



Acceptance of the xylitol chewing gum regimen by preschool children and teachers in a Head Start program: a pilot study

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Abstract

Purpose: This pilot study evaluated the acceptance and compliance of a xylitol chewing gum regimen by both children and classroom teachers in a Head Start program.

Methods: Thirty-five children chewed 100% xylitol gum (XyliFresh 100%, Leaf, Inc., 500 Field Dr., Lake Forest, IL 60045 U.S.A.) three times a day over a three week period. Children's acceptance was evaluated using a picture selection test. Teachers' acceptance was evaluated using a questionnaire. The children's and teachers' compliance was evaluated using a daily checklist that was completed by each teacher.

Results: Positive ratings were given for xylitol gum chewing (94%) and for taste (86%). Children's acceptance and compliance for chewing was excellent. Children chewed the gum at designated times and none of the children swallowed the gum. Teachers' acceptance of the chewing program was low. Three out of five participating teachers thought the gum chewing disturbed the classroom routine and four were not willing to participate in the program next year. Teachers' compliance was good and they followed the instructions during a three-week period.

Conclusions: This study supports the suggestion that chewing xylitol gum is well accepted by children. Collaboration and education is essential to motivate teachers to adopt and supervise school-based prevention programs. (*Pediatr Dent* 23:71-74, 2001)

Despite the evidence of a decline in the incidence of dental caries in the United States over the past several decades, the condition remains a significant problem for the nation's poor children.¹ Unfortunately, groups at the highest risk for disease—the poor and minorities—have the lowest rates of dental visits.¹ The prevention of caries is less effective in the primary dentition and a larger portion of caries goes untreated in children living below the property level.² Study of Head Start participants in North Central Florida indicated that indigent children experience significant dental caries, have low availability of fluoride and have limited access to dental care.³

Numerous field studies have shown that chewing xylitol gum reduces the incidence of dental caries.⁴⁻¹² These types of studies are usually conducted within elementary school-systems, as they are well organized and may have existing prevention programs, such as fluoride rinsing.^{4-7, 12} The acceptance and compliance issues of xylitol gum programs by children and by

supervisors have not been presented thoroughly in these studies. In two studies, a dietary questionnaire was used to follow the consumption of xylitol containing products to determine compliance, but the details were not described.^{7, 13} In other studies, compliance has been assumed, since teachers and parents supervised the use of the gum.⁴⁻¹² According to authors in a study by Isokangas et al.,⁷⁰ a dental nurse controlled and registered the compliance at the schools. Kandelman and Gagnon⁵ used a questionnaire to evaluate the side effects of chewing xylitol gum. Makinen et al.¹⁰ did not report the details of acceptance or compliance of chewing in a study, which evaluated the effect of polyol chewing gums especially on the primary dentition in six-year-old preschool children.

The purpose of this pilot study was to evaluate the acceptance and compliance of the xylitol chewing gum program by children and teachers during schooldays in Head Start preschool classes over a three-week period.

Methods

Children in the Head Start program in Starke, Florida, were invited to participate in this study. Sixty-one healthy children (32 female, 29 male) between three and five years of age with parental consent were randomly assigned to a xylitol and a no-gum group. The children represented a racial mixture of black (78%), white (19%), and Hispanics (4%). The procedures, possible discomforts or risks, as well as possible benefits were explained fully to the parents, and their informed consent was obtained prior to investigation. The research protocol and informed consent forms were reviewed and approved by the University of Florida Health Science Center Institutional Review Board (IRB) Involving Human Subjects.

Thirty-five children from five different classes chewed the xylitol gum (XyliFresh 100%, Leaf, Inc., 500 Field Dr., Lake Forest, IL 60045 U.S.A.) three times a day for a three-week period during schooldays. Detailed instructions for administering and monitoring the gum were distributed to teachers. Teachers delivered one pellet of gum to each study participant after breakfast (8 a.m.), lunch (11 a.m.), and snack (1 p.m.). Children were gathered around a large table for the chewing period. Children were not allowed to jump or play during the chewing period, which lasted for five minutes and was supervised by a teacher. Children who did not chew the gum were

| Table 1. Teachers' Attitudes toward Chewing Program | |
|---|---|
| | N |
| Program was clearly explained | 5 |
| Delivery of gum was timely | 5 |
| Children enjoyed chewing the gum | 5 |
| Chewing disturbed the classroom routine | |
| - Yes | 1 |
| - Sometimes | 2 |
| - No | 2 |
| Want to participate in the xylitol program in next year | |
| - Yes | 1 |
| - Not so sure | 4 |
| Children in the class want to participate in next year | |
| - Yes | 2 |
| - Not so sure | 2 |
| - No | 1 |

involved in other activities during the chewing period. The teacher collected and disposed of the used gum.

Teachers' attitudes toward the trial were measured using a questionnaire. The questionnaire consisted of six closed-ended questions regarding their attitude towards the chewing program and their opinion of children's acceptance (Table 1). Teachers were able to choose a possible response as "yes," "I am not sure," or "no". Teachers followed their delivery and guidance of gum chewing by using a daily checklist. They reported any events concerning the usage of gum, for example if a child refused or was not able to chew the gum. Children's acceptance was measured at the end of the three-week chewing period by use of a picture selection test. Children could choose the cartoon face best representing their subjective response toward the xylitol gum use; a smile (like), a frown (dislike), or a neutral expression (Fig 1).

Results

Five teachers participated in the study. Teachers' attitudes toward the chewing program are shown in Table 1. All five teachers answered that children enjoyed chewing the gum, the chewing program was fully explained and delivery of the gum was timely. Two teachers thought chewing did not disturb the classroom routine and three thought it was disturbing. Four out of five teachers were not willing to participate in the xylitol program next year. Three teachers thought children would not want to participate in the program next year, and two teachers thought they would.

Children's acceptance is shown in Table 2. Chewing of the gum was accepted by 94% of the children, and 86% accepted the taste of the gum. Only two of 35 children did not like the chewing, but they accepted the taste. Five of 35 children did not like the taste, but they accepted the chewing.

Teachers reported the chewing in a daily checklist. Classes chewed the gum at all designated times over the three-week period. Each child chewed the gum for approximately five minutes during the chewing periods and none of the children swallowed the gum.

Discussion

The study found that xylitol chewing gum is well accepted by children between the ages of 3-5 years. The picture selection test employed has been used in measuring children's food preferences.¹⁵ It has been shown to be both reliable and valid.^{16, 17} The compliance of chewing was also excellent. No study participants discontinued chewing and there were no reports of refusal to chew for any of the time periods. In the study of Uhari et al.,¹⁸ 3- to 5-year old Finnish children in day care nurseries chewed the xylitol gum for two months. Only seven out 179 dropped out from the study, because they did not want to continue the chewing. Although the results in the current study suggest that children would chew xylitol gum if given to them, it is possible that children would not like to chew xylitol gum for longer periods of time. Future studies are needed to determine the long-term acceptance in this population.

Teachers' acceptance toward the gum program was low. There are several potential reasons for the low acceptance. First, children who did not chew xylitol gum were in the same class with children chewing the gum and they had other activities during the chewing period, which may have required extra effort to control the class. In a study by Kandelman and Gagnon,⁶ during the second year of the program two out of 13 schools stopped their participation because some teachers had difficulties continuing to integrate this additional workload into their daily activities. Secondly, since chewing the gum has not been accepted behavior in a school environment and teachers in this study were introducing the gum at the first time, it might have generated an extra stress for the teachers. However, even 3-year-old children can quickly learn the technique of chewing without swallowing the gum.¹⁸ It is likely that, after a limited orientation period, children do not need close chewing supervision. Deep-rooted attitudinal relations may also have effected the acceptance. The chewing gum program was originally planned to include another school, but the proposal was turned down due to the determination that chewing the gum is not developmentally appropriate for 3- to 4-year-old children. This attitude prevailed in spite of introducing literature on the success of xylitol programs in other studies.

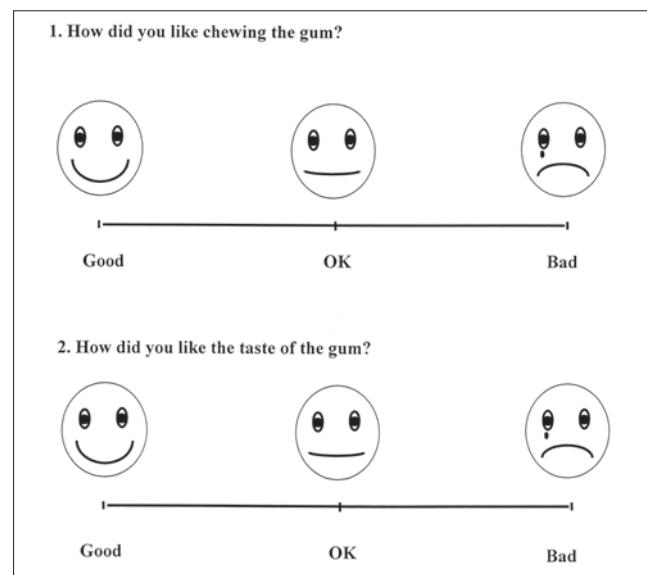


Fig 1. A picture selection test.

Teachers' compliance was good and they delivered the gum and followed the daily checklist as instructed. This pilot study was implemented to collect the preliminary data of the possible success of the preventive xylitol chewing gum program. Thus, the chewing period was only three weeks. The long-term compliance of teachers needs to be determined in further studies.

Makinen et al.¹⁰ confirmed that positive results of the xylitol gum program were obtained in a situation where considerable efforts were made to maintain the interests of the subjects, school personnel, and parents. Nordblad et al.¹⁹ organized a "smart habit" campaign, which was aimed to increase consumption of xylitol chewing gum in 13-year-old school children. The campaign was conducted in elementary schools in the form of a quiz and a lesson related to xylitol. An increase in the daily use of the xylitol gum and knowledge of beneficial properties of xylitol was achieved by the campaign and oral health was positively promoted. Motivation, support, and education are the key factors in the school-based prevention programs and need to be emphasized in the future programs. Collaboration with other institutions, such as health departments, might also increase the acceptance toward the chewing gum program.

The expected daily consumption level of xylitol in the current study was around 4.05g (3 times X 1.35g). According to Akerblom,²⁰ children can tolerate daily doses up to 45g. In the study by Kandelman et al.,⁶ the daily consumption was 3.4g (65% xylitol) and children did not report any side effects. Also, in other studies where products contained much higher quantities of xylitol, no apparent side effects were reported.^{4-6,21} In this short-term study children tolerated gum usage well without reported side effects, which is consistent with the other studies. Chewing was performed safely, since children were gathered around a large table and teachers supervised the chewing. In a study by Uhari et al.,¹⁸ 3- to 5-year-old children attending day care nurseries chewed xylitol gum and there was no reported gum swallowing. Only one out of 179 child had abdominal discomfort. Our conclusion is that even 3- to 5-year-old preschool children can chew xylitol gum safely under supervision.

The oral biologic effects of xylitol support the suggestion that the use of the xylitol gum can be considered a valuable tool in caries prevention. Studies by Uhari et al.^{18,22} have suggested that xylitol is also effective in preventing acute otitis media and reducing the antibiotic use. Chewing gum as a vehicle for delivering other therapeutic products to reduce caries, such as urea and fluoride, have also been used.²³ F-containing chewing gums have been found to give similar salivary F concentrations as other F sources, such as dentifrices, tablets and mouth rinses.^{24,25}

Habitual chewing of xylitol gum may have a long-term preventive effect by reducing the caries risk for several years after habitual chewing has ended.²⁶ In a study by Hujuel et al.,²⁶ six year old children chewed xylitol gum for two years. Five years after the program ended, it was found that xylitol gum had a long-term preventive effect and for the effect to be maximized, habitual chewing should be started at least one year before permanent teeth erupt. Thus, chewing xylitol gum during preschool and early elementary school years may be more important than regular chewing during later school years.

Table 2. Acceptance of Xylitol Gum by Children. N=35

| | Good | OK | Bad | % Accepted (Good+Ok/all) |
|---------|------|----|-----|-----------------------------|
| Chewing | 28 | 5 | 2 | 94 |
| Taste | 22 | 8 | 5 | 86 |

Also, xylitol studies have shown that even if children did not chew during the holidays, the caries preventive effect was significant.⁴⁻¹²

The use of xylitol in the prevention of dental caries is widely accepted in Scandinavia and there are day care nurseries where xylitol chewing gums are given regularly after each meal.²² The current study is the first to investigate xylitol gum for school-based activities such as Head Start programs in United States. Since very young children from low-income and disadvantaged populations in the United States are entitled to enroll in the preschool Head Start programs, caries prevention programs using the xylitol gums in this type of well-regulated institutional program are very attractive. A xylitol chewing gum program may provide an additional method to be used in situations where other prevention methods are difficult to implement. Also, it provides an easy and inexpensive distribution mechanism, since no specific equipment, health care facilities, or personnel are needed. Furthermore, through the xylitol program, it is possible to educate and motivate children, parents, and school personnel to promote oral health practices at school. The systematic use of xylitol can help children to become conscious of their own health and of ways to improve it. However, it is important to note that chewing the gum can never replace the sound oral hygiene practices of brushing with fluoride toothpaste and flossing.

Xylitol-based interventions for dentistry have not been readily adopted in the United States. Research has concentrated mainly on the preventive effect of fluorides and has not focused on xylitol as a potential preventive agent. This may be because studies demonstrating the efficacy of xylitol as a caries-preventive agent have used a chewing gum as its mode of delivery and the use of a chewing gum in schools in the United States is not typically acceptable. If xylitol use is adopted in schools, it offers an efficacious and cost-effective prevention strategy, which may greatly improve the quality of oral health for young children. However, further studies are needed to evaluate the long-term acceptance, compliance, and efficacy of chewing in a school class environment.

Conclusions

1. There was excellent acceptance of daily xylitol gum chewing by children enrolled in the Head Start program.
2. There was poor acceptance of the xylitol chewing gum program by the Head Start teachers.
3. Collaboration and education to motivate teachers is essential for successful prevention programs in schools.
4. Further studies are needed to evaluate the acceptance, compliance, and efficacy of the long-term use of the gum in preschool children in the United States.

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References

1. Litt MD, Reisine S, Tinanoff N: Multidimensional causal model of dental caries development in low-income preschool children. *Public Health Rep*, Sep-Oct; 110(5):607-17, 1995.
2. Brown LJ, Wall TP, Lazar V: Trends in untreated caries in primary teeth of children 2 to 10 years old. *JADA Jan*;131(1):93-100, 2000.
3. Venezie RD, Courts FJ, Conti AJ: Caries experience of Head Start Participants in North Central Florida. *J Dent Res 75 (IADR Abstracts)*:186, 1996.
4. Kandelman D, Bar A, Hefti A: Collaborative WHO xylitol field study in French Polynesia. *Caries Res 22*:55-62, 1988.
5. Kandelman D, Gagnon G: Clinical results after 12 months from a study of the incidence and progression of dental caries in relation to consumption of chewing gums containing xylitol in school preventive programs. *J Dent Res 66*:1407-11, 1987.
6. Kandelman D, Gagnon G: A 24-month clinical study of the incidence and progression of dental caries in relation to consumption of chewing gum containing xylitol in school preventive programs. *J Dent Res 69*:1771-75, 1990.
7. Isokangas P, Alanen P, Tiekso J et al.: Xylitol chewing gum in caries prevention: a field study in children. *JADA*177:315-20, 1988.
8. Makinen KK, Bennett CA, Hujoel PP, Isokangas P, Isotupa KP, Pape HR Jr, Makinen P-L: Xylitol gums and caries rates: A 40-month cohort study. *J Dent Res 74*:1904-13, 1995.
9. Makinen KK, Makinen P-L, Pape HR Jr, Allen P, Bennet CA, Isokangas PJ, Isotupa KP: Stabilization of rampant caries: Polyol gums and arrest of dentine caries in two long-term cohort studies in young subjects. *Int Dent J 45*:93-107, 1995.
10. Makinen KK, Hujoel PP, Bennett CA, Isotupa KP, Makinen P-L, Allen P: Polyol chewing gums and caries rates in primary dentition: a 24-month cohort study. *Caries Res 30*:408-17, 1996.
11. Makinen KK, Makinen P-L, Pape HR Jr., Peldyak J, Hujoel P, Isotupa KP, Soderling E, Isokangas PJ, Allen P, Bennett C: Conclusion and review of the "Michigan xylitol program" (1986-1995) for the prevention of dental caries. *Int Dent J 46*:22-34, 1996.
12. Isokangas P, Makinen KK, Tiekso J, Alanen P: Long-term effect of xylitol chewing gum in the prevention of dental caries: a follow-up 5 years after termination of a prevention program. *Caries Res 27*:495-98, 1993.
13. Isotupa KP, Gunn S, Chen C-Y, Lopatin D, Makinen KK: Effect of polyol gums on dental plaque in orthodontic patients. *Am J Orthod Dentofac Orthop 107*:497-504, 1995.
14. Lam M, Riedy CA, Coldwell SE, Milgrom P, Craig R: Children's acceptance of xylitol-based foods. *Community Dent Oral Epidemiol 28*:97-101, 2000.
15. Venham L, Gaulin-Kremer E: A self-report measure of situational anxiety for young children. *Pediatric Dentistry 1*(2):91-96, 1979.
16. Birch LL: Dimensions of preschool children's food preferences. *J School Health 11*:212-14, 1991.
17. Birch LL: Preschool children's food preferences and consumption patterns. *J Nutr Educ 11*:189-92, 1979.
18. Uhari M, Kontiokari T, Koskela T, Niemela M: The novel use of xylitol sugar in preventing acute otitis media. *Pediatrics 102*:879-84, 1998.
19. Nordblad A, Suominen-Taipale L, Murtomaa H, Vartiainen E, Koskela K: Smart Habit xylitol campaign, a new approach in oral health promotion. *Community Dent Health. Dec*; 12(4):230-34, 1995.
20. Akerblom HK, Koivukangas T, Puukka R, Mononen M: The tolerance of increasing amounts of dietary xylitol in children. *Int J Vitam Nutr Res 22*:53-66, 1982.
21. Scheinin A, Banoczy J, Szoke J: Collaborative WHO field studies in Hungary. I. Three-year caries activity in institutionalized children. *Acta Odont Scand 43*:327-47, 1985.
22. Uhari M, Kontiokari T, Koskela M, Niemela M: Xylitol chewing gum in prevention of acute otitis media: double blind randomized trial. *Br Med J 313*:1180-84, 1996.
23. Romer Rassing M: Chewing gum as a drug delivery system. *Adv Drug Delivery Rws 13*:89-121, 1994.
24. Bruun C, Lambrou D, Larsen MJ, Fejerskov O, Thylstrup A: Fluoride in mixed human saliva after different topical fluoride treatments and possible relations to caries inhibition. *Community Dent Oral Epidemiol 10*:124-129, 1982.
25. Sjogren K, Birkhed D, Persson L, Noren J: Salivary fluoride clearance after a single intake of fluoride tablets and chewing gums in children, adults and dry mouth patients. *Scand J Dent Res 5*: 274-78, 1993.
26. Hujoel PP, Makinen KK, Bennett CA, Isotupa KP, Isokangas PJ, Allen P, Makinen PL: The optimum time to initiate habitual xylitol gum-chewing for obtaining long-term caries prevention. *J Dent Res 78*(3):797-803, 1999.