Scientific Article

Preliminary observations on the relationship between mutans streptococci and dental caries experience within black, white, and Hispanic families living in Houston, Texas

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Abstract

An important goal in pediatric dentistry is to decrease the prevalence of dental decay from a very early stage. One factor that increases that rate is the presence of a high number of mutans streptococci (MS) in a child's mouth. Since it is generally known that a child's first contact with the environment is made with family members, specifically the mother, we studied the interrelationships between MS and dental caries experience among a group of children and their parents representing different racial groups. Both clinical and microbiological data were obtained to determine correlations between parent or grandparent and child caries experience and MS. Intragroup and intergroup comparisons between black, white, and Hispanic families were made with respect to caries and microbiological parameters. The Hispanic adults and children tended to have higher caries experience than in the black and white groups. Significant correlations between MS levels and most measures of caries experience ($P < 0.05$) were observed in children and adults. Although mother-child correlations for caries experience were highly significant ($P < 0.01$), the mother-child correlation for MS infection levels was low and not statistically significant ($P > 0.05$). (Pediatr Dent 17:445–50, 1995)

Results from the recent National Dental Caries Prevalence Survey[1] indicate that almost one-quarter (24%) of white children and one-third of non-white children required restorations in their permanent dentition; even greater percentages (30 and 40% respectively) required restorative services for their primary dentition. In addition, extractions, crowns, replacements, and pulpal treatment were required. Thus, it is important to recognize that substantial caries-related dental treatment needs still exist throughout the general population.

Since 1960 important observations have been made related to the infectious and transmissible nature of dental caries and the possibility of an intra-familial spread of cariogenic microorganisms.[2,3] Many studies have demonstrated that the mutans streptococci (formerly referred to as *Streptococcus mutans*) are important etiological agents in initiating enamel caries in humans.[4] A number of authors[5–7] have noted that these organisms are very difficult to isolate during the first year of life and their frequency of detection increased gradually with the number of erupted primary teeth. Since colonization and multiplication of MS are dependent upon the availability of a nonshedding surface in the mouth, it is usually not detected prior to tooth eruption or insertion of a foreign substance such as an obturator.[5,6] The organism seems to be ubiquitous in human populations, and longitudinal studies have demonstrated a localized pattern of colonization, indicating a dependence on specific factors that may influence its spread from one person to another.[8,9]

The possibility that parents and siblings are the main sources of primary infantile MS infection has been suggested, and colonization seems to be dependent on several factors including size of inoculum, frequency of transfer, ability of the cells to adhere to the tooth surface, and host variables influencing susceptibility to infection.[8–11] Thus, saliva can influence the initial adherence to a varying extent and modify the susceptibility to MS infection.[9] In the Kohler et al. studies,[8,9] children whose mothers had low numbers of MS in saliva rarely harbored this microorganism, but children whose mothers had high salivary levels were usually (but not always) infected; children with the highest salivary MS levels also had the highest caries experience. Mothers with high MS levels tended to have children who were also highly infected. This suggests one possible explanation for the reported familial patterns of caries experience observed by Shaw and Murray[12] who stressed that members of a household are more likely to exhibit similar caries patterns than members of the population

who do not reside together.

In some studies, MS levels in children have been found to be more closely correlated to that of the mothers than to that of the fathers.[13] Fathers may have higher concentrations of MS than either the mother or the child[9, 13] and they and their children may also share common bacteriocin types.[14] Kohler and Bratthall[8] pointed out that either the mother or the father, if they take care of the child most of the time, can be a natural source of infection of the child.

More recent studies,[15] indicating that infant MS strains can exhibit restriction fragment profiles identical to those of their mothers strongly support the notion that mothers transmit this organism to their infants. Caufield and coworkers[16] also observed that mothers harbor a more heterogeneous population of MS than do infants at initial acquisition, although the repertoire appears to be limited to only two or three strains. However, since grandparents frequently are the caretakers of young children, and since even elderly individuals with complete dentures can harbor high levels of MS, grandparents must also be considered as possible transmission sources.[17, 18]

In view of the results of the National Dental Caries Prevalence Survey[1] and the strong MS/dental caries association, it is important to evaluate the intrafamily relationships of MS in a geographic area having many different minority, racial, cultural, and ethnic groups, and a high percentage of migration (white, black, Asian, Latin American, etc.). Immigrant and migrant children, especially in Hispanic families, have a significantly higher prevalence of dental caries and unmet restorative treatment needs than the general population.[20] We still have insufficient knowledge about the relationships of MS in these diverse population groups whose dietary, nursing, child care, and other cultural practices might be equally diverse. Our primary purpose in this project was to study the interrelationships between MS and dental caries experience among a group of children and their parents representing different racial/ethnic groups living in Houston, Texas.

Methods and materials

A total of 62 children and 39 accompanying adult family members seeking routine dental treatment during a two-day screening session at the University of Texas, Dental Branch, Houston were enrolled in the study (Table 1). All subjects who volunteered were enrolled in the study irrespective of their possible selection for future treatment. A thorough explanation of the research procedures was given orally to the adult guardian and child. Verbal consent was obtained, and a data sheet was filled out with identifying information for both child and parent. A clinical dental examination with mouth mirror, explorer, and dental light (no radiographs) was made for all family members present at the time of enrollment. Findings were recorded anatomically on a dental chart and included the number of teeth present, the location of missing teeth, and the presence of decayed and/or restored teeth and tooth surfaces. Because of the young age of the children and in order to facilitate statistical analysis, primary and permanent teeth were combined and missing teeth were omitted in calculating total decayed or filled teeth (TDFT) or surfaces (TDFS). For adults the DMFT and DMFS indexes were used to estimate caries experience.

In order to obtain specimens for microbiological analysis, mouth rinse samples were taken from children and adults using a vigorous 15-sec rinsing with 5 ml of 0.1% peptone-saline solution in a large plastic test tube. The method is simple, reliable, and yields data that correlate strongly with estimates of total oral load of MS.[21] In two young children (2 years) who could not do a mouth rinse, sterile swabs were used to collect the sample of saliva and or plaque from the mouth and the samples were placed into the test tube containing 5 ml rinse solution. Routine laboratory methods were employed in processing the samples before incubation. After mechanical mixing for 20 sec with a Vortex Genie™, Model K-550-G (Scientific Industries Inc, Springfield, MA), the rinse samples were serially diluted and plated on MSB agar (selective for MS).[22] The plates were incubated anaerobically for 24 hr at 37°c and aerobically for 24 hr at room temperature. Enumeration procedures were performed by one experienced investigator (HJK) with a

Table 1. Mean characteristics of children and their parents

Variables	*Children (N = 62) Mean ± SD*	*Mothers (N = 32) Mean ± SD*	*All Adults (N = 39) Mean ± SD*
Age (yrs)	6.8 ± 2.9	35.2 ± 6.9	36.7 ± 7.6
DMFT/TDFT*	6.0 4.5	13.6 5.8	13.8 5.9
DMFS/TDFS*	9.1 8.1	25.2 12.4	26.4 13.8
DT†	4.9 4.4	5.9 5.6	5.9 5.4
DS†	6.8 6.7	8.3 10.0	8.6 9.7
Teeth present	22.6 2.6	25.2 7.0	26.0 5.1
Teeth carious or restored	5.6 4.3	10.5 5.0	10.9 4.6
Teeth carious or restored (%)	24.8 20.1	39.3 18.0	42.5 18.1
MS‡	3.66 ± 1.40	3.88 ± 1.20	3.95 ± 1.14

*Total decayed or filled primary and permanent teeth or surfaces in children; DMFT/DMFS in adults.

†Includes primary and permanent teeth in children.

‡Number of mutans streptococci (Log_{10}) CFU per ml of rinse medium.

binocular dissecting microscope, and the counts for each patient were recorded as the number of MS/ml of rinse medium after logarithmic conversion. The sensitivity of the rinse method is approximately 10 colony forming units (CFU) per milliliter; thus, if the counts were below this level, it was unlikely that the organisms were detected. Details pertaining to the validity, reliability, and reproducibility of the methodology have been presented previously.[21]

Differences between groups in mean caries scores and mean number of MS were tested for statistical significance by use of the *t*-test or the Mann-Whitney U test. Correlation analysis (Pearson's coefficient of correlation) was employed to assess the magnitude of intrafamily and interfamily relationships with respect to caries and microbiological parameters. Intraracial relationships were evaluated by correlation analysis (Pearson) and interracial differences were examined for significance by *t*-test. In performing the nonpaired *t*-tests, the individuals in each group were considered as independent samples.[23]

Results

The mean characteristics of the children and adults enrolled in the study are shown in Table 1. The combined group included 32 mothers, five fathers, two grandmothers, and 62 children. The ages of the children ranged from 2 to 12 years. Mutans streptococci were detected in 38 adults (97.4%) and 58 children (93.5%); MS were not detected in the two youngest children in whom a swab sample had been taken. Results for the family correlation analysis (all groups combined) are given in Table 2. In the adults, significant values ($P < 0.05$) were observed in two of seven correlations: MS versus decayed teeth (DT) and MS versus decayed surfaces (DS), indicating a positive association between the two measures of caries experience and MS levels. Similar, but more highly significant correlations were observed in the children and all of the measures of caries experience correlated strongly with MS levels ($P<0.01$).

Results for the parent-child correlations (all groups combined) are shown in Table 3. For variables dealing with caries experience, child-mother correlations were all highly significant, but the child-mother correlation for MS was unexpectedly low (r = 0.099) and not statistically significant. The high r values obtained in the child-grandmother correlations are of interest despite the small number of grandmothers in this analysis. The negative, but significant father-child correlation ($P = 0.05$) for number of decayed teeth (DT) is also of interest. Although not significant, it is important to point out that the children's mean MS count was higher (12,800 CFU/ml) when the mothers' count was > 10,000 CFU/ml compared to those whose mothers' counts were <

TABLE 2. FAMILY CORRELATION ANALYSIS: ALL GROUPS COMBINED

Variables	*N*	*r*	*p*
Adults			
MS* vs. DMFT	38	0.147	NS†
MS vs. DMFS	37	0.180	NS
MS vs. DT	37	0.401	0.05
MS vs. DS	37	0.365	0.05
MS vs. total teeth	37	–0.076	NS
MS vs. carious or restored teeth	37	0.216	NS
MS vs. % teeth carious or restored	37	0.288	NS
Children			
Age vs. MS	59	0.194	NS
Age vs. TDFT	60	0.063	NS
Age vs. TDFS	60	0.067	NS
MS vs. TDFT	58	0.398	0.01
MS vs. TDFS	58	0.374	0.01
MS vs. DT	58	0.390	0.01
MS vs. DS	58	0.405	0.01
MS vs. total teeth	58	0.170	NS
MS vs. % carious or restored teeth	58	0.390	0.01

*Mutans streptococci Log_{10} CFU/ml.

†NS = not significant ($P > 0.05$).

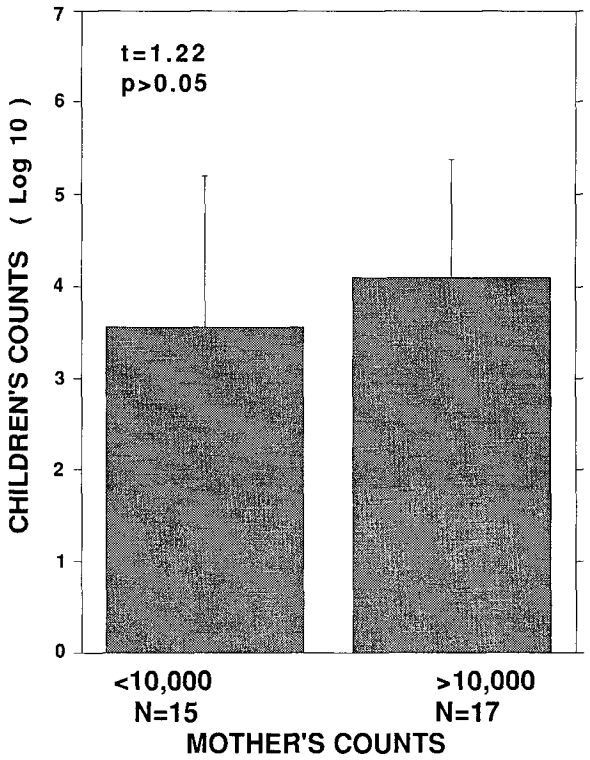

Fig. Mean ± S.D. mutans streptococci (MS) counts in 2 groups of children (Log_{10} CFU/ml of rinse medium) according to their mothers' MS levels.

10,000 CFU / ml (3700 CFU / ml) as shown in the Figure.

The mean ± SD values for age, caries experience, and MS counts for mothers and their children in the three racial groups are shown in Table 4. When these values were examined in a series of 12 *t*-tests, the TDFS scores of children in the white versus Hispanic comparisons were significantly different ($P < 0.05$), but none of the other intergroup comparisons was significant for mothers or their children. In general, caries experience tended to be lowest in the white children, intermediate in black children, and highest in Hispanic children. For mothers, DMFT and DMFS scores were remarkably similar in all three racial groups. Statistical analysis indicated significant r-values for mother-child correlations of caries experience scores in the white and Hispanic groups, but not in the black group.

Discussion

A previous report[24] summarized findings from a cross-sectional study on several groups of recent adult immigrants (< 10 years residence) living in Houston, Texas. Hispanic immigrants tended to have both higher periodontal disease and dental caries experience scores than other groups. Since all subjects involved in the study were seeking treatment at the dental school, it was not known whether the oral health of the patient sample was truly representative of the actual background population. As noted by Ismail and Szpunar,[25] data from recent national surveys show a disturbing pattern of untreated dental caries in blacks and Mexican-Americans. In our preliminary study, dental caries and mutans streptococci (MS) prevalence were examined within black, white, and Hispanic families who were currently living in the greater Houston area irrespective of length of residence. We were particularly interested in assessing the intrafamily relationship between children and their parents with regard to past caries experience and the prevalence of mutans strep-

Table 3. Family correlation analysis: child vs. mother, father and grandmother

Variables	Child vs. Mother N*	r	P	Child vs. Father N	r	P	Child vs. Grandmother N	r	P
DMFT/TDFT	48	0.432	0.01	9	–0.239	NS	5	0.885	0.05
DMFS/TDFS	46	0.451	0.01	9	–0.376	NS	5	0.771	NS
DT	46	0.489	0.001	9	–0.677	0.05	5	0.907	0.05
DS	46	0.489	0.001	9	–0.164	NS	5	0.907	0.05
% teeth carious or restored	46	0.285	0.05	9	–0.258	NS	5	0.844	NS
MS†	46	0.099	NS‡	9	0.336	NS	5	–0.326	NS

*N = number of children.

†Mutans streptococci Log_{10} CFU/ml.

‡NS = not significant ($P > 0.05$).

Table 4. Comparison of intergroup differences in mean age, caries experience, and MS between mother and children

Group	Variables	Mother Mean ± SD	Children Mean ± SD	Mother-Child Correlations r	P*
White		(N = 13)	(N = 30)	(N = 20)	
	Age	32.7 ± 5.0	6.2 ± 3.0	—	—
	DMFT/TDFT	14.0 4.7	4.9 4.3	0.438	0.05
	DMFS/TDFS	26.8 11.8	6.6 6.5	0.444	0.05
	MS†	3.93 ± 1.22	3.59 ± 1.44	–0.086	NS
Hispanic		(N = 13)	(N = 21)	(N = 21)	
	Age	36.5 ± 8.4	7.3 ± 2.8	—	—
	DMFT/TDFT	13.0 4.6	7.8 4.4	0.439	0.05
	DMFS/TDFS	24.5 12.2	13.0 9.3	0.488	0.05
	MS	4.06 ± 0.78	3.73 ± 1.42	0.321	NS
Black		(N = 6)	(N = 11)	(N = 8)	
	Age	37.8 ± 6.5	7.8 ± 3.1	—	—
	DMFT/TDFT	13.8 9.7	6.5 6.4	0.045	NS
	DMFS/TDFS	23.5 14.9	10.0 9.0	0.312	NS
	MS	3.40 ± 1.88	3.62 ± 1.49	0.065	NS

*NS = not statistically significant ($P > 0.05$).

†MS = Mutans streptococci Log_{10} CFU/ml.

tococci (MS). The small number of observations in some instances (blacks, grandmothers, fathers) imposes certain limitations on the data.

For the combined group (children only) correlation analysis indicated a moderately strong relationship between oral rinse levels of MS and the various measures of caries experience such as the TDFT and TDFS scores and the number of decayed teeth (DT) and decayed tooth surfaces (DS). In the adult sample, MS levels correlated weakly with DMFT and DMFS but more strongly (significantly) with DT and DS. The associations between caries and mutans streptococci prevalence have been studied widely in many human populations and our results are consistent with those of many investigators.[4] Although the higher caries prevalence observed in our Hispanic group (children and adults) is in agreement with recent reports,[20, 25] the low mean number of decayed teeth (DT) and decayed tooth surfaces (DS) in the black adults and children was unexpected. It should be noted, however, that the black group was the smallest of the three ethnic groups sampled and these results could be spurious. Although missing teeth were excluded in the calculations of child caries experience, inclusion of the M component in the adult DMFT and DMFS indexes could inflate the data somewhat if noncaries associated.

The inter-relationships observed in our study between the children and other adult family members with respect to caries prevalence and level of oral infection by the mutans streptococci are most interesting. Observations on adult family members other than the mother are too limited for further comment; however, additional investigation would seem to be indicated, especially since mothers may not be the only family member having close contact with a child.[8, 11] As a child emerges from the weaning period, and approaches and attains school age, it is likely that increasing socialization and broader contacts inside and outside the home are established. Mother-child oral microbiologic relationships established during infancy may be altered during this period. Since many of the children in our study were already welladvanced in grade school, this could possibly explain the weak mother-child correlation ($r = 0.099$) in MS counts obtained in our study. From data in the literature, one would expect maternal-child MS relationships to be strongest in the preschool years;[5, 8, 10, 13, 19] however, additional studies are required on a larger sample to more adequately examine this interesting problem. In future studies it will also be important to identify who are the primary caretakers of children and to define possible behaviors or patterns that might be associated with transmission of oral bacteria to the child.

Conclusions

The following conclusions were drawn from this study:

1. Mutans streptococci (MS) levels correlated significantly with the number of decayed teeth (DT) and decayed surfaces (DS) in children and adults.
2. Mother-child correlations were significant for the estimates of caries experience, but weak for MS.
3. White and Hispanic mother-child correlations for caries experience were moderately strong and significant, but black mother-child correlations were not significant.
4. In the mother-child MS relationships, the correlation was strongest in the Hispanic group.
5. No significant racial differences were found for mother's mean age, DMFT, DMFS, or MS levels.
6. Results suggest important mother-child associations in caries experience but not MS levels.
7. Hispanic children had greater caries experience and more untreated caries lesions than the black and white groups.

The authors thank Patricia Carter and Mary Helen Borrego for technical assistance and Dr. Egon Durban, Baylor College of Medicine, for statistical consultation.

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Number of overweight children and adolescents on rise

FOCUS ON PREVENTION IS CRUCIAL — PHYSICAL ACTIVITY MAY PLAY A ROLE

The number of overweight children and adolescents in the United States more than doubled in the past decade, from 5 to 11% of those 6–17 years old, according to an article in the October issue of the AMA's *Archives of Pediatrics and Adolescent Medicine.*

Richard P. Troiano, PhD, RD, and colleagues at the National Center for Health Statistics, Centers for Disease Control and Prevention, Hyattsville, Maryland, studied 2,290 children and adolescents in the third National Health and Nutrition Examination Survey (NHANES) from 1988 to 1991. They compared the results with earlier health examination surveys.

Researchers found that overweight was generally steady for adolescents and rising slowly for children through the 1960s and 1970s, with the greatest increases in overweight prevalence occurring between NHANES II (1976–1980) and the recent NHANES III.

Researchers used a measurement based on height and weight to determine overweight — body mass index (BMI). They recommended using a cutoff point of the 95th percentile of the BMI, because of the potential for changes in weight status as children grow and develop, but also presented data for overweight using the 85th percentile. That criterion is used to define overweight for adults and has been used for adolescents. Using the 85th percentile, 22% of children and adolescents were found to be overweight, up from 15% in the previous survey.

The researchers write: "Although some overweight youths will lose their excess weight as they mature and develop, it is likely that many will go on to become overweight adults. The current prevalence of overweight among youths and the likelihood of continued, if not additional, high prevalence as they age implies increased need for treatment of morbidities associated with overweight in the near and distant future." As reported earlier, NHANES III also found that one-third of adults were overweight, up from one-fourth in the previous survey.

Some patterns were evident regardless of the percentile used to define overweight. By either definition, overweight had increased substantially for both children and adolescents. Among girls in both age groups, non-Hispanic blacks had the highest prevalence of overweight and non-Hispanic whites had the lowest prevalence.

For boys, the pattern by race and ethnicity was mixed. For boys aged 6–11, non-Hispanic whites had the lowest prevalence of overweight, whereas for boys aged 12–17, non-Hispanic blacks had the lowest prevalence.

They conclude: "Researchers are challenged to understand the causes of increasing overweight among children and adolescents as well as adults. Treatment of obesity for adults has been shown to be largely ineffective. Dietary treatment of children and adolescents is further complicated by possible interference with growth. Therefore, it is crucial to focus on prevention of overweight among youths. Attempts to increase physical activity for children and adolescents may provide a promising avenue in this effort."