Effects of Oral Health Education and Tooth-brushing on Mutans Streptococci Infection in Young Children

W. Kim Seow, BDS, MDSc, PhD, DDSc, FRACDS Esther Cheng Vincent Wan

Dr. Seow is associate professor in pediatric dentistry; Ms. Cheng and Mr. Wan are fourth-year dental students, University of Queensland School of Dentistry, Brisbane, Australia.
Correspond with Dr. Seow at k.seow@uq.edu.au

Abstract

Purpose: The purpose of this study was to examine the effects of maternal dental health education and tooth-brushing instruction on the levels of mutans streptococci in preschool children.

Methods: One hundred and seven children (44 boys and 63 girls) with a mean age of 20.5 months, randomly selected from a community child health clinic within a 2-week period, participated in this study. Medical, dental, and dietary information was obtained through a questionnaire. The children's mouths were examined, and plaque samples were obtained by swabbing the teeth and mucosa. A commercial microbiological kit was used to determine the presence of mutans streptococci. The mothers were instructed in tooth-brushing using a soft-scrub method. The children were recalled to the same clinic after a period of 4 weeks to obtain a second evaluation of the mutans streptococci levels.

Results: At the first visit, 69 of the 107 children (64%) showed positive infection with mutans streptococci. Ninety (84%) children returned for the recall examination. In the second examination, only 44 (49%) of the 90 children showed positive results for mutans streptococci. The difference in number of children who tested positive is statistically significant ($P<.01$). At the first visit, children who did not show infection with mutans streptococci were those who reported greater frequency of tooth-brushing ($P<.05$) and less snacking ($P<.05$). There were 26 children (29%) who converted from positive to negative results for mutans streptococci infection between the first and second visits ($P<.01$). This conversion from positive to negative infection was attributed mainly to increased tooth-brushing, as other dental health habits remained the same.

Conclusions: Infection with mutans streptococci in young children is associated with increased snacking frequency and inadequate tooth-brushing. A single dental health education session and tooth-brushing instruction to mothers results in approximately a 25% reduction in mutans streptococci infection in young children from a relatively high socioeconomic status. (*Pediatr Dent*. 2003;25:223-228)

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As dental caries is an infectious disease caused by the group of bacteria known as mutans streptococci, the presence of this bacteria in a child's mouth is an important risk factor for the condition.[1] Mutans streptococci bacteria comprises 2 main cariogenic species, *Streptococcus mutans* and *Streptococcus sobrinus.*[1] It is now well known that mutans streptococci is usually transmitted from the mother, and that the transmission may be delayed by reducing her bacterial counts.[2] However, to date, there is little information regarding how mutans streptococci infection in the child may be controlled. The use of chemotherapeutic agents such as chlorhexidine may be effective,[3] but long-term effects of this preventive method in young children are unknown.

As mutans streptococci reside in the dental plaque, mechanical removal by tooth-brushing and flossing theoretically reduces mutans streptococci infection and dental caries. Many studies have demonstrated that less dental

caries is associated with less plaque and good oral hygiene in both older children and infants.[4-8] In addition, controlled longitudinal studies on the mechanical removal of dental plaque in teenagers have demonstrated lowered counts of the bacteria after prolonged professional cleaning and flossing of the teeth.[8]

Earlier ages of commencement of tooth-brushing have also correlated with less caries in young children.[5] The beneficial effect of this may be the timely elimination of cariogenic organisms at the initial stages of infection, so that long-term colonization of the bacteria is prevented. Although early studies suggested that mutans streptococci colonize the teeth only after tooth eruption,[9] recent studies on pre-term and full-term children showed that over 50% of 6-month-old infants without teeth are already infected with *S mutans*.[10-11] These data suggest that, when the first teeth erupt at approximately 6 months of age, the mouth may be already colonized with mutans streptococci. As the mechanical removal of plaque will help eliminate cariogenic bacteria, there is sound basis for the established recommendation for child caregivers to brush children's teeth as soon as the first teeth emerge.[12]

However, to date, while there is evidence that the presence of dental plaque is a sign of caries-risk,[13] there is very little data which has demonstrated the direct effects of tooth-brushing on mutans streptococci levels in young children. The aim of this study, therefore, was to examine the short-term effects of a single tooth-brushing instruction on mutans streptococci infection in a group of young children. Knowledge of these effects is likely to provide insight into the prevention of early childhood caries, which is highly prevalent in many disadvantaged communities.[14]

Table 1. Demography of Subjects

	Boys	Girls	Total
No (%)	44 (41%)	63 (59%)	107 (100%)
Mean age (mos)	18.5±17.4	21.9±15.9	20.5±16.5
Birthweight (kg)	3.4± 0.6	3.3±0.6	3.3±0.6
Gestational age (wks)	39.4±2.2	39.4±2.1	39.5±2.1
Predentate	11 (21%)	12 (19%)	23 (100%)
Dentate	33 (39%)	51 (61%)	84 (100%)
Incisors only	12 (40%)	18 (60%)	30 (100%)
Incisors and first molars	14 (52%)	13 (48%)	27 (100%)
Full dentition	7 (26%)	20 (74%)	27 (100%)
Number of teeth			
Mean	12.1±6.4	13.3±6.8	12.8±6.6
Range	1-22	1-20	1-22
Decayed and filled teeth			
Children with cavities N(%)	2 (33%)	4 (67%)	6 (100%)
Cavitated teeth in affected children (mean no)	1.5±0.7	4.0±2.5	3.2±2.3
Restorations present N (%)	2 (5%)	0	2.4 (2%)
Restorations in affected children (mean no)	2.5±2.1	0	2.5±0.1

Methods

Subjects

Ethical clearance for the study was obtained by the relevant institutional human ethics committees. All children attending immunization clinics at a community child health center in metropolitan Brisbane during the study period were invited for the dental study. Signed and informed consent was obtained from all mothers.

Dental examination

The mothers were personally interviewed to complete a questionnaire regarding medical, dental, feeding, and brushing histories. The children were placed in the lap position, and the teeth and oral mucosa were examined. To obtain a microbiological sample, a sterile cotton swab was wiped along the dorsum of the tongue and surfaces of all erupted teeth.

Brushing of the child's teeth was demonstrated to the mother by the operator with the child placed in the lap position. A soft circular scrub technique using a child's toothbrush was employed. The toothbrush was given to the child along with a tube of commercial children's toothpaste which contained 0.3 mg percent sodium monofluorophosphate (Colgate Oral Care, Sydney, Australia).

The mothers were then given general dental advice regarding diet, and were instructed to return for a dental follow-up visit to the same center after 4 weeks.

Mutans streptococci assays

The microbiological sample was assayed for mutans streptococci using a commercially available assay kit which employs the use of selective growth media for mutans streptococci (Dentocult CRT Bacteria, Ivoclar, Melbourne, Australia). In this technique, the swab was wiped across the surface of the agar media provided, a pellet of bicarbonate was inserted to generate carbon dioxide, and the vial was stoppered. The kits were incubated at 37°C for 48 hours, then examined for the presence or absence of mutans streptococci colonies.

Statistical analysis

The data were analyzed using chi-square and student's *t* tests where appropriate. The alpha value was 0.05.

Table 2. Infection Prevalence of Mutans Streptococci

	Mutans streptococci		
	Absent N (%)	Present N (%)	*P* value
First visit (N=107)	38 (36%)	69 (64%)	<.01
Second visit (N=90)	46 (51%)	44 (49%)	<.01

Results

Demography

Altogether, 107 children (44 boys and 63 girls) participated in the study (Table 1). The consent rate was 97%, as 3 mothers did not wish to participate in the study. As shown in Table 1, the mean age at examination was 20.5±16.5 months. All the children were born full-term, with a mean birth weight of 3.3±0.6 kg and a gestational age of 39.5±2.1 weeks (Table 1).

Analysis of the occupations of the 107 fathers in the study group revealed that 27 (25%) were of professional class, 47 (44%) in the skilled, technical class, 21 (20%) were unskilled laborers, and 12 (11%) were unemployed. Of the 107 mothers, 40 (37%) held full- or part-time jobs, and 67 (63%) were full-time housewives. Of those who were working, only 1 (1%) was classified as being in the professional category, 29 (27%) held skilled technical positions, and 10 (9%) held unskilled positions.

As shown in Table 1, 84 (79%) children were dentate, and 23 (22%) were predentate. Of those with teeth, 30 (36%) had incisors only, 27 (32%) incisors and first molars, and 27 (32%) had a complete primary dentition. The mean number of teeth present was 12.8±6.6 (range 1-22).

Six (6%) children were found to have dental caries, with the mean number of cavities being 3.2±2.3 (Table 1). Only 2 boys had dental restorations, and these had a mean of 2.5±2.1 restorations.

Infection rates with mutans streptococci

As shown in Table 2, at the first visit, 69 (64%) out of 107 children showed infection with mutans streptococci. Although several dental habits between the infected and noninfected children differ significantly (Table 3), demographic differences between these groups were not found. In particular, there were no statistically significant differences in paternal and maternal occupations between the infected and noninfected children. In addition, all children with dental caries and restorations tested positive for mutans streptococci, although the numbers were small and the results did not reach statistical significance when compared to those who were not infected.

Table 3. Association of Mutans Streptococci Infection Rates with Oral Health Habits Determined at the First Examination

	Mutans streptococci		
Oral health habit	**Present** N (%)	**Absent** N (%)	***P* value**
Daily tooth-brushing (N=84)			
Tooth-brushing performed (N=78)	48 (57%)	30 (36%)	<.05
No tooth-brushing (N=6)	5 (6%)	1 (1%)	
Toothpaste use (N=82)			
Toothpaste used for brushing (N=74)	46 (59%)	28 (35%)	<.05
No toothpaste used for toothbrushing	2 (3%)	2 (3%)	
Fluoride supplements use (N=107)			
Fluoride supplements used (N=8)	3 (3%)	5 (5%)	<.05
No fluoride supplements (N=99)	66 (62%)	33 (30%)	
Daily snacking frequency (N=81)			
>3 daily snacks (N=71)	40 (49%)	31 (38%)	<.05
<3 daily snacks (N=11)	10 (12%)	1 (1%)	
Eating solid foods (N=107)			
Yes (N=82)	50 (47%)	32 (30%)	<.05
No (N=25)	19 (18%)	6 (5%)	
Feeding method (N=25)*			
Fully breast-fed (N=13)	9 (36%)	4 (16%)	†
Fully formula-fed (N=3)	3 (12%)	0	
Mixed breast- and formula-fed (N=9)	7 (28%)	2 (8%)	

*Nonweaned children.
†Not significant.

Association of mutans streptococci infection with oral health habits

Table 3 shows the association of various oral health habits with mutans streptococci infection, employing data obtained at the first visit. Data from the second visit revealed essentially similar associations for these variables. Positive associations were noted with daily tooth-brushing, use of toothpaste, fluoride supplementation, daily snacking frequency of greater than 3 times, and eating solid foods (all $P<.05$). By contrast, no association of any particular feeding method with mutans streptococci was noted ($P>.1$, Table 3).

Table 4. Mutans Streptococci Levels Between First and Second Examination Visits

Change in mutans streptococci levels between first and second visits N (%)	
No change	52 (58%)
Change from + to –	26 (29%)
Change from - to +	12 (13%)
Total	90 (100%)
P value	<.001

Changes in mutans streptococci infection with changes in brushing frequency between dental visits

As shown in Table 4, a total of 90 children returned for a second dental examination at the clinic. In 52 (58%) of the children, there was no change in the mutans streptococci levels. However, in 26 (29%) children, the culture was positive for mutans streptococci at the first visit, but became negative at the second visit. To determine if this change from positive to negative culture was related to changes in preventive health behavior, the tooth-brushing and dietary habits were compared between visits. Results showed that dietary and feeding habits remained the same. The only preventive health habit which differed between the first and second visits was tooth-brushing.

As shown in Figure 1, in the group of 24 children who changed their tooth-brushing habits from no brushing to brushing once daily, 17 (71%) converted from positive cultures at the first visit to negative cultures at the second visit, while 3 (13%) continued to show a positive culture. Another 4 (17%) showed a negative culture at the first visit and positive culture at the second visit.

In contrast, in the group of 49 children who reported that they were brushing at the same frequency at the first and second visits, the majority of children (65%) showed no change in their mutans streptococci levels, while 9 (18%) showed a change from positive culture at the first visit to negative culture in the second visit, and a further 8 (16%) showed negative culture at the first visit and positive culture at the second visit. These differences between the 2 groups are statistically significant ($P<.01$), suggesting that commencement of tooth-brushing is associated with removal of mutans streptococci.

Discussion

It is well established that dental caries in young children is caused by cariogenic bacteria residing in dental plaque, mutans streptococci, which ferments carbohydrates to form demineralizing acids.[1] The timing of infection of mutans streptococci in the mouths of children is highly significant in that the earlier the colonization age, the higher the caries rate of the child.[15]

Early studies have suggested that mutans streptococci can infect the child's mouth only when teeth erupt, as the bacteria requires a nonshedding tooth surface for adherence.[16,17] Later, it was further reported that there is "window of infectivity" for mutans streptococci colonization in children at around the age of about 17 to 23 months.[9] However, more recent studies have shown that mutans streptococci can colonize the mouth even before the teeth erupt, and that over 30% of predentate children at the age of 3 months are already infected with the bacteria.[10] Furthermore, by the age of 6 months, over 60% of children showed presence of the bacteria in the mouth.[11]

In the present study of subjects with a mean age 20.5 months, the prevalence of mutans streptococci infection was 64%, which is higher than the studies of Roeters et al who detected mutans streptococci in 43% of 252 preschool children aged 2 to 5 years in the Netherlands.[18] Lower prevalence rates of infection was also obtained by Karn et al[19] who reported a prevalence of 35% in 149 children aged 8 to 15 months, Radford et al[20] who detected mutans streptococci in 27% of 1-year-olds, and Thorild et al[21] who found cariogenic bacteria in 30% of 18 month-olds and 42% in 3-year-olds.

The early infection of mutans streptococci in the mouths of young children suggests a significant potential risk for early childhood caries, and may explain why some children as young as 18 months of age already show dental caries.[22] As the cariogenic bacteria reside within bacterial dental plaque, it is reasonable that previous literature has demonstrated that the presence of plaque on the teeth is associated with increased caries risk.[23,24]

This study's results show that commencement of daily tooth-brushing can lead to elimination of mutans streptococci from the mouths of infected young children after a period of 4 weeks. Although the period of study was relatively short, it is possible that the changes are permanent if the results of other cross-sectional studies are considered. For example, a recent study reported that 18-month-old children who had started tooth-brushing by 12 months of age were less likely to have mutans streptococci in the dental plaque compared to those who had not.[5]

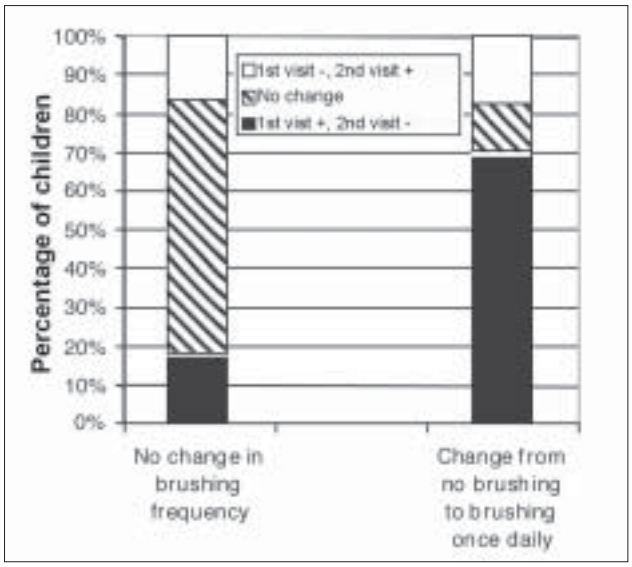

Figure 1. Changes in mutans streptococci with brushing frequency (*P*<.01).

Less infection by mutans streptococci is likely to result in lower caries risk. This hypothesis is supported by investigations which reported that young children with less plaque have less dental caries.[16-18] In addition, several authors have suggested that increased brushing frequency is associated with less caries in preschoolers.[25-27] Fluoride in toothpaste will augment the removal of cariogenic bacteria and promote remineralization of early carious lesions. Schwartz et al showed that caries rates among children in a Chinese kindergarten were significantly reduced through a tooth-brushing program using fluoridated toothpaste.[28]

As preventive health behavior is related to parental education and socioeconomic levels, the success of this study is very likely to be due to the relatively high levels of education of the parents. The community health center in which the study was undertaken was situated in a relatively high socioeconomic suburb,[29] and over 25% of the children reported having fathers who were working in the professional groups, and 44% in the skilled, technical groups. Of the 37% of mothers who were in full- or part-time employment, over 40% were also in the skilled, technical groups. Thus, in the present study, a single oral health education session had been highly effective for these parents who have relatively high levels of education, and improved tooth-brushing habits for their children most likely had resulted in the removal of mutans streptococci infection in the children. The high motivational levels of the parents is further demonstrated by the fact that over 90% of the parents who were first examined returned for a second dental evaluation 4 weeks later.

The results of the present study also showed that, besides oral hygiene, infection with mutans streptococci is related to other factors such as consumption of solid foods and a frequency of snacking greater than 3 times per day. Thus, these results are similar to those of the authors' previous longitudinal studies, which also demonstrated that initiation of mutans streptococci infection in both predentate and dentate children is significantly associated with increased frequencies of snacking and sugar consumption.[10,11]

In the present study, the authors demonstrated that education of mothers to start tooth-brushing for their children can be successfully achieved through a single health education session at a Community Child Health Clinic where they presented, for free, mass immunization. The provision of free toothpaste and toothbrushes probably helped to improve motivation of the parents, as has been shown previously in a study by Sgan-Cohen et al.[30] Other strategies to reach mothers of young children for dental health education and oral hygiene instruction include regular home visits by trained dental health professionals,[31] and the dental education of mothers by other child health professionals in other health settings.[32]

Conclusions

1. Children who have mutans streptococci are those who employ inadequate tooth-brushing techniques and those who snack greater than 3 times per day.
2. There was approximately a 25% reduction of mutans streptococci infection in young children through improved tooth-brushing.
3. As the present study is relatively short, longer-term studies are planned to determine the long-term effects of tooth-brushing on dental health with regard to changes in oral hygiene behavior and caries rates.

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