

XYLITOL CHEWING GUMS AND DENTAL CARIES PREVENTION: A SYSTEMATIC REVIEW

INTRODUCTION

- Dental caries are a major public health problem. Various attempts have been made to deal with the problem. One of them is reducing sugar consumption, but it is not so effective.
- Tobacco-use control programmes have given the idea of substitution therapy, which is replacing a harmful habit with a positive, more culturally acceptable practice. Similarly, sugar substitution can also be effective¹, and xylitol has attracted much attention as an alternative sweetener. The effect of xylitol on caries development is due to its non-cariogenicity & substitution of sucrose with xylitol.
- However, a systematic quantitative evaluation has not yet been performed on xylitol chewing gum, in particular on dental caries. Therefore, this paper systematically evaluates the current literature to add "evidence-based" knowledge about the effects of xylitol chewing gum on dental caries.

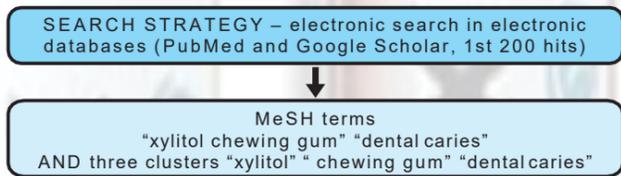
AIM AND OBJECTIVES

- To find out the effectiveness of xylitol chewing gum in the prevention of dental caries.

Objectives :

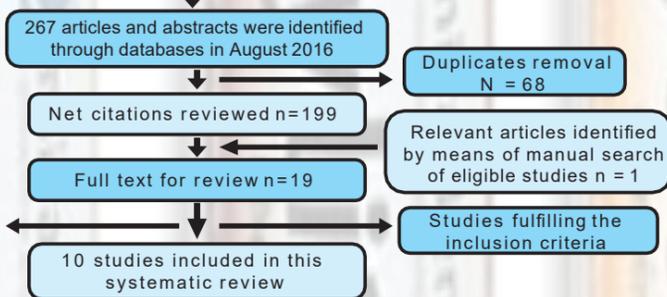
- To access the impact of xylitol chewing gum on dental caries reduction compared with no chewing gum.
- To evaluate the magnitude of dental caries prevention of xylitol chewing gum between experimental and control groups.

MATERIALS AND METHODS



Inclusion :

- Studies evaluate the effect of xylitol chewing gum on caries.
- Published in English.
- Provide original data by means of comparative design.
- Was an RCT, CCT, or observational study.
- Had an adequate definition and measurement of caries.



DATA EXTRACTION & ANALYSIS

- Two authors independently assessed the studies for inclusion criteria and quality.
- One author extracted the data, and both authors reviewed the relevant studies; discrepancies were resolved by consensus.

RESULTS

- 10 studies from 8 countries, 2 from Finland, 2 Canada, one from USA, Japan, China, Italy, Lithuania and Estonia were included. No. of participants in studies were 6,685 and age ranges from 6 to 28 years. Duration of studies ranges from 6 months to 3 years. Quality assessment values, including internal, external and statistical validities, are presented.

- Blinding of examiner is mentioned in 2 studies & blinding in statistical calculation were unclear or not specified in studies. Loss to follow up is high in studies ranges from 14.66% to 52.26%. On the basis of summary of the criteria, the estimated risk of bias was low for 4 studies and moderate for 3 studies & high for 3 studies. PF is measured by formula :-

$$PF = \frac{(\bar{X}_C - \bar{X}_E) / \bar{X}_C}{\bar{X}_E}$$

Where,
 \bar{X}_C is the mean increment in the control group
 \bar{X}_E is the mean increment in the group with the polyol-containing chewing gum

Table 1: overview of included studies

S. no.	Author (year)	Study design and duration	No of subjects, age in years, gender	Groups	Regimen use
I	Isokangas and Colleagues ^{2,3} (1988 & 1993)	CCT 24 months	N = 324 Age = 11-12 year	Chewing gum Non chewing gum	3.5 gram chewing gum 3 times/day
II	Alanen and Colleagues (2000) ⁴	RCT 36 months	N pre = 724 N post = 567 Age = 11-12 year	Chewing gum Non chewing gum	65% xylitol, 2 pieces, 3 times /day
III	Kandelman and Gagnon (1987) ⁵	CCT 12 months	N pre = 574 N post = 433 Age = 11-12 year	Chewing gum Non chewing gum	65% xylitol (1.5 gm), 3 times /day
IV	Peng and Colleagues (2004) ⁶	CCT 24 months	N pre = 1342 N post = 1143 Age = 6-7 years	Chewing gum Non chewing gum	4 times/day 4.3 % xylitol
V	Machiulskiene and Colleagues (2001) ⁷	RCT 36 months	N pre = 602 N post = 432 Mean Age = 11 years	Chewing gum Non chewing gum	5 pieces /day (89 gm)
VI	Kandelman and Gagnon (1990) ⁸	CCT 24 months	N pre = 574 N post = 274 Age = 8-9 years	Chewing gum Non chewing gum	65% xylitol, 1.19 gram per stick
VII	Makinen and Colleagues (1995) ⁹	CCT 40 months	N pre = 1277 N post = 861 Mean Age = 10.2 years	Chewing gum Non chewing gum	65 % xylitol, 3 times /day
VIII	Koveri and colleagues ¹⁰	Cohort Follow-up for 6 years	N pre = 921 N post = 786 Age = 3-6 years	Chewing gum Non chewing gum	65% xylitol (2.5 gm /day)
IX	Campus and colleagues ¹¹	RCT 24 months	N = 204 Age = 7-9 years	Chewing gum Non chewing gum	36.6% xylitol
X	Harsaku Sand colleagues ¹²	RCT 6 months	N = 127 Age = 28 years	Chewing gum Non chewing gum	Xylitol 78.1%

Table 2 Index score and prevented fraction for intervention and control group

Study no.	Index	Intervention group Control Group	Difference in Index Between Groups	Significance	Prevented fraction (%)
I	DMFS	Gum (xylitol) No gum	+0.2 +0.3	P<.001	43
II	DMFS	Gum (xylitol) No gum	▲ 1.87 ± 2.55 ▲ 4.42 ± 4.36	-	58
III	DMFS	Gum (xylitol) No gum	▲ 1.34 (1.08-1.60) ▲ 3.28 (3.05-3.51)	P<.001	66
IV	DMFS	Gum (xylitol) No gum	▲ 0.15 ± 0.42 ▲ 0.26 ± 0.75	P=.003	-
V	DMFS	Gum (xylitol) No gum Gum (xylitol) No gum	5.5 (4.4-6.5) 6.7 (5.52-7.9) 8.1 (6.8-9.3) 12.4 (10.7-14.2)	-	35
VI	DMFS	Gum (xylitol) No gum	▲ 2.09 ▲ 6.06	P<.001	-
VII	DMFS	Gum (xylitol) No gum	▲ 0.9 ± 0.5 ▲ 4.9 ± 0.5	P=.001	52
VIII	DMFS	Gum (xylitol) No gum	▲ 0.3 ± 0.7 ▲ 0.4 ± 0.9	P=.03	-
IX	DMFS	Gum (xylitol) No gum	▲ 0.18 ▲ 0.67	P<.001	40
X	DMFT	Gum (xylitol) No gum	12.3 ± 4.9 10.3 ± 6.3	-	-

Table 3 Methodology, validity quality of included studies

Quality criteria	I	II	III	IV	V	VI	VII	VIII	IX	X
Internal validity	-	+	-	+	+	-	-	-	+	+
a) Random allocation	?	+	-	?	?	?	?	?	?	-
b) Allocation concealment	?	+	?	-	?	?	+	?	?	-
c) Blinding of examiner	?	?	-	?	?	?	?	?	?	?
d) Blinding during statistical analysis	?	?	-	?	?	?	?	?	?	?
e) Balanced experimental groups	+	+	+	+	+	+	+	+	+	+
f) Reported loss to follow up	-	+	+	+	+	+	+	+	+	-
g) % of follow up	?	23.38†	24.56†	14.82†	28.23†	52.26†	32.58†	14.66†	?	?
h) Treatment identical, except for intervention	+	-	?	+	+	+	+	-	+	+
External validity	+	+	+	+	+	+	+	-	+	-
a) Representative population group	?	+	-	-	-	+	-	+	+	+
b) Eligibility criteria defined	?	+	-	-	-	+	-	+	+	+
Statistical validity	?	+	?	?	?	?	?	?	+	-
a) Sample size calculation and power	?	+	?	?	?	?	?	?	+	-
a) Measure of variability presented for the primary outcome	+	+	+	+	+	+	+	+	+	-
a) Included an intention to treat analysis	?	?	-	?	?	?	?	?	?	-
Authors estimated risk of bias	Low	High	Mod	High	High	Low	Low	Low	Mod	Mod

+, yes; -, No; ?, Not specified/unclear † calculated by author

DISCUSSION

- Xylitol chewing gums are an additional preventive strategy along with traditional aids like fluoride toothpaste and mouth rinse. It is indicative that using xylitol gum between or after-meal has a caries-preventive affect in comparison to controls without gum use.
- In this review it was found that approximately 33 % studies are of high quality; most studies were consistent with respect to the direction of treatment i.e. favoured the use of xylitol over no chewing gum but showed less consistency with magnitude (35%-66%). Chewing xylitol gum may also be effective in the prevention of caries in the primary dentition, but because of the limited no. of studies, it is not possible to quantify this effect.
- In this review we assessed the impact of total xylitol load and did not control for the independent variables that could affect caries such as frequency of chewing, dose of xylitol per pallet or slab, and total duration of gum used.
- The findings of our review do not agree with those reported by Lingstrom *et al.* (2003)¹³. The main difference between them relates to inclusion criteria, quality scales, classification of study design, and conclusions based on studies that were considered to be of high quality.
- The reason for the reduction of dental caries is that the bacteria are unable to metabolise xylitol into acids. The findings also suggest that xylitol has a direct effect on caries, complementing the changes in salivary dynamics triggered by the chewing process. This plays a role in accelerating the clearance process in the oral cavity.

CONCLUSION

- There is a considerable amount of evidence that the use of xylitol chewing gum prevents dental caries compared to controls without gum use, and the effectiveness varied from 35% to 66%. Further meta-analyses should be done to strengthen the evidence.
- The evidence is strong enough to support the regular use of xylitol-sweetened chewing gum as a way to prevent caries, and it can be promoted as a public health prevention measure.

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