Prevention of maternal bacterial transmission on children’s
dental-caries-development: 4-year results of a pilot study
in a rural-child population

Ertuğrul Ercan a,*, Ç Türksel Dülgergil a, İsıl Yıldırım b, Mehmet Dalli c

a University of Kirikkale, Dental Faculty, Department of Operative Dentistry, Turkey
b Ankara, Turkey
c University of Dicle, Dental Faculty, Department of Operative Dentistry, Turkey

1. Introduction

From previous studies, it is a well-established data that initial
acquisition of Mutans streptococci (MS) by infants occurs
during a well-delineated age range that is being designated as
the window of infectivity.1 From the follow-up studies, it has
also been shown that the individuals with low infection levels
in this period are less likely to be infected with MS, and
subsequently, have the lowest level of risk to develop caries.2,3
This may be explained by the competition between the oral

A M B R A C T

Aim: Dental caries with its bacterial agent is an infectious disease, and shows a vertical
transmission. The control of bacterial transmission of Mutans streptococci (MS) from
mother to child has been studied, and its results on their children’s caries development,
and on their siblings’ bacterial levels, have been analysed in a field-trial (for 4 years) in rural
area.

Material and methods: In the same tribe, 8 mothers and their 11 children (test children [TC]),
and then (following years) their 9 siblings (test sibling [TSb]), were followed for 4 years. The
study started when the TC group had just started to erupt. Test mothers were subjected to
a preventive regime. Examination of caries development as well as determination of plaque
levels of MS in TC and TSb were carried out annually and at 6-month intervals. At the end of
4 years, two control groups (control children [CC] and control siblings [CSb]) resembling TC
and TSb were selected from the other tribe living in the same village, and bacterial data and
caries status were compared to both test groups.

Results: Microbial data demonstrated that the test children (p < 0.01) and test siblings
(p < 0.05) had significantly low bacterial level in plaque samples. Accordingly, TC had
significantly low dmf-t and -s number compared to corresponding control group
(p < 0.001 for dmf-t, p < 0.0001 for dmf-s).

Conclusion: The preventive regimen was applicable in rural southeastern Anatolia, where an
introverted life style with a great tribal system is prevailing, any other preventive measures
may have been practical or available, and babies are basically cared by mothers.
bacteria, resulting in the invasion of the niches where MS can easily colonize, by less pathogen species.4

Previous cross-sectional studies using bacteriocin profiles, serotyping, or genotyping suggest that in humans mothers are the principle source of MS to their infants.5–8 In other words, the children of mothers having high levels of MS are more likely to exhibit levels of MS corresponding to their mothers’ levels, and often experience a higher caries experience. In a Swedish population infants have around 70% chance of becoming infected before 3 years of age if the mother has >106 MS per ml of saliva. If the mother has a lower level of MS infection (<3 × 105) the corresponding figure is about 20%.6 Infants who become infected before the age of 2 develop significantly more dental caries than children who are infected later or not at all.7 In this respect, treatment of first time mothers with high numbers of MS by dietary and antimicrobial measures could reduce the risk of spreading cariogenic microorganisms to their infants and thus reduces the caries risk in the children.8–12 However, in the modern city-life, the possibility of the infection in the infants from other sources such as kindergartens and baby-sitters, can affect the long-term results of the studies, negatively. However, the introverted life style in the southeast Anatolia in Turkey can be an important opportunity for the early preventive measures aimed to reduce maternal transmission. In this region, due to limited financial sources and widespread settlement properties, community oriented caries-preventive-projects have been ignored for many years. Because of the nature of the tribal system, the newborns do live an introverted life style in the big village houses and courtyards until their school age. For this reason, the specific life style creates an important limited area for the long-term preventive field-trials. In this study, the effectiveness of a preventive method aiming to reduce maternal MS level on the children’s caries experiences has been investigated for 4 years.

2. Methods

The present study was carried out in Bağvar village which is 10 km from Diyarbakir City in southeastern of Turkey. The tribal systems are extensively observed in this region, especially in rural districts. According to the latest national-statistics, the mothers between 30 and 35-year-old had 7 children on average, and also their death–birth ratio was 7%. The child death ratio between 0 and 2 years of age was 12.3%.

After informed consents were obtained from the family members, 8 women whose age range was 24–35 (test mothers) from the same clan and their 11 (3 women had 2 children whose age were close to small sibling) children whose age range was 2–11 months (test children [TC]) were included in this study. Most of the children in TC were in their early primary dentition period. Due to the possibility of early colonization with MS, the children with not more than 2 erupted primary teeth were included in the study. All mothers in the test group were examined by lying or sitting on a table which was prepared according to the criteria suggested by World Health Organization (WHO) for rural districts. All mothers were examined under sunlight by the same operator (CTD). At the same session mothers were requested to bring their children. For each mother, distribution of the number of decay, missing and, if present, filled teeth and surface was recorded using the DMFT index as 4.5 ± 3.7. In this session, mothers’ saliva and children’s plaque MS levels were also determined by the modified-strip method (CRT Bacteria, Vivadent, Liechtenstein) described by Brathall et al.13 Plaque samples were not taken from the babies without teeth and the MS levels were recorded as score 0. The salivary MS levels of the mothers and plaque MS levels of their babies were expressed in four different scores [score 0: no bacterial grow, score 1: bacterial growth between 107 and 108, score 2: bacterial growth between 108 and 109, and score 3: bacterial growth more than 109] and all statistical calculations of the bacteria levels were carried out according to these scores. At baseline, percent distribution of the scores in test mothers, and test children were as follows: 0, 12.5, 62.5, 25% and 18, 73, 9, 0% for the score 0, 1, 2, 3, respectively. The bacterial measurements and caries developments of the mothers and babies were done and recorded at 6- and 12-month recalls.

After examination procedure, only mothers were subjected to a preventive and restorative procedure including different methods and applications. These were: (i) scaling and oral hygiene instruction in the same session, (ii) treatment of dental caries by Atraumatic Restorative Treatment (ART) technique using a high strength glass-ionomer cement restorative filling material (Ketac-Molar, ESPE/3M, USA), (iii) sealing of occlusal pit and fissures with a glass-ionomer cement material if necessary, (iv) daily rinsing with 0.05% NaF during first 30 days, using 0.02% chlorhexidine rinses twice daily (Klorhex, Drogsan, Ankara, Turkey) for 10 days in each 6-month intervals until the children are 3 years old.

At 6-month follow-up recalls, along with the mothers’ measurements, ART fillings were controlled and the use of chlorhexidine mouth rinse (Drogsan, Ankara, Turkey) was recommended to be used for 10 days. The mouth rinses were supplied and distributed to the mothers at 6-month intervals. During the study period, nine (four girls and five boys) additional newborn babies of the test mothers were also included in the study. These babies were classified as test siblings [TSb] and their plaque MS levels were constantly measured at 6-month intervals.

At the end of 4 years, control groups from a different tribe living in the same village, with a similar socio-cultural level and with a similar age-range, were randomly selected. The control groups consisted of 9 mothers with an age distribution of 27–40 years: 10 (5 girls and 5 boys) children with an age distribution of 4–5.5 years of these mothers (control children [CC]) and their 9 (3 girls and 6 boys) siblings (control siblings [CSb]).

TC and CC groups were compared with respect to dmft and dmf-t, plaque MS scores whereas the siblings groups were compared with respect to the plaque MS scores. Statistical analysis was performed using the Graph Pad Prisma V3 programme. The data were analysed with Mann–Whitney U-test for the comparison of the two groups and Chi-square test for the comparison of the qualitative data. The results were considered as significant at p < 0.05 level.
Children, CC = control children].

A statistically significant difference was found with regard to plaque MS scores between TC and CC (p < 0.001) (Fig. 1). A statistically significant difference was found on comparison of both groups with respect to plaque MS scores (p < 0.0001) (Table 2).

### Table 1 – Number and percent distribution of Mutans streptococci scores in both test children and control children

<table>
<thead>
<tr>
<th>Score</th>
<th>Test children</th>
<th>Control children</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7 (63.6%)</td>
<td>1 (10%)</td>
</tr>
<tr>
<td>1</td>
<td>3 (27.3%)</td>
<td>3 (30%)</td>
</tr>
<tr>
<td>2</td>
<td>1 (9.1%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5 (50%)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>0 (0%)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1 (10%)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> x<sup>2</sup>: 78.05.  
<sup>b</sup> p < 0.0001.

### Table 2 – Number and percent distribution of Mutans streptococci scores in both test siblings (TSb) and control siblings (CSb)

<table>
<thead>
<tr>
<th>Score</th>
<th>Test siblings</th>
<th>Control siblings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7 (77.8%)</td>
<td>3 (33.3%)</td>
</tr>
<tr>
<td>1</td>
<td>2 (22.2%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 (33.3%)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>0 (0%)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3 (33.3%)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> x<sup>2</sup>: 53.44.  
<sup>b</sup> p < 0.0001.

### 4. Discussion

This study shows that preventive measures aiming to reduce vertical MS transmission were associated with a significant long-term reduction of dental caries in the children when assessed at 4 and 5 years of age, and were concerned with a significant and remarkable decrease of MS-infection level in the subsequent infants. In recent years, besides the reduction of caries prevalence in the developed countries, dental caries infection as an important community health problem in the under-developed or developing countries remains constant. Not only a high cariogenic diet, poor oral hygiene, socio-cultural condition, education level, and direct or indirect pressures due to living standards, but also incomplete preventive and operative services, inadequacy of effective-widespread and economic preventive measures do facilitate the spreading of dental caries infection. In fact, the unbalanced distribution of provision of service between the different regions leads to the uncontrolled spread of caries disease from time to time both in the underdeveloped and developing countries. Therefore, the long-term effectiveness of pragmatic and economic preventive measures is valuable in preventing the spread of dental caries infection through the community. Thus, preventive measures starting from birth have been thought of as economic and long-lasting alternatives to reduce dental caries. However, the main problem is to find special-socio-cultural and behavioural living samples that can prevent the children from direct effect of other sources, providing new-focuses to children acquiring caries bacteria, Mutans streptococci. This probability was frequently explained by other studies using the same preventive-approach. For example, in the studies performed in North Europe and America, long-term and effective prevention of bacterial transmission in the countries close to the cities or in small towns had been specifically selected and successful results were obtained for future caries experience of the children and siblings. Contrary to this, in the studies performed in hospitalized-centres, the reduction of bacterial transmission from mother to child have usually failed due to the presence of other infection sources.

In a study by Köhler and Andreen, a specific preventive programme was applied to mothers whose MS levels exceed 105 cfu/ml in saliva. The preventive programme including oral hygiene motivation, diet advices and antibacterial application (chlorhexidine) was discontinued when the children attained 3 years of age. At the end of 7 years, more MS colonization levels were found in the test children when compared to their control counterparts (95 and 46% for control and study groups, respectively). The authors emphasized that this significant difference was also influenced by the caries experience of the children after 7 years. Thus, the defs-tot (the total number of decay-filling surfaces for primary teeth) value was reported to be 5.2 in the test and 8.6 in the control group. Although these are higher dmf-s values than that of our study groups, this result is highly consistent with our findings in which the dmf-s values were 1.78 and 0.25 for CC and TC child groups, respectively.
Gunay et al. who have used the primary preventive measure to reduce bacterial transmission in 86 pregnant women from various social backgrounds, found after 4 years that, in the study group, 21.3% of the children with more than score 2 MS level revealed 1.5 dfm-t whereas 60% of the children in control group with high MS levels revealed 7.0 dfm-t ($p < 0.001$). Although this study was performed in the city-life, similar caries ratios resembling those in both test and control groups are in accordance with our study.

Tenvuo et al. applied 0.2% NaF and 1% chlorhexidine gel treatments twice a year for 3 years to 151 mothers whose salivary MS levels were more than 105. At the end of their study the authors concluded that the reduction of maternal salivary MS at the time of tooth emergence may delay, or perhaps even prevent, the colonization of MS in the children’s primary teeth with a concomitant decline in caries incidence, even in a population with an already low prevalence of dental caries. Although our result are in parallel with their conclusion, low caries-rate seen in the test-1 child group highly confirmed the fact that even in low caries prevalence, low sucrose-diet, low chance of bacterial transmission from mother and prevention of older siblings could have led to significantly low MS-colonization, yielding low caries incidence.

Despite the fact that, in the mothers with high colonization level, routine preventive programme would not be effective to reduce salivary bacterial number; the chance of bacterial transmission to their children could reduce. In previous studies this reduced-transmission potential has been explained by the easy shedding of xylitol-resistant MS into studies this reduced-transmission potential has been confirmed. Moreover, the low MS districts of southeastern Anatolia, people usually consume sucrose-diet, low chance of bacterial transmission from mother–child–sibling triad, our study, despite few references, established the fact that even in low caries prevalence, low sucrose-diet, low chance of bacterial transmission from mother and prevention of older siblings could have led to significantly low MS-colonization, yielding low caries incidence.

Our results from both test and control sibling groups have confirmed the recent findings by Wan et al. that contrary to belief so far, early MS detection could be obtained in predentulous infants. Moreover, our 4-year results of siblings groups have also confirmed the fact that colonization by MS in siblings was associated with high levels of MS in the mothers and the older children. Although, the study by Köhler and Andreen is a unique model including bacterial transmission from mother–child–sibling triad, our study, despite few numbers of the triads, is the first example of such a bacterial transmission-study performed in an introverted-community (into the same clan). However, due to to few technical equipments, unexplored mutants strains similarity, including both genotyping and fenotyping, among the mothers–children, mothers-siblings and children–siblings who are the members of the same clan, is the main lack of this study.

Actually, when compared with the studies performed in some industrialized countries it could be possible to reduce bacterial transmission via more primitive procedures in rural communities consuming low sucrose diet. This assumption is highly parallel with our field-trial that in many rural-districts of southeastern Anatolia, people usually consume less sucrose than those in city-centres. Moreover, the low MS levels in TC and Tsb, in the present study, may be attributed not only to preventive regimen but also to the introverted life style in village environment. The people in most districts of southeast Turkey as in Diyarbakir and its bounded villages live an introverted life style. This living style probably does eliminate other sources that a child can be infected in city-life and therefore it is an advantage for children and their siblings living in those areas. It does also create an ideal environment until the completion of primary dentition, which prevents the caries-infection in the child with primitive preventive measures directed to mothers.

In conclusion, a minimum preventive regimen, which was directed only to mothers during first 2–3 years of their new-born children, resulted in significantly reduced salivary MS levels in the mothers and a delay in the colonization of the organism in not only those children but also their subsequent siblings. Accordingly, it can be asserted from this evidence that early preventive interventions in mothers may cause a more pronounced decline in the future caries experience of infants in rural districts than in their city-dwelling counterparts.

**References**


