 18 months of age and caries prevalence at 5 years of age.

Materials and methods

This study was based on data from the dental services and from the Norwegian Mother, Father and Child Cohort Study

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(MoBa) conducted by the Norwegian Institute of Public Health [18]. Data were collected by questionnaire to parents at 18 months of age and from dental examination at 5 years of age.

Study population

All children born in 2002 ($n = 7002$) in one county (Akershus) were in 2007 invited to participate in the study. In total, 5623 children (80%) were included. Non-participants were either those who did not want to participate, children who did not show up or who were not invited by the dental personnel. Of the 5623 children, 1358 children had available data from the MoBa study, and 270 children were excluded because of incomplete data. The final study sample consisted of 1088 children, 583 boys and 505 girls.

The Norwegian MoBa is a population-based pregnancy cohort study conducted by the Norwegian Institute of Public Health. Participants were recruited from all over Norway from 1999 to 2008. The women consented to participation in 41% of the pregnancies. The cohort includes approximately 114.500 children, 95.200 mothers and 75.200 fathers. The establishment of MoBa and initial data collection was based on a license from the Norwegian Data Protection Agency and approval from The Regional Committees for Medical and Health Research Ethics and is currently regulated by the Norwegian Health Registry Act.

Questionnaire

The questionnaire provided information on breastfeeding, oral health behaviours and child characteristics.

Parents reported if the child was breastfed at the ages 6–8 months, 9–11 months, 12–14 months and 15–18 months. The answers were categorized as yes (the child was breastfed) or no (the child was not breastfed) in each age period. The variables were combined into one variable; breastfeeding duration and categorized into no breastfeeding after 6 months of age, 8 months, 11 months, 14 months and still breastfed at 18 months of age.

As no children were exclusively breastfed after 6 months of age, the reported breastfeeding was partial breastfeeding according to WHO definitions; the child received solid food, formula milk or milk in addition to breastmilk [19].

The parents answered questions about the child receiving drink during night at 18 months of age. Drink during night included water, breastmilk, sugary drink and milk from either cup or bottle, and was reported as never, sometimes and each night. In the analysis, the variables were combined into one variable; drink at night and categorized as water or no drink, breastmilk, sugary drink and milk.

Consumption of sugary drink during day was reported as more seldom than once a week, 1–6 times a week or daily and in the analyses categorized as less than once a week and once a week or more often. The most common drinks were sugar-sweetened juice and fruit juice.

Tooth brushing frequency was reported as twice daily or more often, once daily and sometimes or never. In the analyses, tooth brushing frequency was dichotomized as brushing twice daily and less than twice daily.

Use of fluoride lozenges was reported as daily, sometimes or never and in the analyses dichotomized into daily and less than daily.

Parental origin was registered as mother and father's country of birth. The results were categorized into Western and non-Western, combined into one variable and dichotomized as both parents having Western background and one or both having non-Western background. Non-Western background included parents born in Asia, Africa, South America, Central America and Eastern Europe.

Education was registered as mother's length of education, dichotomized as having long and short education. More than 12 years at school was defined as long education and 12 years or fewer was defined as short education.

Clinical examination

Dental hygienists performed the clinical examination of the children as part of the regular dental recall examination in the dental services at 5 years of age. The examination was performed in a dental office. Radiographs were taken in accordance with standard routine in dental services (when visual inspection of approximal surfaces was impossible) and used in addition to clinical caries registration in 73% of children.

Caries was registered at tooth level and included caries lesions extending to dentine. Caries experience included teeth recorded as decayed, filled or missed because of caries, and the children were categorized as having or not having teeth with caries experience.

Intra- and interexaminer agreement

Clinical caries criteria were given to and discussed with the examiners before data collection started. A gold standard based on the second and third authors' registrations was compared with the examiners' registrations. Using Cohen's kappa intra- and interexaminer agreements were tested based on 20 bitewing radiographs of primary molars including eight approximal surfaces in each radiograph. Mean intra- and interexaminer values were 0.85 (SD 0.12) and 0.86 (SD 0.10). Cohen's kappa was categorized as substantial to almost perfect agreement [20].

Ethical aspects

Informed consent was obtained from all parents. The Regional Committee for Medical Research Ethics approved the study (2.200.54 and 2013/1881).

Statistical analyses

The statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 28.0 (Armonk, NY: IBM Corp.). Bi- and multivariate logistic regression analyses were

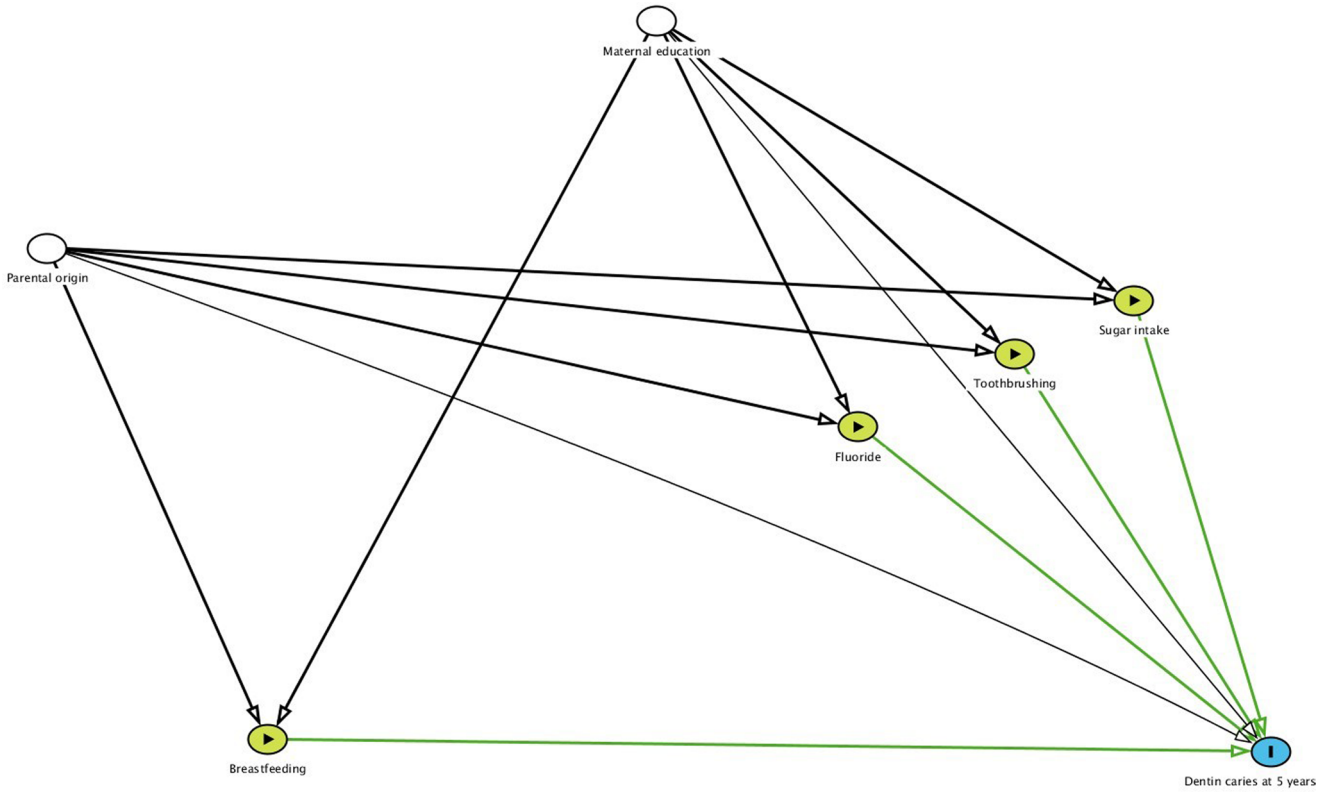

Figure 1. DAG to visualize the hypothesized association between breastfeeding as exposure and caries prevalence as outcome, with confounders and covariates.

conducted with caries at 5 years of age as the dependent variable. Figure 1 shows a DAG to visualize the relationship between breastfeeding and caries mediated by confounders and covariates. Results were reported using frequencies, odds ratios (OR) and 95% confidence intervals (CI).

Results

Table 1 shows characteristics of the children and oral health behaviour at 18 months of age.

The majority had parents with Western background and mothers with long education. Half of the children did not have their teeth brushed twice daily, and 64% used fluoride lozenges less than daily. Sugary drink was offered to half of the children once a week or more often. More than one-third (38%) of the children were breastfed after 11 months of age, and 16% were still breastfed at 18 months of age. Drink during night at 18 months of age was offered to 17% of the children.

Of the studied children, 10% had developed dentine caries at the age of 5 years.

Table 2 shows results from bivariate analyses exploring the association between breastfeeding duration, drink during night at 18 months of age and maternal education, parental origin and dentine caries experience at 5 years of age. Children having mothers with long education were more likely to be breastfed longer than children whose mothers had short education. Breastfeeding duration was not associated with parental origin or caries prevalence. Children receiving sugary drink or milk during night had higher probability of having mothers with short education (OR 2.5, CI 1.7–3.7), parents with non-Western origin (OR 4.3, CI 2.0–9.0) and caries at 5 years of age (OR 2.4, CI 1.4–4.1).

Table 3 presents the results from multivariate logistic regression analysis exploring the association between breastfeeding duration, drink during night, oral health behaviour, child characteristics and dentine caries prevalence at 5 years of age. The results showed that breastfeeding duration was not associated with caries prevalence when controlled for oral health behaviour and child characteristics. Children who at 18 months of age brushed less than twice daily (OR 2.4, CI 1.5–3.9) and had frequent sugar intake (OR 1.7, CI 1.1–2.7) had higher probability of developing caries at 5 years of age than other children. Children having parents with non-Western background had higher probability of having caries prevalence (OR 3.4 CI 1.5–8.1) than children with Western parents.

Discussion

The study aimed to explore breastfeeding from 6 to 18 months of age and to study the association between breastfeeding and caries prevalence. The results showed that breastfeeding was not associated with caries development in preschool children.

The majority of children were breastfed from 6 to 12 months of age, and one of five children was breastfed at 18 months of age. This is in line with a recent study where a high proportion of 6-month-old children were breastfed in Norway

(71%) compared to other European countries; Sweden (61%) and Germany (57%) [21]. The differences may be explained by traditions and norms in countries and information from medical professionals on implementing breastfeeding. The health authorities in Norway encourage breastfeeding up to 2 years of age supported by WHO recommendations [5,22]. In addition, the maternal leave system in Norway makes it possible to continue breastfeeding up to child age of 2 years. Mothers with high education were more likely to continue breastfeeding up to 18 months of age compared with mothers having low education. An explanation for this may be that mothers with high education more often adopt information about benefits of breastfeeding concerning growth and development of children [7,22]. Another explanation may be that mothers with high education have jobs that make it easier to continue breastfeeding after returning to work.

In this study, there was no association between breastfeeding up to 18 months of age during day or night, and caries prevalence at 5 years of age. The results contradict a recent umbrella review suggesting an association between breastfeeding after 12 months of age and ECC [12]. The umbrella review consists of four systematic reviews published between 2000 and 2017, which all concluded that breastfeeding before 12 months of age had a protective effect, but prolonged breastfeeding and breastfeeding at night were associated with increased caries risk [13–16]. Several recently published original studies and one systematic review are in accordance with results from the present study, showing no association between breastfeeding up to 23 months and caries prevalence [7,9,23–26]. Two studies even report no association between breastfeeding up to 36 months and caries prevalence [23,25]. This inconsistency in results underlines the complicated association between breastfeeding and caries development [26]. The causal pathway between breastfeeding and ECC is affected by several confounding factors such as frequency of tooth brushing and sugar intake, and parents' educational level. Systematic reviews show high heterogeneity in included studies and the methodological differences make it difficult to compare results [13].

Breastmilk has high concentration of lactose compared to cow's milk [27,28]. Studies done *in vitro* have shown that breastmilk has low cariogenic potential, it did not induce bacteria substantially to change biofilm structure nor demineralize tooth enamel [29].

In this study, there was an association between frequent intake of sugary drinks at 18 months of age and caries prevalence. This result supports results from another study showing that sugar-sweetened beverages were more important for caries development during preschool age than breastfeeding [23].

In the present study, an association between low frequency of tooth brushing at 18 months of age and caries prevalence at 5 years of age was found. Brushing twice daily with fluoride toothpaste under supervision has been shown to prevent ECC [30–32]. The results suggest that frequency of sugar intake and tooth brushing are more important for caries development than breastfeeding, and that frequent

Table 1. Description of child characteristics and oral health behaviour in children at 18 months of age ($n = 1088$).

	%	(*n*)
Child characteristics		
Gender		
Boy	54	(583)
Girl	46	(505)
Maternal education[a]		
Long	67	(733)
Short	33	(353)
Parental origin		
Both Western	96	(1050)
One or both non-Western	4	(38)
Oral health behaviour		
Tooth brushing frequency[a]		
Twice daily	51	(588)
Less than twice daily	49	(527)
Fluoride lozenges		
Daily	36	(393)
Less than daily	64	(695)
Sugary drink[a]		
Less than once a week	50	(529)
Once a week or more often	50	(525)
Breastfeeding duration		
Stop at 18 months	16	(174)
Stop at 14 months	22	(238)
Stop at 11 months	23	(241)
Stop at 8 months	16	(167)
Stop at 6 months	23	(241)
Drink during night		
Water or no drink	83	(886)
Breastmilk	6	(64)
Sugary drink or milk	11	(113)

[a]Reduced because of internal dropout.

Table 2. Bivariate logistic regression analyses exploring the association between breastfeeding duration and drink during night at 18 months of age and maternal education, parental origin and dentine caries experience at 5 years of age ($n = 1088$).

	Maternal short education		Non-Western parental origin		Having dentine caries	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Breastfeeding duration						
Stop at 18 months (ref)						
Stop at 14 months	1.1	(0.7–1.7)	1.2	(0.3–5.2)	1.0	(0.5–1.9)
Stop at 11 months	**1.8**	**(1.1–2.9)**	2.2	(0.6–8.3)	0.7	(0.3–1.5)
Stop at 8 months	**2.4**	**(1.5–3.9)**	1.4	(0.3–6.3)	1.2	(0.6–2.4)
Stop at 6 months	**3.5**	**(2.2–5.4)**	3.3	(0.9–11.7)	1.4	(0.7–2.7)
Drink during night[a]						
Water or no drink (ref)						
Breastmilk	0.8	(0.4–1.4)	1.9	(0.6–6.7)	1.8	(0.9–3.9)
Sugary drink or milk	**2.5**	**(1.7–3.7)**	**4.3**	**(2.0–9.0)**	**2.4**	**(1.4–4.1)**

ref = reference category.
[a]Reduced number because of internal dropouts.
Statistically significant differences are marked in bold.

Table 3. Multivariate logistic regression analysis exploring the association between breastfeeding duration, drink during night, oral health behaviour, child characteristics and dentine caries prevalence at 5 years of age ($n = 1006^a$).

	Having dentine caries	
	OR	(95%CI)
Breastfeeding duration[a]		
Stop at 18 months (ref)		
Stop at 14 months	1.3	(0.5–3.3)
Stop at 11 months	0.8	(0.3–2.1)
Stop at 8 months	1.4	(0.6–3.5)
Stop at 6 months	1.3	(0.5–3.1)
Drink during night[a]		
Water or no drink (ref)		
Breastmilk	2.0	(0.7–6.0)
Sugary drink or milk	1.7	(0.9–3.1)
Tooth brushing frequency[a]		
Twice daily (ref)		
Less than twice daily	**2.4**	**(1.5–3.9)**
Sugary drink[a]		
Less than once a week (ref)		
Once a week or more often	**1.7**	**(1.1–2.7)**
Fluor lozenges		
Daily (ref)		
Less than daily	1.2	(0.8–2.0)
Maternal education[a]		
Long (ref)		
Short	1.5	(0.9–2.4)
Parental origin		
Both Western (ref)		
One or both non-Western	**3.4**	**(1.5–8.1)**
Gender		
Boy (ref)		
Girl	0.9	(0.6–1.5)

ref: reference category.
[a]Reduced number because of internal dropouts.
Statistically significant differences are marked in bold.

sugar intake together with breastmilk may increase caries risk. Parents with children who are breastfed after 12 months of age should receive individual caries prevention based on the child's need including information on frequency of sugar intake and tooth brushing.

The strengths of this study were the use of longitudinal data from MoBa linked to data from dental examination of the children. The study gained a unique opportunity to monitor a large sample of children. Collection of data on exposure took place prior to the study, which minimizes recall bias. Limitations of longitudinal studies are self-selection and reduced participation rate. During the recruitment period of MoBa approximately 55% of those invited to participate did not give their consent. Self-selection in epidemiological studies may introduce systematic errors in prevalence estimates as well as in association measures. Recent studies on potential bias in previous analyses of variables in the MoBa study have shown no statistically significant differences in association measures between participants of the study and the total population regarding exposure and outcome associations [33].

The study used questionnaires and clinical examinations. Limitations of questionnaires could be non-response, misconceptions and answering in a social favourable way [34]. Questions were uncomplicated, relating to child characteristics and daily oral health behaviour, which again assumed to reduce recall and report errors. Experienced dental hygienists in dental clinics performed clinical examinations, and the calibration showed substantial to almost perfect agreement [20]. Radiographs were not taken on all children due to ethical reasons. In children where radiographs were omitted, visual inspection of approximal surface was possible securing examination of caries.

Conclusion

There was no association between breastfeeding up to 18 months of age and caries development during preschool age. Caries prevalence at 5 years of age was associated with high frequency of sugar intake and a low frequency of tooth brushing with fluoride toothpaste. Mothers who continue breastfeeding after 12 months of age must be encouraged to avoid and limit giving their children sugary snacks and drinks and brush the child's teeth twice daily to prevent ECC.

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