

SHORT COMMUNICATION

Xylitol-resistant mutans streptococci strains and the frequency of xylitol consumption in young children

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Introduction

In clinical studies, the beneficial effects of xylitol have been demonstrated in association with its daily, habitual use [1]. Furthermore, regular maternal xylitol consumption has been shown to decrease transmission of mutans streptococci (ms) to the child [2]. Regular xylitol consumption has been connected with selection of ms which have lost their sensitivity to the inhibitory action of xylitol [3]. In rat experiments, these so-called “xylitol-resistant” (Xr) ms strains have been shown to be less cariogenic than the “xylitol-sensitive” (Xs) ms strains [4]. In fact, several *in vitro* studies suggest that the Xr strains may be less virulent than the Xs strains of ms [5], while other *in vitro* studies have shown no difference in the virulence properties of these strains [6,7]. Very little is known about the frequency, quantity, and duration of xylitol consumption needed to select the Xr strains of ms in the oral cavity. Dental plaque is the major biofilm in the oral cavity. The present study aimed to investigate associations between prevalence of Xr strains in dental plaque and the frequency of xylitol use in young children.

Material and methods

The study group comprised 64 children (27 girls and 37 boys) ranging in age from 19 to 46 months (mean 26.2; SD 5.6 months) at the time plaque was collected. They were participants of caries prevention programs, i.e. 39 from the city of Turku and 25 from the communities of Maaninka and Siilinjärvi near Kuopio, Finland. The children had previously been

screened for ms and their dentition found ms colonized. The screening sample had been taken by dental floss (Oral-B Flossette®; Oral-B Laboratories, Belmont, Calif., USA) from the dental plaque in the proximal spaces of the teeth and cultivated by the SM Dentocult Strip Mutans® test (Orion Diagnostica, Espoo, Finland).

The dental plaque samples for the present study were collected from available surfaces with visible plaque. Sterilized wooden dental sticks or dental curettes were used for this. The parents had been advised not to brush their child's teeth prior to collection of the sample. The specimen was scraped directly into a transport vial containing trypticase soy broth with 10% glycerol (v/v). The vials were stored at –70°C, placed on dry ice, and transported by air to Québec City, Canada, where they were kept in liquid nitrogen until analysis. Subsequently, the samples were thawed, diluted, dispersed, and then plated on TSY20B agar with a Spiral Plater (Spiral Systems Inc., Cincinnati, Oh., USA). The ms were cultivated for 72 h at 37°C in an anaerobic chamber. The total number of ms colonies was counted and the proportion of Xr strains was determined by autoradiography with ¹⁴C-xylitol. Cultivation methods and determination of the Xr and Xs strains have already been described in detail [8,9]. The proportions of the Xr strains were given as percentages of all counted ms colonies.

The parents were interviewed concerning the health, possible medications, and oral hygiene habits of the child, and also concerning the xylitol use of the child and other family members. Questions concerning xylitol: “Is xylitol being used in the family? How

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Table I. Relation between reported xylitol use and the proportion of xylitol-resistant (Xr) strains of all mutans streptococci

Reported xylitol use	Proportion of xylitol-resistant Xr mutans streptococci strains				Ms growth	No ms growth	Total
	0% Xr	1–25% Xr	26–75% Xr	76–100% Xr			
Several times	2	–	1	5	8	7	
Once a day	5	3	–	5	13	4	
Weekly	7	–	2	3	12	6	
Seldom	6	1	1	2	10	4	
	20	4	4	15			
Total					43	21	64

Spearman correlation coefficient 0.297 ($p=0.053$).

often is xylitol used in the family? How often has this child used xylitol products during the past 3 months: 3–5 times daily, daily, 1–3 times weekly, seldom/never?” Xylitol use of other family members was reported as “use” or “no use”. The statistical analysis was carried out using the original, not categorized, Xr percentages, applying the Spearman correlation coefficient and one-way analysis of variance (SPSS program) and the Pearson chi square test.

Results

The association between prevalence of Xr strains and use of xylitol, measured by the Spearman correlation coefficient, was 0.297 (Table I). Very high (76–100%) proportions of Xr strains were counted in 10 (48%) samples from the 21 subjects who used xylitol at least once a day. In contrast, the corresponding number of samples was 5 (23%) from the 22 subjects who used xylitol only weekly or less (Table I). Neither age nor gender-related differences were found in xylitol consumption or the Xr/Xs ratio.

Within the four xylitol consumption classes, the mean percentage of Xr strains of all ms strains was highest (61%) among the children who used xylitol several times a day, and lowest (22%) among those who seldom or never used it (Table II). The Xr percentages among the once-a-day and weekly users were in between those figures. The differences were not statistically significant. In the present study, 32 families, i.e. 78% of the families involved, had reported use of xylitol by other family members. The mean Xr percentage of their participating children was 44% (SD 44), whereas in the 11 families who reported no use of xylitol the mean Xr percentage

was 20% (SD 38). The reported use of xylitol in the family correlated strongly with the use of xylitol by the child (Pearson chi-square 34.3; d.f. 3, $p<0.01$).

Discussion

The present results concerning young children and the early ms colonization of teeth show a tendency towards high Xr percentages in connection with frequent consumption of xylitol. Earlier *in vivo* studies on the occurrence of Xr ms have connected high Xr percentages with frequent consumption of xylitol [3,9,10]. In adolescents, the Xr strains, once established, seem to remain stable even if xylitol consumption becomes infrequent [9].

In young children, the oral cavity is exposed to a variety of microorganisms from the child's close environment. The type of ms strains may therefore depend on the type of ms at the source of transmission and on the xylitol consumption of the child itself. Whether the level of the Xr strains in early childhood is related to future caries development will be seen in the follow-up examination of the ms colonized children.

In this study, 64 dental plaque samples were analysed for Xr/Xs. However, no ms growth was observed in 21 (33%) presumably positive samples. This may have been due to differences in the cultivating methods of the screening test versus the resistance analysis, or the sample sites may have influenced the no growth figures.

A second possible reason could be the known fact that frequent use of xylitol decreases the amount of dental plaque [1]. In general, the thickness of oral biofilm was fairly small on the surfaces of the deciduous teeth of the present children. And third, the colonization pattern, the circumstances in the oral cavity, as well as the number (density) of bacteria may have individual variation or fluctuation. Interestingly enough, among those who used xylitol several times a day, the proportion of no growth was higher, although not significantly higher, than that among xylitol less consuming, other groups (Table II). Xylitol use, and its effects on the ecology of ms bacteria in the oral biofilm, is still an issue for future investigation.

Table II. Mean percentages of xylitol-resistant Xr mutans streptococci strains of all mutans streptococci in relation to xylitol use

Reported xylitol use	Mean % Xr	SD	<i>n</i>
Several times a day	60.5	43.9	8
Once a day	37.5	44.0	13
Weekly	34.8	45.5	12
Seldom	22.0	39.0	10
Total	37.4	43.6	43

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