Abstract

Caries prevalence among 3- to 4-year-old Head Start children and psychosocial information from their parents were obtained. The prevalence of maxillary anterior caries in the 369 children was 16%, with the most severely affected tooth surfaces being the mesial surfaces of the central incisors. Approximately 90% of parents whose children were found to have maxillary anterior caries knew that allowing their child to take a bottle to bed would harm the child's teeth. Significant differences were found in mutans streptococci levels between children with and without the anterior caries pattern. Although 86% of children with anterior caries were reported to have taken a bottle to bed, 69% of those children who did not have anterior caries also were reported to have taken a bottle to bed. Of the children with maxillary anterior caries, 87% had posterior caries, suggesting that anterior caries subsequently may contribute to an increased caries risk in other teeth. (Pediatr Dent 15:41–44, 1993)

Social and biological factors contributing to caries of the maxillary anterior teeth

David M. O'Sullivan, BS Norman Tinanoff, DDS, MS

Introduction

Maxillary anterior caries in preschool children is considered a distinct disease pattern, as reflected by its many names including nursing caries, baby bottle tooth decay, and bottle caries. The condition long has been attributed to prolonged or inappropriate bottle use that allows milk or sweetened liquids to contact the teeth with high frequency (for review, see Ripa[1]). A better understanding of the microbiology of the disease has emerged recently, with studies showing the association of *mutans* streptococci with "nursing" caries[2] and the transmission of the associated microorganism from parent to child.[3] Additionally, there are suggestions that "nursing" caries may later affect caries rates and patterns in other areas of a child's mouth.[4]

As part of a longitudinal study of caries risk in preschool children, we have collected caries data and *mutans* streptococci levels from 3- and 4-year-old Head Start children, as well as psychosocial information from their parents. These data have allowed us to: define caries prevalence and patterns in anterior teeth of this population, compare them to *mutans* streptococci levels, correlate them with parents' reported inappropriate bottle feeding practices and knowledge of the disease, and contrast them to other caries patterns in the child's mouth.

Materials and Methods

The subjects of this study were 3- and 4-year-old children enrolled in two different Head Start programs in Connecticut. Head Start is a federally funded preschool program available to families whose household incomes are generally below federal poverty guidelines. Children from the Hartford Head Start program live in an inner city urban community. The racial/ethnic background of these children is predominantly African-American and Hispanic. The municipal water in Hartford is fluoridated optimally. Children from the Thames Valley Council for Community Action Head Start reside in both urban (Norwich and New London) and rural sites. These children are predominantly Caucasian. The municipal water at the urban sites is fluoridated optimally; however, the fluoride content of the water from the rural areas is variable, with 86% of the wells having less than 0.3 ppm fluoride.[5]

Clinical examinations and estimates of salivary *mutans* streptococci levels were obtained from 481 children, while matching clinical and psychosocial questionnaire data were obtained from 369 child/parent pairs. The interexaminer reliability between the two dental examiners was 99.5%, based on a pilot study using the same children who participated in this study. Examinations were conducted on-site, using portable dental chairs, mirrors, #23 explorers, and focusable flashlights. Caries diagnosis was based on the modified method of Radike,[6] and results for each child were recorded so that each tooth surface could be indicated as carious, filled, or missing. Teeth that were missing due to caries were recorded as having five carious surfaces. Estimates of salivary *mutans* streptococci levels were obtained using the spatula method of Kohler and Bratthall,[7] in which a sterile tongue blade moistened with the child's saliva was impressed onto mitis salivarius agar supplemented with sorbitol, kanamycin sulfate, tellurite, and bacitracin.[8] The plates were incubated for 72 hr at 35°C, after which time colony forming units (CFUs) of *mutans* streptococci were determined semi-quantitatively.

Questionnaires in English or Spanish, depending on the parent's preference, were administered to the parents/guardians of the Head Start children by interview technique. Information was obtained regarding parents' oral health, dental knowledge, health opinions, stress,[9] and locus of control,[10] as well as their child's brushing

habits, diet (weekly consumption of various foodstuffs), and antibiotic exposure. Parents were encouraged to answer each of the applicable 125 questions, although they were permitted to refuse. Interviewers were instructed to reword questions when it was clear that there was difficulty understanding the question.

Statistical differences between parental responses were evaluated using Student's *t*-test, and differences between levels of *mutans* streptococci were evaluated with the Chi-square analysis.

Results

Of the 481 children examined (mean age 3.8 years), 210 (44%) had caries. These children also were categorized as having maxillary anterior caries only, posterior caries only, or both. Maxillary anterior caries was found in 78 children (16%). Of the children with the anterior pattern, 68 (87%) also had the posterior pattern. Among these children with both anterior and posterior caries, the mean dmfs was 14.4, or more than double the combined mean dmfs of children with only one caries pattern (Table 1).

The distribution of caries in the maxillary anterior dentition in those children determined to have anterior caries is illustrated in the figure. Mesial surfaces of the canines also were evaluated, but these surfaces are not shown because none were carious. Almost one half of the children had caries on the mesial surface of the central incisors. Lingual surfaces, especially on lateral incisors, seemed to be affected more than their corresponding buccal (labial) surfaces. The distal surface of the lateral incisors and the incisal surfaces appeared to be the least affected with caries.

There was a significant difference ($P < 0.01$) in recoverable salivary *mutans* streptococci between children with and without maxillary anterior caries (Table 2). All but one child with maxillary anterior caries had recoverable *mutans* streptococci. A significant difference ($P < 0.05$) also was found between the anterior caries only group and the anterior and posterior caries group when *mutans* levels were categorized as low (0 CFUs), moderate (1–50), high (51–100), and too numerous to count (> 100, Table 3).

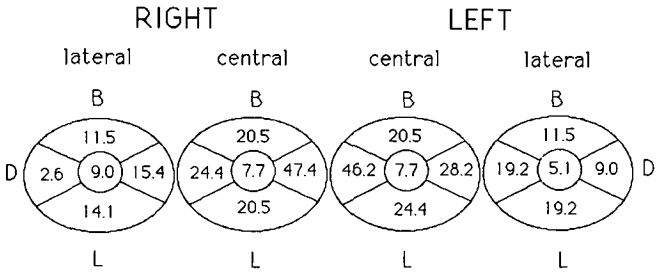

Fig. Percentages of affected surfaces in children with maxillary anterior caries.

When exploring differences between children with the anterior pattern vs. those with anterior and posterior patterns, significant differences were noted in their parents' responses to three of the 125 psychosocial questions: frequency of ice cream intake (number of times consumed during the last week, $P < 0.01$); parent's confidence to avoid getting cavities (choices of not at all sure, pretty sure, very sure, and extremely sure, $P < 0.05$); and parent's confidence to "keep [themselves] from losing any teeth" ($P < 0.05$). There were no significant differences between these groups on any of the other questions.

Regarding the questions that asked specifically about nursing bottle habits, the percentage of children who were determined to have maxillary anterior caries and were reported to have taken a bottle to bed was significantly higher ($P < 0.05$) than those who did not have maxillary anterior caries and were reported to have taken a bottle to bed. However, anterior caries was not found in 213 children (69%) reported to have taken a bottle to bed; and conversely, caries was found in eight children (14%) reported not to have taken a bottle to bed (Table 4). The percentage of children reported to have taken a bottle to bed and from whom *mutans* streptococci were recovered — but did not have maxillary anterior caries — was 79%.

It appears that parental knowledge about the detrimental effects of inappropriate or prolonged bottle feeding had no influence in preventing children from getting anterior caries. More than 90% of parents of children with anterior caries knew that al-

Table 1. Comparison of dmfs by anterior and posterior caries patterns

	Mean dmfs ± SD	*% of Subjects Affected*	*# of Subjects*
Only anterior caries	4.0 ± 3.2	4.2	20
Only posterior caries	2.9 2.5	26.8	129
Both anterior and posterior caries	14.4 ± 12.7	12.1	58

Table 2. Mutans streptococci infection by disease type

	Maxillary Anterior Caries	*Posterior Only*	*Caries-Free*
Mutans streptococci infection	(N = 77)*	(N = 129)	(N = 271)†
Yes	97.4%	93.0%	73.4%
No	2.6%	7.0%	26.6%

* One missing sample; † Three missing samples; Chi-square analysis: $P < 0.01$.

Table 4. Responses to "Did your child take a bottle to bed?"

	Maxillary Anterior Caries	*All Others*
Response	(N = 59)	(N = 307)
Yes	86.4%	69.4%
No	13.6%	30.6%

Chi-square analysis: $P < 0.05$.

lowing their child to take a bottle to bed would be harmful. The percentage of parents who knew that taking a bottle to bed would harm their child's teeth was essentially the same for those parents whose children did get anterior caries (92%), compared to those parents whose children did not (89%).

Discussion

The traditional approach to treating and preventing maxillary anterior caries has been to identify which parents are using the nursing bottle inappropriately, and then to educate them.[11] The surprising findings that 14% of this population whose children were found to have anterior caries reported that their child did not use the bottle inappropriately, and that 69% of those children who did not get anterior caries were reported to have taken a bottle to bed, suggest that such a question is not a good predictor. It also is disturbing that 90% of parents interviewed knew that allowing their child to sleep with a bottle would be harmful, yet allowed the practice.

A problem with correlating information obtained in this study with maxillary anterior caries is that parental knowledge may have changed between time of onset of the disease (between 12–18 months of age) and time of interview/examination. Parents might have known at the time of the interview about the harmful effects of the bottle habit, but might not have known during the time the bottle was being taken to bed. Many of the parents in our study volunteered information that they learned about the harmful effects of the bottle-to-bed habit only after seeing their children's carious teeth. That explanation might account for the difference between this study and that of Johnsen,[12] in which he reported that 40% of the parents of children with carious incisors and 85% of the parents of caries-free children knew of the cariogenicity of the bottle-to-bed habit. It appears that, in some cases, dental education may not be received early enough to prevent children from developing maxillary anterior caries. In other cases, parents may be well aware of the consequences of the bottle habit, but reluctant to act on this knowledge. These findings suggest that education is necessary, but the focus of preventing maxillary anterior caries needs to include implementation.

Perhaps the seriousness and societal cost of maxillary anterior caries are down played because of low estimates of its prevalence. While 16% of our sample had maxillary anterior caries, Marino et al.[13] reported the prevalence of "nursing" caries to be no greater than 6% in children under the age of four, and Johnsen et al.[14] reported the prevalence of "nursing" caries at 11% among preschool children in a fluoridated community. However, there is a wide range in the prevalence of maxillary anterior caries, with estimates as high as 75% in Native American populations.[15]

In addition to the health and restorative problems associated with anterior caries, these children may be at greater risk of developing posterior caries because of the increased infection level of *mutans* streptococci associated with anterior caries. If infection spreads from the anterior to the posterior dentition, it would be a factor in initiating posterior caries. The majority of children in this study with both caries patterns had the highest *mutans* infection. Results from this study clearly show that children with both patterns have more than double the mean dmfs of those with one pattern alone, indicating that dmfs of individual patterns are not simply additive; children with multiple disease patterns have far worse caries.

The lower levels of *mutans* infection in children with only anterior caries suggest that they may have stopped the bottle-to-bed practice at an earlier age (before eruption of the molars) than the children who had both caries patterns. The significant differences in responses on the questionnaire between parents of children with anterior caries only and both caries patterns further suggest that the parents of children with the anterior pattern are less indulgent and less fatalistic, possibly accounting for the practice being discontinued at a younger age.

There have been few studies describing maxillary anterior caries distribution by tooth surface. One such study looked at children with "severe nursing caries" and reported that 17 of the 22 applicable surfaces were affected in more than 50% of the children.[16] None of the maxillary anterior tooth surfaces in our study were affected in more than 50% of children, but the relative percentages in both studies (the order of severity of affected surfaces) were similar.

Table 3. Differences in mutans levels by children with caries pattern

Mutans CFUs	*Anterior Only*	*Anterior and Posterior**	*Caries-Free*
>100	8	32	41
51–100	5	6	13
1–50	5	19	145
0	2	0	72

*One missing sample; Chi-square analysis: $P < 0.05$.

The greatest incidence of caries was found on the mesial surfaces of the central incisors, which would be expected, since these surfaces become the first non-self-cleansing areas.

The finding that almost 70% of the children reported to have taken a bottle to bed did not develop the anterior caries pattern refutes the belief that inappropriate use of the bottle is correlated strongly with the disease. Inappropriate use of a bottle and *mutans* infection may be necessary, but are not sufficient, factors for initiation of maxillary anterior caries. Other factors, such as heredity, fluoride usage, oral hygiene and dietary practices, also may be important for disease initiation in certain children.

This study was supported by NIH Grant DE09217.

Mr. O'Sullivan is research associate, and Dr. Tinanoff is professor, Department of Pediatric Dentistry and Orthodontics at the University of Connecticut Health Center, Farmington, CT. Reprint requests should be sent to: David M. O'Sullivan, Department of Pediatric Dentistry and Orthodontics, University of Connecticut Health Center, 263 Farmington Avenue, Farmington, CT 06030-1610.

1. Ripa LW: Nursing caries: A comprehensive review. Pediatr Dent 10:268–82, 1988.
2. van Houte J, Gibbs G, Butera C: Oral flora of children with "nursing bottle caries." J Dent Res 61: 382–85, 1982.
3. Berkowitz RJ, Jones P: Mouth-to-mouth transmission of the bacterium Streptococcus mutans between mother and child. Arch Oral Biol 30: 377–79, 1985.
4. Johnsen DC, Schechner TG, Gerstenmaier JH: Proportional changes in caries patterns from early to late primary dentition. J Public Health Dent 47:5–9, 1987.
5. Keck D, Kimmel L, Tinanoff, N: Fluoride in Connecticut water supplies and prescribing dietary fluoride supplements. J Conn State Dent Assoc, 66:30–33, 1990.
6. Radike AW: Criteria for diagnosis of dental caries. In Proceedings of the Conference on Clinical Testing of Cariostatic Agents. Chicago, Oct. 14–16, 1968. Chicago: American Dental Association, 1972.
7. Kohler B, Bratthall D: Practical method to facilitate estimation of Streptococcus mutans levels in saliva. J Clin Microbiol 9: 584–88, 1979.
8. Kimmel L, Tinanoff N: A modified mitis salivarius medium for a caries diagnostic test. Oral Microbiol Immunol 6:275–79, 1991.
9. Holmes TH, Rahe RH: The social readjustment rating scale. J Psychosom Res 11:213–18, 1967.
10. Rotter JB: Some problems and misconceptions related to the construct of internal versus external control of reinforcement. J Consult Clin Psychol 43:56–67, 1975.
11. Kammerman AM, Starkey PE: Nursing caries: a case history. J Indiana Dent Assoc 60:7–10, 1981.
12. Johnsen DC: Characteristics and backgrounds of children with "nursing caries." Pediatr Dent 4: 218–24, 1982.
13. Marino RV, Bomze K, Scholl TO, Anhalt H: Nursing bottle caries: characteristics of children at risk. Clin Pediatr 28: 129–31, 1989.
14. Johnsen DC, Schultz DW, Schubot DB, Easley MW: Caries patterns in Head Start children in a fluoridated community. J Public Health Dent 44:61–66, 1984.
15. Kelly M, Bruerd B: The prevalence of baby bottle tooth decay among two Native American populations. J Public Health Dent 47:94–7, 1987.
16. Dilley GJ, Dilley DH, Machen JB: Prolonged nursing habit: a profile of patients and their families. ASDC J Dent Child 47:102–8, 1980.