

Association between early childhood caries and clinical, microbiological, oral hygiene and dietary variables in rural Turkish children

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Mutans streptococci are the principal bacteria isolated from children with early childhood caries (ECC). The aim of this study, therefore, was to determine the relationships between factors related to ECC with salivary mutans streptococci (MS). A total of 95 children with ECC from low-income families in rural Ankara participated in this study. Breast and/or bottle-feeding habits continued in 31.5% of the children beyond 37 months. Forty percent of the bottle-fed, 35.5% of the breast-fed, and 29.4% of the breast-and bottle-fed children continued their habits beyond 37 months. Caries prevalence was significantly related to the age and feeding habits. Eighty one percent of the children did not have a toothbrushing habit and 41% had been taking sweetened medicine. High counts of MS are determined with increasing age, bottle usage, and snacking habits. We concluded that factors related to ECC are common among Turkish children.

Key words: early childhood caries, feeding patterns, mutans streptococci.

Frequent and prolonged consumption of carbohydrate-rich substrates from a nursing bottle or prolonged breast feeding may cause a type of rampant caries in infants. This type of caries is referred to as early childhood caries (ECC) or nursing bottle caries. The condition is also associated with sweetened pacifier usage, frequent use of sweetened medicaments, presence of a visible dental plaque or poor oral hygiene, early colonization and high levels of cariogenic bacteria, other factors such as socioeconomic status, parental education level, and maternal flora, and predisposing conditions of the host like enamel hypoplasia. The disease has distinguishing characteristics: the pattern of caries development may be distinctive; many teeth may be affected; caries develops rapidly often soon after teeth eruption; and it develops in tooth surfaces that usually are at low risk of caries¹. Although prevalences of ECC have varied in individual surveys from about 1% to nearly 70%, the national prevalence of the

condition has been found to be 5.8% in high socioeconomic population and might be higher for the country as a whole^{2,3}.

Early childhood caries is described as a social, political, behavioral, medical and dental problem. It is a social problem because it clusters in the disadvantaged members of society. Childhood diseases, hunger, and lack of education, family support and parental employment are some of the problems facing families where ECC is endemic⁴. ECC is a medical problem because infants with ECC continue to grow at a slower pace compared with caries-free infants⁵. Children born after maternal complications during pregnancy or who have had traumatic births are at risk of developing ECC⁶. Preventive methods are not applied to many vulnerable children, who later develop serious dental problems⁷. Moreover children with severe ECC often require costly treatment in a hospital under sedation or general anesthesia^{8,9}.

The relationship between breast-and bottle-feeding and ECC among Turkish children has been shown in a previous study³. However, children who use a nursing bottle beyond the regular dietary need do not necessarily develop ECC. This indicates special factors influencing the onset of the disease¹⁰. Even within families the dental health of a child's relatives may vary under similar caries-provoking conditions. Differences therefore may be found in their microbiological flora, for instance, regarding mutans streptococci (MS). Mutans streptococci are the principal bacteria isolated from children with ECC. The aim of this study was therefore, to evaluate the relationship between infant feeding habits such as method of feeding, duration of breast- or bottle-feeding, bottle content, between meal snacking, brushing habit, and consumption of sweetened medication with salivary MS and the prevalence of caries in 9-57-month-old Turkish children.

Material and Methods

Ninety-five children aged 9-57 months old enrolled in the Mother and Child Health Center were eligible to participate in this study. This group represented a convenient sample, although the goal of the study was to enroll 150 child-parent pairs. Lower than expected attendance at the Mother and Child Center resulted in 110 eligible subjects. Ninety-five of these parents consented to participate in the study. This center is directly related to the Ministry of Health and is located in a low-income rural area near Ankara. The drinking water in Ankara is nonfluoridated¹¹. The mothers of the studied children were interviewed by pediatric dentists on a standard questionnaire. The questions referred to current nursing habits, consumption of cariogenic foods, oral hygiene habits, and usage of sweetened medication for their children.

Children were clinically examined by a pediatric dentist using #23 explorer, mirrors and flashlights. For each child, the number and location of erupted teeth were recorded. A tooth was considered erupted if any part of the crown had penetrated the mucosa. Children having at least two affected primary maxillary incisors with caries were considered to have ECC. Dental caries were recorded using dft (decay, filling/teeth) index and WHO criteria¹².

This study was approved by an Internal Institution of Human Subjects Review Board and all children in need of treatment were referred to our university.

All saliva samples were collected at the same hour in the morning. Saliva samples were obtained by placing a sterile loop sublingually. The end of the loop was cut and placed into a vial containing 180 µl of Reduced Transport Fluid (RTF). All samples were transported immediately to the laboratory. The samples were dispersed with a vortex mixer for 30 seconds at setting 6 and serially diluted in ten-fold steps in 0.05 M sodium phosphate buffer with 0.4% KCl (pH=7.3). Aliquots of 20 µl from the different dilutions were then placed in duplicate on Mitis Salivarius Bacitracin (MSB) agar plates (Difco Detroit, Michigan, USA). The plates were incubated in a candle jar for 48 hours at 37°C in anaerobic conditions. Representative colonies with morphological characteristics of MS were isolated and biochemically verified to be MS utilizing mannitol and sorbitol fermentation tests. The total number of MS in the sample was determined by counting those colonies with morphological characteristics of MS on the MSB agar. The number of colony forming units (CFU) for MS counts was recorded as low (0 CFU), moderate (1-50 CFU) and high (>50 CFU).

Nonparametric statistical test (Kruskal-Wallis) was used to compare dft values with feeding habits, bottle content, brushing habit, and sweetened medication consumption. Tests of the association between salivary MS level and feeding habits, brushing habit, and sweetened medication consumption were carried out using the chi-square test.

Results

Ninety-five children, 48 (50.5%) boys and 47 (49.5%) girls, were examined. Among these, 28 (29.5%) were caries-free and 67 (70.5%) had carious lesions. The mean dft score of the group was 6.2.

Distribution of children according to age as related to caries prevalence and MS colonization in saliva is shown in Table I. Analysis using Kruskal-Wallis test showed differences between the age groups of the children and prevalence of caries to be statistically significant ($p=0.001$).

Table I. Distribution of Children According to Age as Related to the Prevalence of Dental Caries and Mutans Streptococci Colonization

Age (months) High	n (total)	With caries			MS colonization		
		n	Mean±SD	Median	Low	Moderate	
9-20	26	8	4.37±3.46	4.0	7	16	3
21-36	37	27	8.07±4.64	7.0	15	19	3
37+	32	32	10.25±4.46	10.0	14	17	1
						P=0.001*	P=0.32**

* Kruskal-Wallis test.
 ** Chi-square test.

All the children were colonized with MS and this factor was not related to age of the children due to the high caries prevalence in all age groups.

Caries experience and MS colonization in relation to feeding habits are shown in Table II. According to the results, 32.6% (n=31) of the children had been exclusively breast-fed, 10.5% (n=10) had been solely bottle-fed and 53.7% (n=51) had been

fed using both methods. The method of feeding showed a statistically significant association with caries prevalence, with higher prevalences occurring in children who were bottle-fed only (p=0.011).

Duration of nursing habits thought to be harmful were also included in the questionnaire. The results showed that prolonged infant feeding time was common in breast-fed, bottle-fed and

Table II. Distribution of Children with Caries According to Feeding Methods and Mutants Streptococci Colonization

Method of Feeding High	n (total)	With caries			MS colonization		
		n	Mean±SD	Median	Low	Moderate	
Breast only	31	22	6.95±3.90	6.50	11	18	2
Bottle only	10	8	13.37±4.75	11.5	3	7	-
Both	51	35	8.60±4.75	8.0	22	24	5
Feeding with spoon	3	2	10.0±2.83	10.0	-	3	-
						P=0.011*	P=0.648**

* Kruskal-Wallis test (only first three groups were taken into consideration).
 ** Chi-square test.
 MS: mutans streptococci.

Table III. Distribution of Children with Caries According to Age, and Methods and Duration of Feeding Practices

Age (months)	n (total)	With Caries		
		n	Mean±SD	Median
9-20 months				
Breast only	8	2	2±0.0	2
Breast and bottle	17	4	5.17±3.71	4
21-36 months				
Breast only	12	9	5.78±2.17	6
Bottle only	6	4	11.75±3.50	11.5
Both	19	14	8.50±5.42	6.5
37+ months				
Breast only	11	11	8.8±4.26	9
Bottle only	4	4	15±5.77	15
Both	15	15	10±3.9	11
Feeding with spoon	3	2	10±2.82	10

both breast-and bottle-fed groups (Table III). For those children who were solely breast-fed, solely bottle-fed, or fed using both methods, feeding patterns continued in 38.7%, 60%, and 37.27% of the children, respectively, between 21-36 months.

Prolonged feeding times continuing beyond 37 months occurred in 31.5% for the whole population. Forty percent of the bottle-fed, 35.5% of the breast-fed, and 29.4% of both breast-and bottle-fed children continued this habit beyond 37 months.

The relation of bottle content with caries experience and MS colonization was also evaluated. According to the replies on the questionnaires, all of the children were given drinks with sugar, honey and/or other sweeteners. Among the 61 bottle-fed children, 61.9% (n=39) had a recoverable MS level and all groups had high caries prevalence scores (Table IV).

The relation of between-meal sweet snacks and caries prevalence is given in Table V. At the time of the survey two-thirds of the children (66.3%) had the habit of consuming cariogenic foods between meals. The results show that caries prevalence and MS colonization increased with increased snacking habit. Table V shows that most children did not have a brushing habit (81%), and these children experienced more carious lesions and MS colonization. However, the level of MS as not associated with brushing habit. Finally, the number of children who received sweetened medication experienced more carious lesions. There was no relationship between caries experience and salivary MS level with sweetened medication (Table V).

Discussion

This study examined factors related to ECC in Turkish children. Children included in this

Table IV. Distribution of Children with Caries and MS Colonization According to Bottle Content

Bottle content	n (total)	With caries			MS colonization		
		n	Mean±SD	Median	Low	Moderate	
High							
Milk and sugar	25	15	8.40±2.80	8	8	16	1
Milk, sugar and/or honey	9	8	9.12±4.09	9.50	4	4	1
Infant formula and milk+sugar	13	12	10.50±5.77	11	3	8	2
Beverages and milk+sugar	10	7	9.43±7.34	5	8	1	1
All of these	7	3	11.67±8.02	11	2	5	-

Table V. Distribution of Children with Caries and MS Colonization According to Snacking, Brushing and Consumption of Sweetened Medication

Between meal sweet snacks	n (total)	With caries			MS colonization		
		n	Mean±SD	Median	Low	Moderate	
High							
Never	10	8	5.6±3.62	5	2	6	2
Occasionally or 1x/day	22	15	8.73±3.67	9	7	14	1
≥2x/day	63	44	9.21±5.12	8.0	27	32	4
			P=0.142*				P=0.307**
Brushing habit							
Yes	18	11	6.91±5.12	6.0	7	10	1
No	77	56	9.02±4.91	8	29	42	6
			P=0.221				P=0.923
Sweetened							
Yes	39	31	9.42±4.90	10	16	13	2
No	56	36	8.03±4.61	8.0	10	22	4
			P=0.235				P=0.317**

* Kruskal-Wallis test.

** Chi-square test.

investigation were aged 9-57 months and from low socioeconomic backgrounds living in a rural area. The percentage of children in this population with caries lesions was 75.5.

The age range of children in this study was chosen to extend to 57 months, since prolonged nursing habits are widespread among Turkish children. In our study, one-third of the children (31.5%) continued nursing practices beyond 37 months and two children aged 57 months were still being bottle-fed. Prolonged breast-feeding beyond two years of age is rare in more western oriented societies compared to many advanced Islamic societies¹³⁻¹⁵. Our questionnaire showed that 35.5% of breast-fed children continued this habit beyond 37 months.

More caries lesions and higher MS colonization were observed in the groups with feeding habit duration beyond 37 months, but only prolongation of bottle-feeding habits appeared to be significantly related to the presence of caries and MS colonization in this study. Several studies suggest that breast- or bottle-feeding does not lead to higher caries prevalence unless another carbohydrate source is available for bacterial fermentation^{16,17}, oral hygiene practices are undertaken¹⁸⁻²⁰. Similarly, the results of this study also suggest that, when evaluating prolonged nursing habits with bottle or breast as a contributory factor of ECC, other factors such as intake of cariogenic foods and oral hygiene habits should be considered. Because dental caries is a multifactorial disease, it is unjustified to judge the prolonged nursing habit as solely responsible, without an examination of the diet²¹. A diet survey, including bottle content and consumption of sweetened medicines and snacks, and review of oral hygiene habits of the children were also included in this study. The bottle content was sweetened beverages for the bottle-fed children, and none of the children consumed milk alone. It is customary to sweeten liquids such as milk, tea, and juice in the Turkish population. Moreover, 66.3% of the children had the habit of intaking cariogenic food two or more times in a day. The very high percentage of sugar, honey or other sweeteners added to the feeding bottle or cups may have masked the effects of the consumption of cariogenic foods and its association with caries prevalence.

Regular toothbrushing may counteract the effects of a cariogenic diet^{19,22}. According to

the results of this study, two-thirds of the children had a high snacking habit, but 81% had no oral hygiene habits.

Sweetened medicine usage is another important factor in the etiology of ECC. Medicinal syrup remains a suspected etiological factor when taken for an average period of more than a week per month, for at least a year²³. It has been suggested that children who are given long-term antibiotic therapy in early childhood may develop fewer carious lesions because antibiotics may eliminate or reduce MS concentration^{24,25}. Although the children who participated in this study had no systemic problems, 41% had been taking a medicinal syrup frequently on an irregular schedule. This result shows that there is a strong tendency for self-medication among Turkish children and irregular use of syrups might be responsible for the increase of lesions and ECC.

Another risk factor considered was the correlation between salivary MS and caries prevalence. Several studies indicate that the establishment of MS is associated with caries initiation in early childhood^{17,26,27}. MS and caries patterns may be affected by age, tooth morphology, eruption sequence, and dietary and behavioral variables^{10,26,28}. The results of this investigation are in agreement with these studies. High counts of MS are determined with increasing age, bottle usage, and snacking habit. The cultivated MS percentage was higher than the uncultivated MS percentage in children with or without a brushing habit and in children with all types of nursing habits. Therefore, it is unlikely that high consumption of cariogenic diets and lack of oral hygiene habits accounted for the proliferation of aciduric microflora.

We concluded that ECC is a risk factor in Turkish infants and children. Although only age and feeding practices were found to be related with caries, it was shown that addition of sugar to milk, prolonged bottle- and breast-feeding, sweet snacks between meals, and insufficient brushing habits were practiced with most of the children. Evidence indicated that children with the condition remain at high risk for future caries attack²⁹. The early identification of poor oral hygiene, improper feeding habits, and frequent use of sweetened medication should be considered in preventive health promotion strategies in Turkey.

REFERENCES

1. Ripa LW. Nursing caries: a comprehensive review. *Pediatr Dent* 1998; 10: 268-292.
2. Milnes A. Description and epidemiology of nursing caries. *J Public Health Dent* 1996; 56: 38-49.
3. Ölmez S, Uzamış M. Risk factors of early childhood caries in Turkish children. *Turk J Pediatr* 2002; 4: 230-236.
4. O'Sullivan DM, Tinnanoff N. Social and biological factors contributing to caries of the maxillary anterior teeth. *Pediatr Dent* 1993; 15: 41-44.
5. Acs G, Lodolini G, Kaminsky S. Effect of nursing caries on body weight in a pediatric population. *Pediatr Dent* 1992; 14: 302-305.
6. Peretz B, Kafka I. Baby bottle tooth decay and complications during pregnancy and delivery. *Pediatr Dent* 1997; 19: 34-36.
7. Horowitz HS. Research issues in early childhood caries. *Community Dent Oral Epidemiol* 1998; 26 (Suppl): 67-81.
8. Peretz B, Faibis S, Ever-Hadani P. Dental health behaviour of children with BBTD treated using general anesthesia or sedation and their parents in a recall examination. *J Dent Child* 2000; 67: 51-58.
9. Kalnellis MJ, Damiano PC, Momary ET. Medication costs associated with the hospitalization of young children for restorative treatment under general anesthesia. *J Public Health Dent* 2000; 60: 28-32.
10. Kreulen CM, J de Soet H, Hogeveen R, et al. Streptococcus mutans in children using nursing bottles. *J Dent Child* 1997; 64: 107-110.
11. Ataç A, Ölmez S, Kayalbay H, et al. Ankara ilindeki şişe ve musluk sularının flor seviyelerinin spesifik iyon elektrodu yöntemi ile saptanması. *TDB Derg* 1994; 24: 12-13.
12. World Health Organization. Oral health surveys. Basic Methods (3rd ed). Geneva: World Health Organization; 1987.
13. Al-Dashi AA, Williams SA, Curzon ME. Breast-feeding, bottle-feeding and dental caries in Kuwait, a country with low-fluoride levels in the water supply. *Community Dent Health* 1995; 12: 42-47.
14. Persson LA, Holm AK, Arvidsson S, et al. Infant feeding and dental caries-a longitudinal study of Swedish children. *Swed Dent J* 1985; 9: 201-206.
15. Hattab FN, Al-Omari MA, Angmar-Mansson B, Daoud N. The prevalence of nursing caries in one-to four-year-old children in Jordan. *J Dent Child ASDC* 1999; 66: 53-58.
16. Thibodeau EA, O'Sullivan DM. Salivary mutans streptococci and caries development in the primary dentition and mixed dentitions of children. *Community Dent Oral Epidemiol* 1999; 27: 406-412.
17. Llena-Puy MC, Montanana-Llorens C, Forner-Navarro L. Cariogenic oral flora and its relation to dental caries. *J Dent Child* 2000; 42: 67-69.
18. Mohan A, Morse DE, O'Sullivan DM, Tinanoff N. The relationship between bottle usage/content, age and number of teeth with mutans streptococci colonization in 6-24 month old children. *Community Dent Oral Epidemiol* 1998; 26: 12-20.
19. Wendt LK, Hallonsten AL, Koch G, Birkhed P. Analysis of caries related factors in infants and toddlers living in Sweden. *Acta Odontol Scand* 1996; 54: 131-137.
20. Matee MI, Miks FH, Moselle SY, van Palenstein Helder WH. Mutans streptococci and lactobacilli in breast-fed children with rampant caries. *Caries Res* 1992; 26: 183-187.
21. Dilley GJ, Dilley DH, Mohen JB. Prolonged nursing habit. *J Dent Child* 1980; 42: 102-108.
22. Reisine S, Douglass JM. Psychosocial and behavioral issues in early childhood caries. *Community Dent Oral Epidemiol* 1988; 26 (Suppl): 32-44.
23. Muller M. Nursing-bottle syndrome: risk factors. *J Dent Child* 1996; 63: 42-50.
24. Loesche WJ. Role of Streptococcus mutans in human dental decay. *Microbiol Rev* 1986; 50: 353-380.
25. Dasanayake AP, Roseman JM, Caufield PW, Butts JT. Distribution and determinant of mutans streptococci among African-American children and association with selected variables. *Pediatr Dent* 1995; 17: 192-198.
26. Fujiwara T, Sasada E, mima N, et al. Caries prevalence and salivary mutans streptococci in 0-2 year old