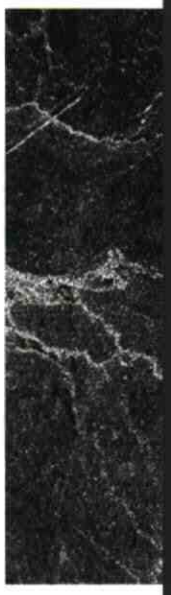

Critical Appraisal

XYLITOL

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High-concentration xylitol chewing gum has been used therapeutically in public health programs in Europe for quite some time. The use of xylitol as a sweetener is slowly increasing in the United States. There is much evidence that xylitol can be a useful adjunct in preventing dental caries because of its effect on mutans streptococci (MS) in the oral environment. This review examines some of the literature that identifies the various benefits and capabilities of xylitol as a preventive therapeutic agent. Xylitol chewing gum is a convenient and pleasant preventive tool that almost all patients can use and enjoy.

THE OPTIMUM TIME TO INITIATE HABITUAL XYLITOL GUM-CHEWING FOR OBTAINING LONG-TERM CARIES PREVENTION

P.P. Hujoel, K.K. Makinen, C.A. Bennett, et al
Journal of Dental Research 1999 (78:797–803)

ABSTRACT

Objective: The purpose of this study was to determine whether habitual chewing of gums sweetened with sorbitol, xylitol, and xylitol-sorbitol mixtures has long-term effects and to determine which teeth receive the most substantial long-term effect—those erupting before, during, or after the habitual gum chewing.

Materials and Methods: Children with an average age of 6 years old chewed gums sweetened with xylitol, sorbitol, or xylitol-sorbitol mixtures. A control group consisted of children who did not chew gum. The children chewed the gum for 5 minutes five times a day during the school year and for variable times during nonschool days over a 2-year period. Five years after the gum chewing ended, 288 children were reexamined.

Results: Compared with children in the control group, those who chewed sorbitol gum had no significant long-term effect on caries risk. However, those who chewed xylitol gum or xylitol-sorbitol gum reduced their caries risk by 59% and 44%, respectively. The long-term caries risk reduction associated with xylitol strongly depended on when teeth erupted. Teeth that erupted after 1 year of gum chewing or after the 2-year habitual gum use ended had long-term caries risk reductions of 93% and 88%, respectively. In contrast, teeth that erupted before the gum-chewing regimen started had no significant long-term benefit.

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Conclusion: To maximize the long-term caries-preventive effects, habitual xylitol gum chewing should be started at least 1 year before the permanent teeth erupt.

COMMENTARY

This study clearly indicates that, for long-term benefits from xylitol gum, chewing should begin at about 5 years of age. Other studies, however, demonstrate the efficacy of xylitol gum throughout life.

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STABILISATION OF RAMPANT CARIES: POLYOL GUMS AND ARREST OF DENTINE CARIES IN TWO LONG-TERM COHORT STUDIES IN YOUNG SUBJECTS

K.K. Makinen, P.L. Makinen, H.R. Pape, et al
International Dental Journal 1995 (45:93–107)

ABSTRACT

Objective: This article examined two studies involving children in Belize, Central America, that evaluated rehardening of carious lesions in dentin following the use of chewing gum containing polyol sweeteners.

Materials and Methods: Various chewing gums were used in both stick and pellet form that incorporated sucrose, xylitol, sorbitol, or a combination of both xylitol and sorbitol. The control group did not use gum at all. One study included only permanent teeth in 10-year-old children who used the gum for 40 months. The other study included primary teeth and permanent first molars in 6-year-old children who used the gum for 24 months. The children chewed the gum for 5 minutes at a time, three to five times per day. Experienced, calibrated examiners recorded caries at baseline for all children. Blinded clinical examinations were performed periodically over the course of the study to document rehardening of carious lesions.

Results: The examiners found the greatest number of arrested caries and remineralized caries in the children who used the gums containing 100% xylitol or a combination of xylitol and sorbitol. It is interesting that the 100% xylitol pellet-shaped gum resulted in the highest number of arrested caries of all the tested treatments.

Conclusions: Dentin caries can be slowed or arrested by chewing gum with a high xylitol concentration. This effect can also apply to rampant caries and in the absence of restorative or other preventive programs.

COMMENTARY

In two populations with a high rate of caries, a controlled regimen using chewing gum containing dietary polyol sweeteners significantly increased the number of arrested and remineralized carious lesions. Also, the rehardening rate increased during the later stages of the study in each population. This study further supports the use of polyols, particularly xylitol, as effective agents in helping to control dental caries. It also provides several interesting photographs of remineralized lesions.

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INFLUENCE OF MATERNAL XYLITOL CONSUMPTION ON ACQUISITION OF MUTANS STREPTOCOCCI BY INFANTS

E. Soderling, P. Isokangas, K. Pienihakkinen, J. Tenovuo

Journal of Dental Research 2000 (79:882–887)

ABSTRACT

Objective: This 2-year study addressed the possibility of mothers' use of xylitol chewing gum preventing mother-child transmission of MS. Topical fluoride and chlorhexidine varnish treatments were used in control groups.

Materials and Methods: One hundred sixty-nine mothers, all of whom had high levels of salivary MS during pregnancy, participated in the study. Those in the xylitol group chewed xylitol-sweetened gum at least two or three times each day, beginning 3 months after childbirth. Mothers in the other two groups were given chlorhexidine or fluoride varnish treatments at 6, 12, and 18 months after delivery of their child. Only the mothers were treated; the children did not receive any of the varnish treatments or use xylitol gum. Saliva samples were obtained from the mothers at 6-month intervals, and plaque samples were obtained from the children at 1 year and 2 years. Levels of MS were determined from all samples.

Results: Detectable mother-child transmission of MS at 1 year of age was as follows: xylitol group—6.8% of children, chlorhexidine group—3.6%, and fluoride group—18.2%. At 2 years of age, the children in the xylitol group showed the lowest increase in detectable mother-child transmitted MS at 9.7%. The findings for children in the chlorhexidine and fluoride groups were 28.6% and 48.5%, respectively. The xylitol group fared significantly better than did the other two groups. The salivary MS levels of the mothers remained high and were similar in all three groups throughout the study.

Conclusions: The probability of mother-to-child transmission of MS can be significantly reduced if the mothers regularly use xylitol chewing gum. The study also indicated that chlorhexidine or fluoride varnish treatments did not reduce mother-child transmission of MS.

COMMENTARY

Xylitol chewing gum might serve as a useful adjunct to reduce parent inoculation of children with MS. Unfortunately, this is a complex issue, and the chances of success would likely be higher with children in a relatively controlled environment. An interesting finding in this study was that although consumption of xylitol by the mothers significantly reduced the mother-child transmission of MS, it did not decrease salivary levels of MS in the mothers. Most of the mothers in the study had high MS levels in their saliva at all examinations and therefore a high potential for transmitting MS to their children. The authors presumed the mothers' MS was primarily xylitol resistant. Based on previous in vitro studies, they speculated that the MS in mothers in the xylitol group had impaired adhesion properties and therefore reduced mother-child transmission.

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INFLUENCE OF MATERNAL XYLITOL CONSUMPTION ON MOTHER-CHILD TRANSMISSION OF MUTANS STREPTOCOCCI: 6 YEAR FOLLOW-UP

E. Soderling, P. Isokangas, K. Pienihakkinen, J. Tenovuo
Caries Research 2001 (35:173–177)

ABSTRACT

Objective: This is the third report of a longitudinal study exploring the effects of xylitol consumption by mothers on mother-child transmission of MS, and on the children's risk of future caries development. The purpose of this study was to assess the MS counts at 1 and 4 years after discontinuation of maternal xylitol consumption.

Materials and Methods: At baseline, during pregnancy, all mothers had high salivary levels of MS and were randomly assigned to groups receiving xylitol, fluoride, or chlorhexidine. The mothers in the xylitol group chewed xylitol-sweetened gum for 21 months starting 3 months after childbirth. Mothers in the two control groups received chlorhexidine or fluoride varnish treatments at 6, 12, and 18 months after delivery. One hundred fifty-nine and 147 children participated at the 3- and 6-year examinations, respectively. Plaque samples were collected at age 3 years, and saliva samples were collected at age 6 years by individuals who were blinded to the study design and treatment group.

Results: The colonization percentages of MS increased during the follow-up in all groups. At 3 years of age, 27.6% of the children in the xylitol group were colonized with MS, compared with 64.5% in the fluoride group and 37.0% in the chlorhexidine group. The children's risk of MS colonization was 2.3-fold in the fluoride group compared with that in the xylitol group, a statistically significant difference. At the 6-year examination, 51.6% of the children in the xylitol group, 83.9% in the fluoride group, and 84.6% in the chlorhexidine group had detectable MS counts in their saliva samples. Salivary levels of MS were significantly lower in the xylitol group than in the other groups. There was no significant difference in the levels of salivary MS of the mothers at 3 years. The study detected no significant associations between MS colonization and type of day care or use of antibiotics or fluoride by either mother or child. At 6 years of age, only a small percentage of the children did not use xylitol products at all. Approximately one-third of the children in the three groups chewed xylitol gum on a nondaily basis, and the rest of the children chewed xylitol gum on a weekly basis or infrequently.

Conclusion: The xylitol-associated reduction in the probability of mother-child transmission of MS shown at 2 years in this longitudinal study had a continued effect on the children's MS counts at ages 3 and 6 years.

COMMENTARY

The results of this follow-up study indicate that a reduction in the mothers' MS counts produces a long-term reduction in MS colonization of their children. The authors evaluated independent xylitol use by the children at 6 years of age and found no difference in use patterns among the groups. Owing to subject dropout, at the 6-year examination the chlorhexidine group had a small sample size, so no definite conclusions could be made for this group. Because high-concentration chlorhexidine varnish treatments can lower oral MS levels for several months, more frequent varnish treatments might have improved the results for this group.

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MAINTAINING MUTANS STREPTOCOCCI SUPPRESSION WITH XYLITOL CHEWING GUM

G.H. Hildebrandt, B.S. Sparks

Journal of the American Dental Association 2000 (131:909–916)

ABSTRACT

Background: Chlorhexidine is well known as an effective therapeutic agent in reducing oral microflora, specifically MS, which are the primary bacteria involved in the initiation of carious lesions. When chlorhexidine rinses are discontinued, however, the pretreatment level of infection quickly returns to baseline values.

Objective: The purpose of this study was to determine the effectiveness of xylitol chewing gum in preventing MS regrowth after use of a chlorhexidine mouthrinse.

Materials and Methods: One hundred fifty-one subjects with salivary MS levels of at least 105 colony-forming unit (CFU)/mL rinsed twice daily for 14 days with 0.12% chlorhexidine gluconate. The subjects were then divided into three groups: (1) 51 members comprised the test group and chewed two pellets of xylitol-sweetened chewing gum for at least 5 minutes, three times daily after meals, for 3 months; (2) 50 members made up the placebo group and chewed one stick each of a sorbitol-aspartame and saccharin-sweetened chewing gum following a similar regimen; and (3) the remaining 50 members comprised the control group and did not chew gum. Salivary samples from all groups were used to measure MS levels at baseline, after the chlorhexidine rinse phase, and then at 1- and 3-month intervals.

Results: At baseline and immediately after the chlorhexidine rinse, MS levels were not significantly different between the three groups (5.4, 5.4, and 5.2 CFU/mL before the rinse and 2.7, 3.1, and 3.0 after the rinse). At 3 months after chlorhexidine rinsing, mean MS levels increased toward baseline but at different rates. The placebo group increased by 40-fold, the control group increased by 25-fold, and the test group increased by eightfold. Differences between the control and test groups as well as between the placebo and test groups were statistically significant.

Conclusions: The use of xylitol chewing gum significantly delays the return of oral MS after therapeutic use of a chlorhexidine mouthrinse. In contrast, the chewing of gums sweetened with sorbitol-aspartame and saccharin and not chewing gum at all are similarly ineffective in suppressing MS bacteria.

COMMENTARY

Numerous scientific studies demonstrate the effectiveness of xylitol chewing gum in reducing the incidence of dental caries. It is interesting that few dentists use this simple, inexpensive, pleasant, and effective method of preventing and controlling carious lesions. It is time for the profession to seriously view dental decay as an infectious disease and to pursue a medical model for its prevention. The use of antimicrobial rinses and xylitol chewing gums can and should play a prominent role in dental preventive programs.

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HOW XYLITOL-CONTAINING PRODUCTS AFFECT CARIOGENIC BACTERIA

M.C. Roberts, C.A. Riedy, S.E. Coldwell, et al
Journal of the American Dental Association 2002 (133:435–441)

ABSTRACT

Objective: Xylitol sweetener is an effective preventive agent against dental caries. The mechanism of action is still unknown, however. The objective of this study was to examine the effect that xylitol contained in snack foods and candy has on *Streptococcus mutans* and *Streptococcus sobrinus* levels in children and adults.

Materials and Methods: Levels of cariogenic bacteria were studied before and after consumption of xylitol candy in both children and adults. Salivary samples were taken from 187 children and 2 adults who consumed xylitol-containing food for 4 weeks. The researchers cultured the bacteria and determined the bacterial type, numbers, and resistance levels to xylitol.

Results: Levels of *S. mutans* remained the same before and after consumption of xylitol-containing foods. The bacteria from 7 children and both adults were studied further to determine the tolerance to xylitol. In general, *S. mutans* increased in tolerance to xylitol.

Conclusions: Consumption of xylitol-containing foods did not reduce levels of *S. mutans*. However, there was a distinct trend toward the bacteria becoming more tolerant to the sweetener.

COMMENTARY

At first glance, the results of this article seem contradictory to the established benefits of xylitol. However, the information learned in this study does add to our understanding of how this sweetener may work. The fact that *S. mutans* strains that are tolerant to xylitol increased may actually be a positive development. It seems that these strains may be less virulent in producing the acid that causes tooth decay. Work being done at the University of Florida by Jeff Hillman is focusing on strains of *S. mutans* that do not cause caries but rather displace more virulent strains. The work presented in this article is consistent with Hillman's approach and sheds some light on how xylitol may work.

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Editor's Note: We welcome readers' suggestions for topics and contributors to Critical Appraisal. Please address your suggestions to the associate editor:

Critical Appraisal
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THE BOTTOM LINE

Much research supports the effectiveness of xylitol as a weapon in the fight against dental caries. By decreasing the cariogenic effects of *Streptococcus mutans*, xylitol can help to prevent caries and to facilitate caries arrest and remineralization.

By using xylitol chewing gum, parents might also reduce the transmission of *S. mutans* to their children. As children get old enough to manage chewing gum, they can be enticed to participate in their own caries-prevention program because they perceive chewing gum as being fun. Ideally, xylitol gum use should begin at approximately 5 years of age or at least 1 year prior to permanent tooth eruption. This might ensure compliance and could represent an important part of a comprehensive preventive program that includes regular use of fluoridated toothpaste, flossing, fluoride mouthrinses where indicated, dietary analysis, and periodic dental examinations.

Even in the absence of other preventive measures, regular use of high-concentration xylitol chewing gum might reduce a person's caries incidence. For older patients who may not chew gum, xylitol mints are available, although there is little evidence concerning the efficacy of the mints.

SUMMARY

Commonly used in Europe, xylitol chewing gum has not yet caught on in the United States as a significant preventive therapy, probably since it is not readily available to the public. The availability is improving, however, so we might expect to see more widespread use of xylitol chewing gum as the dental profession embraces its benefits and educates patients as to its use.