

Effect of different patterns of breastfeeding on dental caries of children at 3-5 years of age

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Abstract

Aim: To study and compare the prevalence and severity of dental caries in children from 3-5 years of age with different patterns of breastfeeding practices.

Materials and Method: All the children, aged 3-5 years, attending Immunization Clinic/ Outpatient Department were recruited for the study. The detailed lactation history was inquired from the mothers to assign them into 3 different study groups:

- A. Group I: Children who were not breast-fed.
- B. Group II: Children with exclusive breastfeeding for 6 months and continued breastfeeding for ≤ 1 year.
- C. Group III: Children with exclusive breastfeeding for 6 months and continued breastfeeding for >1 year but ≤ 2 years.

The detailed case history was taken after recording child's basic information. A dental examination was carried out for each child and standardized indices were recorded for oral health assessment. Chi-square test was used for statistical significance of difference in prevalence of caries. Kruskal Wallis test and Mann Whitney test were used for inter group comparisons. Confounding variables were adjusted using negative binomial with log link function.

Results: Children who were not breastfed (Group I) had 61% prevalence of caries and mean dmft index of 1.6. The prevalence of caries was 57% with mean dmft index of 1.0 in Group II and the prevalence of caries was 26% with mean dmft index of 0.6 in Group III. Negative binomial model proved highly significant relation of dental caries with breastfeeding up to 2 years.

Conclusion: The prevalence and severity of dental caries was significantly less in breast fed children, especially in those children who were breast fed for 2 years.

Keywords: Ad libitum breastfeeding, Dental caries, Early childhood caries

Introduction

Breastfeeding and human milk are the reference normative standards for infant feeding and nutrition. It confers unique nutritional and non nutritional benefits to the infant and the mother and optimize growth and development of the child.⁽¹⁾ Optimal infant and young child feeding includes exclusive breastfeeding for the first six months of life followed by continued breastfeeding with adequate complementary foods for up to two years and beyond.⁽²⁾

Human milk is full of species specific, anti-infective factors and truly the first vaccination to prevent diseases. It contains easily digestible nutrients in optimal amount and in appropriate ratios to achieve maximum growth. It is uniquely adapted to the infant's needs and is the most appropriate milk for the human infant.⁽²⁾

Dental caries is a disease of microbial origin that is induced by refined carbohydrates in the diet.

In a review based on available epidemiological data from countries worldwide on prevalence of dental caries, it has been found that during the past decade there is an alarming increase in prevalence of dental caries globally.⁽³⁾ It is a serious health problem affecting people and therefore measures should be taken for its control. If left untreated, it may cause pulpitis, periodontal infection, abscess, which may lead

to extraction of teeth, malocclusion of permanent teeth, phonetic problems and lower self-esteem.^(4,5) It has also been demonstrated that children with dental caries weighed less than 80% of their ideal body weight and growth is resumed after comprehensive oral rehabilitation.⁽⁶⁾

Human breast milk is uniquely superior in providing the best possible nutrition to infants and has not been epidemiologically associated with caries. Frequent night time bottle-feeding with milk is associated with, but not consistently implicated in early childhood caries. Breastfeeding more than 7 times daily after 12 months of age is associated with increased risk for early childhood caries. Ad libitum breastfeeding after introduction of other dietary carbohydrates and inadequate oral hygiene are risk factors for early childhood caries.⁽⁷⁾ The evidence in the literature finding the association between breastfeeding and dental caries is ambivalent.

Identification of pattern of breastfeeding related to the prevention of dental caries is important for maintaining an optimal oral health in children. Therefore, the aim of our study is to determine the association of different patterns of breastfeeding on dental caries of children at 3-5 years of age.

Materials and Method

An observational, descriptive study was conducted at Department of Pedodontics and Preventive Dentistry and Department of Pediatrics, University College of Medical Sciences and Guru Teg Bahadur Hospital, Delhi. An approval from institutional ethical committee was obtained before commencement of the study. A total of 360 healthy children, aged 3-5 years, of both genders who fulfilled the criteria of feeding, attending immunization clinic/ Outpatient Department of Pediatrics were recruited for the study.

The children with the following conditions/diseases were excluded from the study i.e. Severe acute malnutrition (Weight for Height ≤ 3 SD),⁽⁸⁾ Obesity (BMI ≥ 30 kg/m²),⁽⁸⁾ chronic systemic illnesses, known congenital anomalies, dental fluorosis, preterm and low birth weight babies, born to mothers with major illnesses during pregnancy, born to mothers with history of smoking during pregnancy.

The purpose and design of the study was explained to the guardian. Written informed consent was obtained from the guardian for participation of their children in the study.

For Children who fulfilled the inclusion criteria, a detailed lactation history was inquired from the mother. A lactation history criterion was used to assign them into different study groups.

- **Group I** included those children who were not breast-fed at all/ received breastfeeding for ≤ 2 weeks
- **Group II:** Children who were exclusively breastfed for 6 months and continued breastfeeding for ≤ 1 year
- **Group III:** Children who were exclusively breastfed for 6 months and continued breastfeeding for >1 year but ≤ 2 years. However, children consuming non-nutritive drinks e.g. water, tea, juices occasionally were included under exclusive breastfeeding.

Detailed history was taken after recording child basic information including dietary habits, oral hygiene habits, history of bottle feeding, history of breastfeeding and socioeconomic status.⁽⁹⁾ Information about dietary habits including number of feedings per day, frequency of snacking and number of fruits / vegetables per day were recorded. Oral hygiene habits like age at which tooth brushing started and frequency

of brushing were elicited. Detailed history of bottle feeding was taken mainly related to duration and adding of sugar in feeding bottle. History of breastfeeding was taken with respect to duration of exclusive breastfeeding and age at which breastfeeding was terminated.

Children underwent dental examination and dental caries were assessed using standardized indices in the Department of Pedodontics and Preventive dentistry.

Before the clinical examination was carried out on study population, calibrations among the examiners were carried out and kappa values of 0.95 for intra-examiner reproducibility and 0.87 for inter-examiner reproducibility were found.

Dental caries index - decayed, missing, filled teeth (dmft) and decayed, missing, filled surfaces (dmfs) caries index as per WHO oral health assessment form (1997)⁽¹⁰⁾ were used.

The data was transferred to the Microsoft excel, checked for accuracy and analyzed into a computer equipped with SPSS Software 2008. Chi-Square was performed to find the statistical significance of difference in the prevalence of dental caries. Mean values of decayed missing filled teeth and decayed missing filled surfaces were compared using Kruskal Wallis test and Mann Whitney test is used for intergroup comparisons. The significance of difference between multiple groups was assessed by Post Hoc Tukey test. A p-value of less than 0.05 suggested statistical significance. Confounding variables were adjusted using negative binomial with log link function to find the association of breastfeeding and dental caries. All the potential confounders included were categorical variables; therefore, estimate for each co-variable compares the association of particular category to a reference category.

Results

The study sample consisted of 207 males and 153 females with the mean age of 4 years. Dental caries was present in 40% of the cases with the mean dmft of 1.0 and mean dmfs of 1.3.

Comparison of dental caries in various groups: The number of children with dental caries were highest in Group I (61%) when compared to Group II (57%) and Group III (26%). The 3 study groups are compared in (Table 1).

Table 1: Comparison of dental caries in various groups (n=360)

	Caries affected n(%)	Caries free n(%)	p value
Group I** (Not breastfed) (n=120)	61 (50.8%)	59 (49.2%)	0.001 (Chi-square test)
Group II** (Exclusive breastfed for 6 months followed by breastfeeding for ≤ 1 year) (n=120)	57 (47.5%)	63 (52.5%)	
Group III (Exclusive breastfed for 6 months followed by breastfeeding for >1 year but ≤ 2 year) (n=120)	26 (21.7%)	94 (78.3%)	

** p value < 0.001 when compared with the Group III (Chi-square test)

The difference in prevalence of dental caries was significant between groups ($p < 0.001$). When multiple comparisons were done, difference was *statistically significant* between Group I and Group III; and Group II and Group III.

The severity of dental caries was determined by calculating mean values of dmft and dmfs index. Analysis shows that mean dmft and dmfs values were highest for Group I and lowest for Group III. (Table 2) shows mean values of dmft and dmfs indices in various groups.

Table 2: Mean values of dmft and dmfs index in various groups (n=360)

	\bar{X} dmft \pm SE Median (IQR) ^φ	\bar{X} dmfs \pm SE Median (IQR) ^φ	p value
Group I** (Not breastfed) (n=120)	1.6 \pm 0.20 1.0 (0.0-3.0)	2.2 \pm 0.28 1.0 (0.0-4.0)	0.001 Kruskal-Wallis Test
Group II** (Exclusive breastfed for 6 months followed by breastfeeding for \leq 1 year) (n=120)	1.0 \pm 0.13 0.0 (0.0-2.0)	1.2 \pm 0.15 0.0 (0.0-2.0)	
Group III (Exclusive breastfed for 6 months followed by breastfeeding for $>$ 1 year but \leq 2 year) (n=120)	0.4 \pm 0.09 0.0 (0.0-0.0)	0.5 \pm 0.11 0.0 (0.0-0.0)	

^φInterquartile range

** p values of mean dmft and dmfs $<$ 0.001 when compared with the Group III (Mann-Whitney test)

The differences in mean dmft and mean dmfs was statistically significant between the groups ($p < 0.001$). Mann-Whitney test was used for multiple comparisons that revealed difference between Group I and Group III and between Group II and Group III statistically significant ($p < 0.001$).

Negative binomial model for adjustment of confounding variables: Confounding variables were that previous studies had suggested were plausible predictors of caries experience. In order to assess the influence of breastfeeding and various confounding factors (i.e. that are age, gender, tooth brushing frequency, frequency of snacking, bottle feeding and socioeconomic class) on caries experience in the children, we utilized negative binomial model.

Negative binomial with log link function is used because variance of dmft is higher than mean value.

The expected count of dmft in Group II was 128% higher than in Group III. Similarly, expected count of dmft in Group I was 194% higher than in Group III. Among confounding variables, age of the child, frequency of snacking and bottle feeding had significant association ($p < 0.05$) (Table 3).

Table 3: dmft values after adjusting for confounding variables

Variable		Unadjusted analysis	Adjusted analyses			
		Crude RR ^φ (95% CI) ^ψ	Estimate	Standard error	p-value	Adjusted RR ^φ (95% CI) ^ψ
Group	Group I	3.88 (2.61-5.78)	1.08	0.26	0.00	2.94 (1.76-4.93)
	Group II	2.37 (1.57-3.59)	0.82	0.23	0.00	2.28 (1.44-3.62)
	Group III	1	Reference			1
Age	3 years	0.24 (0.15-0.36)	-1.31	0.24	0.00	0.27 (0.16-0.43)
	4 years	0.42 (0.42-0.81)	-0.50	0.19	0.008	0.60 (0.41-0.88)
	5 years	1	Reference			1
Sex	Male	1.04 (0.77-1.39)	0.26	0.17	0.14	1.29 (0.92-1.80)
	Female	1	Reference			1
Tooth brushing frequency	None/Occasional	1.00 (0.75-1.35)	0.25	0.17	0.15	1.29 (0.92-1.80)
	Once/Twice	1	Reference			1

Frequency of Snacking	< 3 times	0.71 (0.35-1.06)	-1.41	0.20	0.00	0.24 (0.16-0.36)
	≥ 3 times	1	Reference			1
Bottle-feeding	Yes	2.40 (1.77-3.25)	0.55	0.21	.009	1.73 (1.15-2.61)
	No	1	Reference			1
Socio-economic class	Class III	0.99 (0.72-1.35)	-0.31	0.19	0.1	0.74 (0.51-1.06)
	Class IV	1	Reference			1

φRelative risk, ψConfidence interval Model LR Chi-square = 158.837, df-9, p value < 0.00.

The expected count of dmfs in Group II was 129% higher than in Group III. Similarly, expected count of dmft in Group I was 234% higher than in Group III. Among confounding variables, age of the child, frequency of snacking and bottle feeding had significant association ($p < 0.05$) (Table 4).

Table 4: dmfs values after adjusting for confounding variables

Variable		Unadjusted analysis	Adjusted analyses			
		Crude RR ^φ (95% CI ^ψ)	Estimate	Standard error	p-value	Adjusted RR ^φ (95% CI ^ψ)
Group	Group I	4.29 (2.95-6.26)	1.20	0.25	0.00	3.34 (2.03-5.49)
	Group II	2.28 (1.54-3.38)	0.83	0.22	0.00	2.29 (1.47-3.57)
	Group III	1	Reference			1
Age	3 years	0.22 (0.15-0.33)	-1.36	0.22	0.00	0.26 (0.16-0.39)
	4 years	0.48 (0.35-0.66)	-0.67	0.18	0.00	0.51 (0.35-0.73)
	5 years	1	Reference			1
Sex	Male	1.08 (0.82-1.42)	0.26	0.16	0.11	1.30 (0.94-1.80)
	Female	1	Reference			1
Tooth brushing frequency	None/Occasional Once/Twice	0.94 (0.71-1.24)	0.18	0.16	0.27	1.20 (0.87-1.66)
		1	Reference			1
Frequency of Snacking	< 3 times	0.24 (0.17-0.35)	-1.42	0.20	0.00	0.24 (0.16-0.36)
	≥ 3 times	1	Reference			1
Bottle-feeding	Yes	2.64 (1.98-3.53)	0.57	0.20	0.00	1.76 (1.18-2.63)
	No	1	Reference			1
Socio economic class	Class III	0.99 (0.73-1.34)	-0.32	0.18	0.07	0.72 (0.51-1.03)
	Class IV	1	Reference			1

φRelative risk, ψConfidence interval

Model LR Chi-square = 158.837, df-9, p value < 0.00

Negative binomial with log link function is used because variance of dmft is higher than mean value.

Discussion

The present study was carried out in 3-5 year old children to study the effect of different patterns of breastfeeding on dental caries of children. The 3-5 year age group was selected since the deciduous dentition is completed by this age and effect of breastfeeding will be clearly evident at this point of time. The study

groups i.e. Group I (non breastfed) was selected in order to make good comparison with Group II and III who were breast fed. Group II and III were based on breast feeding recommendations by American Academy of Pediatrics⁽¹⁾ and Indian Academy of Pediatrics.⁽²⁾ Both bodies recommend exclusive breast feeding for 6 months and continued breastfeeding for 2

years and beyond. Since many mothers are likely to stop breastfeeding in less than 2 years, Group II was formed. Group II also helped in detailed analysis.

The data collected in study showed that children who were not breastfed (Group I) had 50.8% prevalence of caries and mean dmft index of 1.6. The prevalence of caries was 47.5% with mean dmft index of 1.0 in Group II as compared to 21.7% prevalence of caries with mean dmft index of 0.6 in Group III. The results were similar to a study by Dini et al⁽¹¹⁾ who found 56.7 percent prevalence of caries and 2.3 mean dmft index in non-breast fed children and 40.6 percent prevalence and 1.5 dmft index in children who were breast fed till 2 years.

Our findings were similar to results of the study by Mattos- Graner et al⁽¹²⁾ who found that the prevalence of ECC in children who were not breastfed at all or who were breastfed up to 3 months was higher compared to those children breastfed for longer than 12 months. Huntington et al⁽¹³⁾ showed that children who were breastfed had lower significant risk of ECC. Children who were not breastfed had double the risk of ECC when compared to their breastfed siblings. Silver⁽¹⁴⁾ found that the breast fed babies appeared to have an advantage, with more of them being caries free. Weerheijm et al⁽¹⁵⁾ Mohebbi et al⁽¹⁶⁾ and Kramer et al⁽¹⁷⁾ observed prolonged breastfeeding does not lead to higher prevalence of dental caries. In line with these studies, this study revealed that breastfeeding and its duration was not associated with increase in prevalence and severity of dental caries. On the contrary, it was observed that breastfeeding has a protective role against dental caries.

Negative binomial model further proved highly significant relation of dental caries with breastfeeding up to 2 years. The model also showed significant increase in caries with the increase in age, greater frequency of snacking and use of bottle for feeding the child. Relationship of gender, frequency of tooth brushing and socioeconomic status with dental caries was not observed.

Breast milk is tailored to the infant's specific nutritional needs, contains immunological agents such as secretory IgA and IgG and has anti-inflammatory properties that offer protection to the potentially immature immune systems of both term and preterm infants.⁽¹⁸⁾ Breast milk contains bioactive components that are resistant to digestive processes and that enhance the infants immune system, thereby contributing to short and long term health protection.⁽¹⁹⁾ The immune factors present in human breast milk plays an important role in protection against dental caries.⁽²⁰⁾ Erikson and Mazhari⁽²¹⁾ reported that human breast milk is not cariogenic as it did not cause a significant drop in plaque pH and consequently cause enamel decalcification even after 12 weeks exposure. Breast milk contains bacterial and viral antibodies with relatively high concentration of secretory IgA

antibodies, which play a vital role in the general and oral defense system.⁽²²⁾ IgA and IgG also have the potential to retard streptococcal growth.^(23,24) Grenby et al,⁽²⁵⁾ Rose⁽²⁶⁾ and Aimutis⁽²⁷⁾ described that the components in milk namely lactoferrin, lysozyme, albumin, peroxidase have an inhibitory or bactericidal activity against *S.mutans* and *S.sorbinus*. Alaluusua et al⁽²⁸⁾ showed that breastfeeding does not affect the mutans streptococci levels in the child and thus does not allow the development of dental caries. Sharma and coworkers⁽²⁹⁾ found least number of high colony forming units of *S.mutans* in breast fed children as compared to children using nursing bottle. The colony forming units of *S.mutans* were maximum in the children who were neither breastfed nor fed with nursing bottle. This indicated decreased caries potential in oral cavity of breast fed children.

Lactoferrin is an antibacterial milk protein comprising features of a lysozyme, immunoglobulin and lacto-peroxidase.^(30,31) It plays an important role in the human innate defense mechanisms against pathogenic microorganisms such as bacteria, fungi and viruses.^(32,33) Lactoferrin has strong bactericidal action against *Streptococcus mutans*.^(23,24) It also chelates iron, making this essential nutrient inaccessible to an invading microorganism, thereby limiting its growth. The human milk, components are able to inhibit adhesion of *S. mutans* to hydroxyapatite crystals.^(34,35) Therefore, biochemically breast milk is protective against *Streptococcus mutans*.

Lactose sugar is present in breast milk but it is not easily fermented as sucrose. Lactase enzyme does not split lactose into glucose and galactose in the oral cavity, rather in the intestine. Lactose in breast milk is also protected by its antibacterial and enzymatic qualities. Breast milk having lactose in absence of other added sugars does not cause dental caries.⁽²⁰⁾ The anti – infective activity of human milk is potentially greater than the sum of its microbial components secretory IgA, lactoferrin, Lewis factor X, SLPI (secretory leucocyte protease inhibitor), defensins, complements, mucins, prostaglandins and interleukins.⁽³⁶⁾ Breast milk may have a protective role against dental caries due to its nutritional content, buffering capacity and other defense mechanisms. Breast milk protects against all infectious diseases of infancy, including dental caries.⁽³⁴⁾

Contrary to the present study, Okawa et al⁽³⁷⁾ and Tanaka et al⁽³⁸⁾ reported that breastfeeding for 18 months or longer increases the prevalence of dental caries. Weerhijam et al⁽¹⁵⁾ demonstrated that frequent breast feeding was contributing factors in process of nursing caries. Feldens et al⁽³⁹⁾ suggested prolonged breastfeeding per se is not a risk factor if it occurs once/ twice a day but greater frequency of breastfeeding allowed prolonged contact of human milk with teeth contributing to dental caries. They attributed cariogenicity in children with high frequency of breastfeeding to the sugars in their diet which could

possibly contributed to increased levels of *S. mutans*, a variable not investigated in the study. Azevedo et al,⁽⁴⁰⁾ Yonezu et al⁽⁴¹⁾ found association between caries and bedtime breastfeeding.

The most important limitation of studies mentioned above was that the internationally adopted definitions of breastfeeding were not used and multiple definitions of dental caries and early childhood caries were used. Valaitis et al⁽⁴²⁾ in a systematic review verified that the definitions of variables compared in studies were weak, inconsistent, ambiguous or even absent. They found none focused solely on examination of the association between breastfeeding on demand and ECC. They observed that investigators combined on-demand and night time breastfeeding into one category but issues related to night time breastfeeding may differ from those assumed to be related to on-demand breastfeeding. On the basis of the scientific evidence, they concluded that evidence did not suggest strong association between breastfeeding and dental caries.

Authors^(15,37-47) found that caries was positively associated with breastfeeding when there was ad libitum feeding, greater number of breastfeeding a day, prolonged breastfeeding and mainly frequent breastfeeding during the night, which results in accumulation of milk on the teeth that may produce tooth decay. However, the mechanism of breastfeeding appeared to protect the teeth against dental caries. Breast milk is expressed directly into the soft palate and thus does not stagnate over teeth while being sucked.⁽⁴⁷⁾

Our study had several strengths. There was no selection bias as the sample was chosen randomly. Definition of exclusive breastfeeding and dental caries used were well accepted. A variety of potential confounding factors were controlled using negative binomial model. The parents were motivated for a dental check up. This influenced their participation in the study. The mothers of caries free children were sensitized in the process to care for child's dentition. The study was a good opportunity to instill preventive dental behavior in children and to give them suitable dental treatment.

The study also had some limitations. History of exclusive breastfeeding and duration of breastfeeding was assessed at 3-5 years of age and this could lead to recall bias. Although we have adjusted our analyses for most potential cofounders but residual cofounding effects like maternal oral health status, individual susceptibility, fluoride use may be included in further studies on the subject.

Conclusion

The prevalence and severity of dental caries was significantly less in breast fed children, especially in those children who were breast fed for 2 years. Breastfeeding for 2 years was found most protective for dental caries. In view of above, breastfeeding up to age of 2 years should be encouraged by pediatricians and

pediatric dentist to promote oral health in 3-5 year old children.

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