

# Effects of polyol and sucrose candies on plaque, gingivitis and lactobacillus index scores

Observations on Helsinki school children

ULPU HARJOLA & HEIDI LIESMAA

Oral Health Unit, Helsinki City Health Department, Helsinki, Finland

Harjola, U. & Liesmaa, H. Effects of polyol and sucrose candies on plaque, gingivitis and lactobacillus index scores. Observations on Helsinki schoolchildren. *Acta Odontol. Scand.* 36, 237–242

The purpose of this study was to determine whether partial substitution of xylitol and sorbitol for sucrose could produce changes in plaque formation, gingivitis and oral bacteriology in children. The subjects consisted of 55 volunteer schoolchildren aged 14 to 16, divided into the following groups: 1) Polyol Group (26 children), 2) No-Sweets Group (8), 3) Sucrose Group (21).

During the two weeks of the study, the Polyol Group consumed chewing gum and pastilles containing xylitol and sorbitol, mainly after meals. The No-Sweets Group was instructed to consume no sweets during the study. The Sucrose Group chewed gum and ate sweets same as before the study. The variables measured were the visible plaque index (VPI), gingival bleeding index (GBI) and lactobacillus index (Dentocult®). The scores for these indices were determined at the beginning and end of the study. The results for the Polyol and No-Sweets groups were similar; both the xylitol-sorbitol mixture and abstention from sweets reduced the VPI and GBI scores substantially. In the Sucrose Group, the VPI and GBI scores remained practically unchanged. Changes in the Dentocult index were difficult to assess due to high variability, though significant differences were observed between treatment groups, polyol utilization and total abstention from sweets leading to similarly decreased scores. The results may be due to differences between the microbiological and biochemical effects of sucrose and the polyol mixture, which resulted in reductions in plaque, gingival bleeding and lactobacilli.

**Key-words:** Saliva; xylitol; sorbitol; sucrose; dental plaque; lactobacillus

*Ulpu Harjola, Helsinki City Health Department, Oral Health Unit, Toimen Linja 4 C, SF-00530 Helsinki 53, Finland*

In the Turku Sugar Studies, the substitution of xylitol for sucrose was found to decrease visible-plaque index scores (5) and salivary lactobacillus counts (4). Most of the subjects in these studies were students of dentistry and others who followed instructions precisely (6) and whose periodontal health was good at the start (7).

The purpose of the study described below was to determine whether the partial substi-

tution of a xylitol and sorbitol mixture for sucrose would result in oral changes demonstrable by objective measurements in a group of schoolchildren. The variables included the visible plaque index (VPI) for plaque, the gingival bleeding index (GBI) for gingivitis, and Dentocult® scores for salivary lactobacillus counts. A secondary purpose of the study was to observe whether these indexes might be used in dental health education.

## MATERIAL AND METHODS

The people tested numbered 55, students aged 14–16 years (mean = 15) from a Helsinki secondary school. Consent was obtained from parents after they had been informed about the nature of the study. Prior to starting, interviews were carried out to determine the sweets consumption by subjects.

VPI and GBI (1, 2) were determined for the following teeth in each subject, Nos. 16, 21, 24, 34, 41 and 44, the facial, mesial and lingual surfaces of these teeth being examined. The findings were displayed as percentages with positive-findings of all the surfaces examined, and additionally in terms of frequencies of ordinal scores.

The Dentocult® index scores were measured from saliva sample cultures (3). These determinations, made at the beginning of the study, are shown below in Table 1 (VPI 1, GBI and Dentocult 1).

The subjects were then assigned to one of the three groups. The grouping was made at random, except that the No-Sweets Group was in part formed from those who normally did not eat sweets or chew gum according to the interviews on sweets consumption.

- 1) Polyol Group (26 persons): during the two weeks of the tests, candies containing sucrose were replaced by products containing xylitol and sorbitol as specified below.
- 2) No-Sweets Group (8 persons): abstained from candy-eating.
- 3) Sucrose Group (21 persons): continued to chew gum and eat sweets flavoured with sucrose *ad lib*.

In the Polyol Group, each child was given a daily ration of two packets of chewing gum<sup>1</sup> and one package of pastilles<sup>2</sup>. According to the manufacturer, both products contain a xylitol-sorbitol mixture as sweetener. Thus the daily xylitol dosage was 12.2 grammes and the daily sorbitol dosage was 8.2 grammes.

The children were told to take the sweets mainly after meals, but no check could be made to see that they did so.

After two weeks on these regimes, the subjects were reexamined for VPI, GBI and Dentocult. The results are termed below VPI 2, GBI 2, and Dentocult 2 in Table 1.

## RESULTS

*Candy-eating habits*

Reliable information was difficult to obtain at the interview. One finding was that only five of the 55 subjects stated that they ate candies once a week at the most. Thus the small numbers in the No-Sweets Group were due to the difficulty of finding subjects willing to forego chewing gum and sweets for two weeks.

*Situation before treatment*

The  $\chi^2$ -test revealed no significant differences regarding VPI 1, GBI 1 and Dentocult 1 between the treatment groups. There was a clear but low positive correlation at the 5% level between VPI 1 and GBI 1 (Kendall's  $\tau = 0.32$ ). Dentocult 1 correlated neither with VPI 1, nor GBI 1.

*Influence of treatment on Visible Plaque Index (VPI)*

The mean scores and standard deviations for VPI appear in Table 1 and Fig. 1. Findings for the beginning and end of the study are shown.

The findings for the Polyol and No-Sweets Groups were similar; both the eating of the polyol mixture and abstention from sweets led to a drop in VPI of a similar

<sup>1</sup> Xylitol "Jenkki" spearmint, Hellas, Turku

<sup>2</sup> Xylitol fruit pastilles, Hellas, Turku

magnitude. Owing to the wide variability within other groups, only the decrease in the Polyol Group was found significant when applying the t-test (Table 1). The VPI of the Sucrose Group remained essentially unchanged throughout the study.

#### *Influence of treatment on Gingival Bleeding Index (GBI)*

The mean scores and standard deviations for the GBI at the start and end of the study are shown in Table 2 and Fig. 1.

The GBI changes were similar to the VPI changes. The decrease of GBI scores in the Polyol Group was highly significant ( $p < 0.001$ ) and almost significant ( $p = 0.07$ ) in the No-Sweets Group. In the Sucrose Group the scores changed little. In the Polyol Group the GBI scores decreased in 23, increased in 1, and remained unchanged in 2 subjects. In the No-Sweets Group GBI scores decreased in all 8 cases. In the Sucrose Group the scores increased in 8 cases, remained unchanged in 2 and decreased in 11.

#### *Influence of treatment on Dentocult scores*

The results from the Dentocult culture are shown as both arithmetic and geometrical means (Table 3, Fig. 2). The arithmetic mean of the Dentocult scores decreased in the Polyol and No-Sweet Groups and remained almost unchanged in the Sucrose Group. Utilizing geometrical means to reduce the effect of extreme values, also provided an adjustment for initial mean counts, which were high in the Polyol Group. Analyses utilizing geometric mean values show that the greater initial values observed in the Polyol Group, decreased substantially more than those of the Sucrose and No-Sweets Groups. The mean slopes of the latter two groups are near zero, while the mean slope of the polyol group is markedly different (Fig. 2).

Table 1. Mean values and standard deviations of the Visible Plaque Index before (VPI 1) and after treatment (VPI 2)

Group	VPI 1		VPI 2		P*
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	
Polyol	13.54	17.58	3.65	9.81	0.021
No-Sweets	16.10	13.53	7.00	9.81	0.14
Sucrose	10.65	15.68	13.17	17.38	>0.2

\* Student's t-test

Table 2. Mean values and standard deviations of the Gingival Bleeding Index before (GBI 1) and after treatment (GBI 2)

Group	GBI 1		GBI 2		P*
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	
Polyol	45.20	18.77	16.37	11.74	<0.001
No Sweets	55.90	30.36	19.60	14.97	= 0.07
Sucrose	52.23	22.36	46.65	16.45	>0.2

\* Student's t-test

Table 3. Arithmetic and geometrical means of the Dentocult index before and after treatment

Group	Dentocult 1		Dentocult 2	
	Arithm.	Geom.	Arithm.	Geom.
Polyol	$31 \times 10^4$	$34 \times 10^3$	$2 \times 10^4$	$4 \times 10^3$
No-Sweets	$15 \times 10^4$	$6 \times 10^3$	$1.6 \times 10^4$	$1 \times 10^3$
Sucrose	$21 \times 10^4$	$9 \times 10^3$	$22 \times 10^4$	$6 \times 10^3$

Table 4. Rank correlations (Kendall's  $\tau$ ) before and after treatment

Group	VPI		GBI		DC	
	$\tau$	P	$\tau$	P	$\tau$	P
Polyol	0.32	<0.10	0.20	n.s.	0.73	<0.001
Sucrose	0.45	<0.05	0.41	0.05	0.77	<0.001
No-Sweets	0.67	<0.10	0.54	0.10	0.92	<0.01

n.s. = not significant

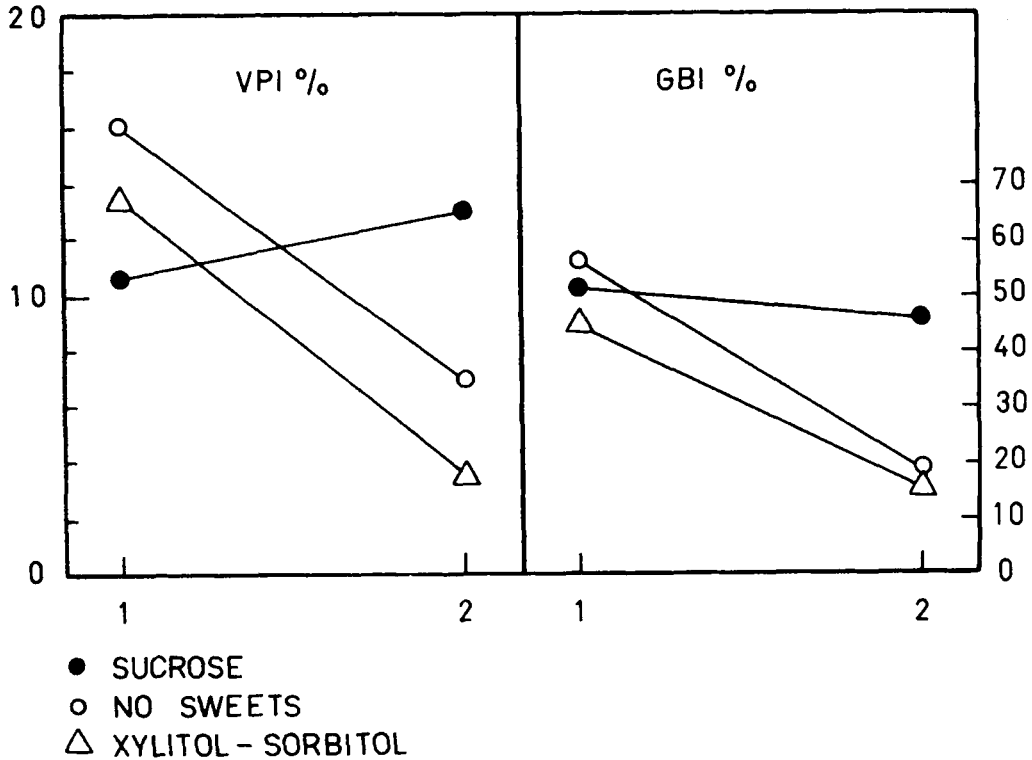


Fig. 1. Development of the mean scores of the Visible Plaque Index and the Gingival Bleeding Index before and after treatment.

The results from this series were also analyzed in terms of the logarithmic values of the Dentocult scores. The logarithms to base 10 were thus used, the zero values being for convenience replaced by  $\log 1 = 0$ . Significant differences between the experimental groups prior to the treatment phase were not observed for the frequencies of logarithmic Dentocult scores.

During the treatment the logarithmic Dentocult counts in the Polyol Group dropped in 17 cases, increased in 1, and remained unchanged in 8. In the No-Sweets Group the scores decreased in 5 cases and remained unchanged in 3. In the Sucrose Group they fell in 5 cases, were unchanged in 11, and increased in 6. The effect of treatment differed significantly between the Polyol and Sucrose Groups ( $\chi^2 = 9.26$ ,  $\alpha < 0.01$ , 2 D.F.), however, no difference was found between the Polyol and No-Sweets Groups.

#### *Rank correlations between scores before and after treatment*

In addition to the above analyses, the comparison of ordinal scores before and after treatment yielded the rank correlations displayed in Table 4. The rank correlations between VPI, GBI and Dentocult scores after treatment corresponded to the situation before treatment. There was thus a positive correlation at the 5% level between VPI 2 and GBI 2.

The results as a whole demonstrated that all the indexes had changed in the same direction: the VPI, GBI and Dentocult scores fell during the two weeks in the Polyol and No-Sweets Groups, but not in the Sucrose Group.

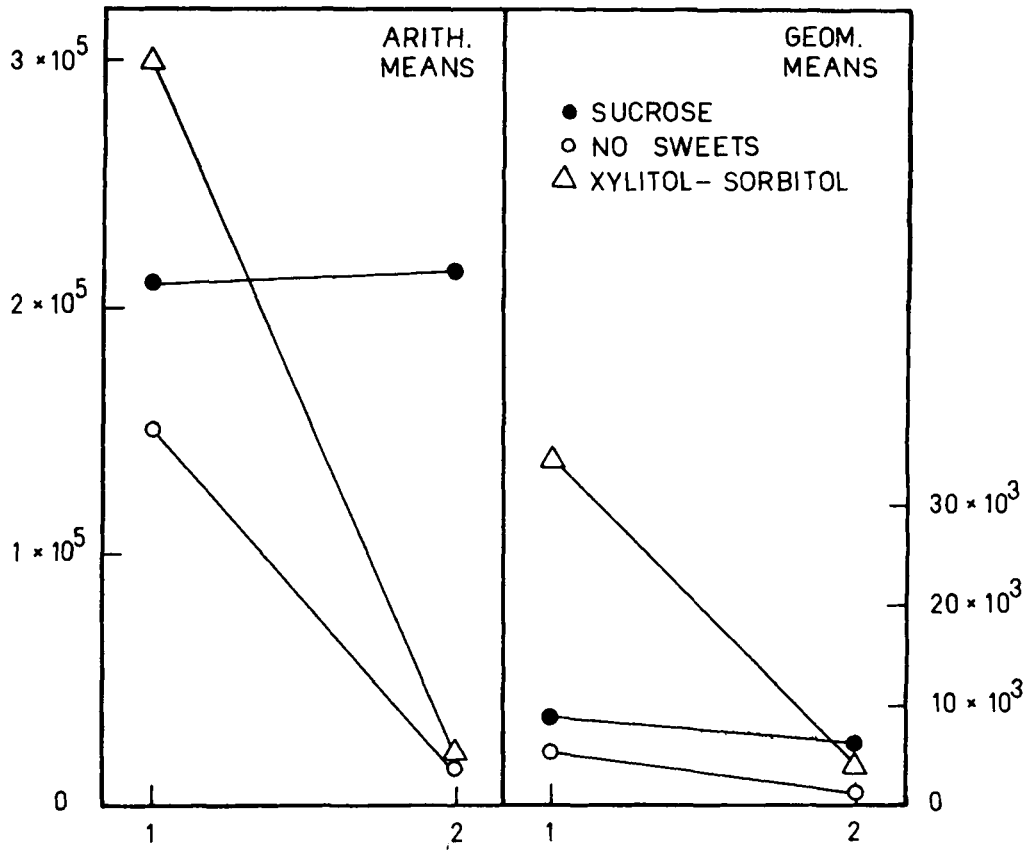


Fig. 2. Arithmetic and geometrical means of the Dentocult scores before and after treatment.

#### DISCUSSION

Clearly it is impossible to carry out a study of this type on a double blind basis. This fact plus the small numbers in the No-Sweets Group are admittedly a weakness. However, it was considered more important to have groups with cooperative subjects. On the positive side, examinations were performed by the same examiner who was unaware of the individual scores of the first examination.

The results can be examined bearing in mind the properties of xylitol, sorbitol and sucrose. For many reasons sucrose provides a substrate favorable to micro-organisms conducive to plaque, whereas the same micro-organisms consume xylitol and sorbi-

tol in small quantities or not at all. These differences are obvious in both the VPI and the GBI scores, and they could also be observed in the Dentocult counts. Apart from their effects on bacterial metabolism, there is a possibility that both xylitol and sorbitol promote oral defence reactions by increasing the buffering effect and secretion of saliva.

One explanation for the results is provided by the differences between the microbiological and biochemical effects of sucrose and xylitol-sorbitol mixture (polyol). They also indicate that polyol utilization and total abstention from sweets lead to practically the same results in VPI, GBI and Dentocult scores.

Secondarily, the findings support the view that these indexes may be employed to monitor the effects of dental health education.

#### REFERENCES

1. Ainamo, J. & Bay, I. Näkyvän plakin ja ienverenvuodon käyttö suuhygienian mittavälineinä. *Proc. Finn. Dent. Soc.* 1975, 71, 228–233
2. Ainamo, J. & Bay, I. Problems and proposals for recording gingivitis and plaque. *Int. Dent. J.* 1975, 25, 229–235
3. Larmas, M. A new dip-slide method for the counting of salivary lactobacilli. *Proc. Finn. Dent. Soc.* 1975, 71, 31–35
4. Larmas, M., Mäkinen, K.K. & Scheinin, A. Turku sugar studies. VIII. Principal microbiological findings. *Acta Odontol. Scand.* 1975, Suppl. 70, 33, 173–216
5. Mäkinen, K.K. & Scheinin, A. Turku sugar studies. VI. The administration of the trial and the control of the dietary regimen. *Acta Odontol. Scand.* 1975, Suppl. 70, 33, 105–127
6. Mäkinen, K.K. & Scheinin, A. Turku sugar studies. VII. Principal biochemical findings on whole saliva and plaque. *Acta Odontol. Scand.* 1975, Suppl. 70, 33, 129–171
7. Paunio, K., Mäkinen, K.K., Scheinin, A. & Ylitalo, K. Turku sugar studies. IX. Principal periodontal findings. *Acta Odontol. Scand.* 1975, Suppl. 70, 33, 217–222