

Effectiveness of Xylitol Oral Wipes in Prevention of Early Childhood Caries among High Caries Risk Toddlers - A Randomized Control Trial

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Abstract: *Aim:* Early Childhood Caries is a worldwide and a highly prevalent disease which needs prevention, intervention and treatment accordingly. Prevention of Early Childhood Caries is a challenging task for parents, care givers, dental care fraternity. The pathognomic feature of ECC is that it has a typical etiologic factors and even typical progressing pattern which makes it easy to intercept, treat and eventually prevent it. If left untreated, it may lead to consequences including malnourishment and anemia due to difficulty in consuming food, speech problems, and malocclusion due to early loss of teeth. It spreads to the other teeth and also to the permanent dentition. Apart from these, psychological problems results from mocking and peer pressure as the child is cornered and sidelined. Since many parents are not aware of the causes of Early Childhood Caries they follow a routine, such as feeding the baby with sweets, letting baby sleep with feeding bottle overnight not cleaning gum pads sufficiently which eventually leads to caries. There is lack of knowledge among parents on oral hygiene maintenance and aids available. There is a need for the education of the parents on preventive measures available to prevent Early Childhood Caries. Hence, the present study aims at evaluating the effectiveness of xylitol oral wipes in prevention of early childhood caries among high caries risk toddlers. **Method:** In this randomized control trial, 20 high caries risk children of age 18 to 36 months according to AAPD caries risk assessment tool 2014 and inclusion criteria are selected for the study. Parents were explained about the risks of ECC and educated on the different oral hygiene methods available. Stimulated saliva was collected in container for checking the SM count and pH of saliva at baseline. The study samples were randomly assigned to one of the 3 group. Group I - received normal oral wipe (after having lunch and night before sleeping) with fluoridated toothpaste (morning), and group II received xylitol oral wipes (after having lunch and night before sleeping) with non fluoridated xylitol containing toothpaste (morning). Each parent was asked to use the intervention for 30days. After which salivary sample were collected to check for salivary SM count and salivary pH. **Results:** Group received xylitol oral wipe +xylitol toothpaste showed maximum reduction in SM count in saliva and increase in pH of saliva in comparison with control group. **Conclusion:** Xylitol oral wipes are good alternative to conventional non - xylitol oral wipes for cleaning gum pads in high caries risk toddlers, combined with fluoridated toothpaste is also a better preventive strategy to prevent ECC.

1. Introduction

Dental caries is a multifactorial infectious disease infecting all population worldwide. ECC is defined as “the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth” in a child under the age of six.¹

Known by several other names like baby bottle tooth decay syndrome/Maternally Derived Streptococcal Mutans Disease /Nursing bottle caries/ Nursing bottle syndrome/ night bottle mouth/ nocturnal bottle caries etc. According to the analysis done in 2019, studies revealed the overall prevalence of Early Childhood Caries in India to be 49.6%.² In rural regions of India - 40.6% among 0 to 3 year old children, of whom 50.3% had non - cavitated surfaces and 49.7% had cavitated surfaces.³ Early Childhood Caries is a worldwide and a highly prevalent disease which needs prevention, intervention and treatment accordingly.

The pathognomic feature is that it has a typical etiologic factors and even typical progressing pattern which makes it easy to intercept, treat and eventually prevent it. If left untreated, it may lead to consequences including malnourishment and anemia due to difficulty in consuming food, speech problems, and malocclusion due to early loss of

teeth. It spreads to the other teeth and also to the permanent dentition. Apart from these, psychological problems results from mocking and peer pressure as the child is cornered and sidelined. Since many parents are not aware of the causes of Early Childhood Caries, they follow routine, such as feeding the baby with sweets, letting baby sleep with feeding bottle overnight which eventually leads to caries.

The American Academy of Pediatric Dentistry recognizes the benefits of caries preventive strategies involving sugar substitutes, particularly xylitol, on the oral health of infants, children, adolescents, and persons with special health care needs.¹ According to AAPD, xylitol reduces the levels of Streptococcus mutans both in the plaque and saliva. Xylitol impairs the glycolysis in Streptococcus mutans, resulting in its energy cycle being ineffectual and leading to cell death.

Development of dental caries is the result of the interaction between cariogenic microflora, a diet rich in fermentable carbohydrates and host factors (including saliva secretion rate and buffering capacity) over time.⁷

Mutans streptococci (MS), particularly Streptococcus mutans and Streptococcus sobrinus are the major causative bacteria in human tooth decay. Most of the children acquire these bacteria from their mothers by saliva contacts during

the emergence of the primary teeth at the age of 6 - 30 months⁴⁻⁶. The initial establishment of MS cannot happen before the eruption of the first teeth, because tooth surfaces are needed as the habitat for the bacteria.⁴

Children whose mothers are the primary caretaker during the first 2 years of life are found to have more MS than children with caretakers. Colonization of infant's oral cavity can occur through Vertical Transmission - mainly from mother to infant or Horizontal Transmission - from siblings of similar age and children in a day care center.⁵

First window of infectivity occurs at 6 months of age after eruption of first primary tooth and second window of infectivity occurs at 6 years of age after eruption of first permanent tooth.

Xylitol has properties that reduce levels of mutans streptococci (MS) in the plaque and saliva. Xylitol disrupts the energy production processes of MS leading to a futile energy consumption cycle and cell death. It cannot be fermented by plaque bacteria. Xylitol also penetrates into the bacterial cytoplasm and accumulates as xylitol 5 - phosphate, which impairs the glycolysis and adenosine triphosphate production and results in cell growth inhibition.¹⁰

For the maximum prevention of dental caries, 7 - 20 g/day of xylitol is given, divided into several doses in candies or chewing gum. The best time to use xylitol is immediately after eating and clearing the mouth by swishing with water.¹

In contrast to other sweetener, it is not a substrate for the majority of bacteria existing in the oral cavity but a passive substitute for cariogenic sugars. It manifests anti - carious action principally against Streptococcus mutans.¹

Hence there is need to assess and evaluate the effectiveness of xylitol oral wipes in prevention of Early Childhood Caries.

Aim of the study

The aim of the present study is to evaluate the effectiveness of xylitol oral wipes in prevention of early childhood caries among high caries risk toddlers

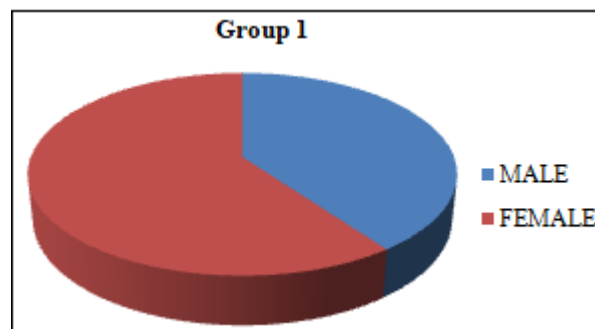
Objectives of the study

- To assess streptococcus mutans count and pH among the included participants at baseline of three groups.
- To evaluate the effect of oral wipes with fluoridated toothpaste on high caries risk toddlers.
- To evaluate the effect of xylitol wipes with non - fluoridated xylitol containing toothpaste on high caries risk toddlers.
- To record the included parameters at the end of the study for three groups.
- To conduct inter - group comparison.

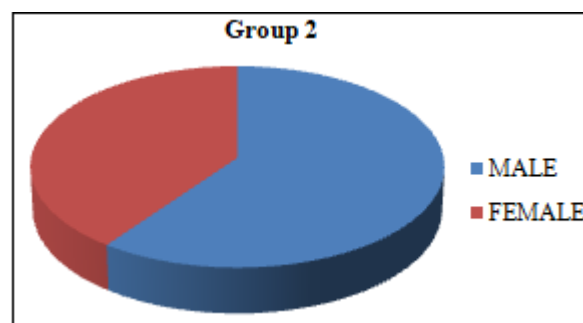
2. Results

This study is a randomised control trial that evaluates efficacy of xylitol oral wipes in reduction of caries in high caries risk toddlers. Data was collected and processed using

Excel. The statistical tests used for the analysis of the result were ANOVA test. A total of 20 samples have been taken for the study with age group of 18 to 36 months were randomly divided into three group using simple random sampling. 4 (40%) males and 6 (60%) female in group 1, and 6 (60%) male and 4 (40%) females in group 2 participated in the study. (Graph 1, 2)



Graph 1: Distribution of Gender - group1



Graph 2: Distribution of Gender – group

Parameters	Group 1	Group 2	P value
Gender			
Males	40%	60%	-
Females	60%	40%	
ph	6.72 ± 0.31	6.65 ± 0.26	0.85
S. mutans count in CFU	98000 ± 6324	96000 ± 12649	0.864

P < 0.05 is considered as statistically significant

Parameters	Group 1	Group 2	P value
Ph	6.64 ± 0.24	6.84 ± 0.12	0.00272
S. mutans count in CFU	94000 ± 13498	68500 ± 12920	0.0000000955

P < 0.05 is considered as statistically significant

Table 3: Intra group Assessment of Ph before and after the duration of intervention between the 3 groups – using paired t test

Parameters	Before	After	P value
Ph in group 1	6.72 ± 0.31	6.64 ± 0.24	0.532
Ph in group 2	6.65 ± 0.26	6.84 ± 0.12	0.0575

P < 0.05 is considered as statistically significant

Table 4: Intra group Assessment of S. mutans before and after the duration of intervention between the 3 groups – using paired t test

Parameters	Before	After	P value
S. mutans in group 1	98000 ± 6324	94000 ± 13498	0.407
S. mutans in group 2	96000 ± 12649	68500 ± 12920	0.00014

P < 0.05 is considered as statistically significant

Interpretation: Xylitol oral wipes combined with fluoridated toothpaste showed significant increase in pH of saliva followed by xylitol oral wipes in combination with xylitol containing non - fluoridated toothpaste with least increase in group 1 normal oral wipes and fluoridated toothpaste.

3. Discussion

Children with ECC have a threefold increased risk of developing tooth decay in their permanent teeth compared to children without ECC.²² The quality of life associated to oral health is negatively impacted by childhood tooth decay, although this is addressed by dental care. Any indication of smooth - surface caries in children younger than 3 years old indicates severe ECC.⁷

ECC is a multifactorial disease, bacteria being one of the factor important in causing it, if this factor is removed prevention of ECC is not a task. Prevention is most important because it destroys not only oral health but also effects the general health, children might suffer from malnutrition, developing malocclusion, mocking and peer pressure also psychological trauma.

Prevention of such condition is must and also we have various effective measures available in market. One among such measures is AAPD approved sugar substitute - xylitol. Xylitol is a naturally occurring 5 - carbon sugar polyol currently approved for use in foods, pharmaceuticals, and oral health products in more than 35 countries. Xylitol was approved by the Food and Drug Administration as a dietary food additive in 1963 and has been used widely in the general market since the mid 1970s. Xylitol has properties that reduce levels of mutans streptococci (MS) in the plaque and saliva. Xylitol disrupts the energy production processes of MS leading to a futile energy consumption cycle and cell death.⁸ Further, consumers of clinically effective levels of xylitol show MS strains with reduced adhesion to the teeth and other reduced virulence properties such as less acid production.^{9 - 13}

This study compared the efficacy of xylitol oral wipes in combination xylitol containing non - fluoridated toothpaste/ fluoridated toothpaste with normal oral wipes with fluoridated toothpaste in reduction of SM count in saliva and its effect on pH of saliva. pH strips form GC buffer kit was used to check the pH of the saliva and salivary SM count was estimated using Kirby-Bauer test, at baseline and after 30days of intervention.

30 toddlers of mean age 4.5years of which 15were girls and 15were boys considered as high caries risk under AAPD caries risk assessment tool 2014 were included in the study. Toddlers were randomly divided to 3 different groups to receive interventions, normal oral wipes with fluoridated toothpaste, xylitol oral wipe with xyliol toothpaste and xyltio wipes with fluoridated toothpaste respectively.

Socio - demographically all participants hailed from in and around of dakshin kannada district, Karnataka. Mother is a important pillar in the family and is usually considered the cornerstone of any family. Mother's age, level of education,

employment, anxiety levels, knowledge on oral health and her oral health status has a affect on child's teeth and attitude on oral health.²² Positive oral health - related attitudes of Mothers will lead to better oral hygiene habits in children. Furthermore, it was detected that mother's attitude towards dentistry may influence their child's dental health and attendance and such relation was confirmed by other reports on child oral health behaviour in other countries.²² Studies by Kiwanuka *et al.*²³ and Mascarenhas *et al.*²⁴ suggested the influence of maternal educational on the dental health of their children. Children of the mothers with higher educational qualification, reported to have better dental health. Sharma et al showed a strong relationship between the DMFT score of children and their mother's education. Caries was found to be higher in children of mothers with low educational level.²⁵ this study included children from lower educational background hence, there was less awareness and knowledge on preventive strategies for prevention of ECC. Role of mothers' educational level on the oral health of the child is an important factor to be considered.

Parental education improves awareness and understanding of health related issues and better the dental health practices of the child. Parents with a positive dental attitude and better dental knowledge will probably help their children develop better dental health habits. Thus, it is of great importance to involve the parents in dental health promotion programs.²²

In this study, they were instructed to use normal wipes and xylitol oral wipes twice daily post meals in afternoon and before bed and toothpaste once daily in the morning for 30 days. Whereas in Guruswamy et al study, they used xylitol wipes twice daily for 14 days, Zhan et al study, they used 4 wipes twice daily for 1 year and in Almeida study, they used the wipes only for 2 days. We introduced xylitol wipes slowly because according to the American Academy of Pediatric Dentistry, it should be used very slowly over a week to acclimate the body to the polyol, especially in young children, to avoid side effects like gas and diarrhea.

In the present study, we assessed the S. mutans count pH level of saliva as it is the major cariogenic organism in the initiation of caries and acidogenic environment allows for the growth of this organism in oral cavity, whereas Zhan et al study determined the reduction in S. mutans and lactobacilli and the number of carious lesions. Similar studies like that of Almeida et al⁵ evaluated the plaque removal efficacy of the xylitol wipes, Shikhar Kumar et. al evaluated the salivary and dental plaque pH changes after consumption of sugared and sugar - free (xylitol) chewing gums in children, Isokangas et al analysed caries occurrence in Children after Maternal Consumption of Xylitol Chewing Gum, and Goval et al²⁹ compared the sugar - free textured wipes with that of toothbrushing, Peter Milgrom et al assessed effectiveness of a xylitol pediatric topical oral syrup to reduce the incidence of dental caries among very young children.

We found reduction in SM count at the end of 30days intervention in group 2 and group 3, increase in pH was also noted in group 2 and 3 in comparison to group 1 which received normal oral wipes and fluoridated toothpaste.

Study done by Isokangas et al, in 2000, xylitol chewing gum showed significant reduction in salivary SM count 70% which is in accordance with the present study. Peter Milgrom et, al., reported increased frequency of xylitol exposure decreased the incidence of dental caries in children which is similar to the results of the present study. E. Giertsen et. al, found that combined use of xylitol and fluoride mouthrise showed a significant reduction in salivary SM count which was same as the present study. Salivary pH was increased following the regular consumption xylitol in a study by Isokangas et. al, which is in accordance with our study.

In the present study, xylitol oral wipes were given in combination with fluoridated toothpaste and xylitol containing non - fluoridated toothpaste which was compared with a control group respectively. The results showed significant reduction in salivary SM count and increased pH when xylitol oral wipes was combined with fluoridated toothpaste followed by xylitol oral wipes with xylitol toothpaste.

4. Conclusion

Prevention is better than cure, as said is a major step in reducing incidence of ECC in children. Incorporating xylitol in daily life has proved to be a better caries preventive strategy. Recent studies show that xylitol given as chewing gum have ability to reduce SM count in saliva thereby reducing incidence of caries.

Our study concluded that:

- Xylitol in combination with fluoride significant reduction in salivary SM count.
- Xylitol alone also showed reduction in salivary SM count.
- Usage of xylitol inform oral wipes and toothpaste showed rise in salivary pH.
- Acceptance of xylitol oral wipes by children was good due to its sweet taste.
- The mean salivary SM count was less in children who received xylitol oral wipes and xylitol toothpaste/fluoride toothpaste while there was no changes seen in group that received normal oral wipes and fluoride toothpaste from baseline.

In conclusion, within the limitations of this study, xylitol oral wipes can be used in toddlers for cleaning gum pads and tooth surface to prevent caries.

Further studies with much larger sample size required to substantiate our results.

References

- [1] American Academy of Pediatric Dentistry. Policy on early childhood caries (ECC): Consequences and preventive strategies. The Reference Manual of Pediatric Dentistry. Chicago, Ill.: American Academy of Pediatric Dentistry; 2022: 90 - 3.
- [2] Ganesh A, Muthu MS, Mohan A, Kirubakaran R. Prevalence of early childhood caries in India—a

- systematic review. The Indian Journal of Pediatrics.2019 Mar; 86 (3): 276 - 86.
- [3] Henry JA, Muthu MS, Saikia A, Asaithambi B, Swaminathan K. Prevalence and pattern of early childhood caries in a rural South Indian population evaluated by ICDAS with suggestions for enhancement of ICDAS software tool. International journal of paediatric dentistry.2017 May; 27 (3): 191 - 200
- [4] Berkowitz RJ, Turner J, Green P (1981). Maternal salivary levels of Streptococcus mutans and primary oral infection of infants. Arch Oral Biol 26: 147 - 149.
- [5] Caufield PW, Cutter GR, Dasanayake AP (1993). Initial acquisition of mutans streptococci by infants: evidence for a discrete window of infectivity. J Dent Res 72: 37 - 45.
- [6] Mohan A, Morse DE, O'Sullivan DM, Tinanoff N (1998). The relationship between bottle usage/content, age, and number of teeth with mutans streptococci colonization in 6 - 24 - month - old children. Community Dent Oral Epidemiol 26: 12 - 20.
- [7] Policy on the use of xylitol in caries prevention. Am Acad Pediatr Dent Ref Man 2010; 35 (6): 45 - 47.
- [8] Trahan L, Néron S, Bareil M. Intracellular xylitolphosphate hydrolysis and efflux of xylitol in Streptococcus sobrinus. Oral Microbiol Immunol 1991; 6 (1): 41 - 50.
- [9] Trahan L, Söderling E, Dréan MF, Chevrier MC, Isokangas P. Effect of xylitol consumption on the plaque - saliva distribution of mutans streptococci and the occurrence and long - term survival of xylitol resistant strains. J Dent Res 1992; 71 (11): 1785 - 91.
- [10] Söderling E, Trahan L, Tammiala - Salonen T, Häkkinen L. Effects of xylitol, xylitol - sorbitol, and placebo chewing gums on the plaque of habitual xylitol consumers. Eur J Oral Sci 1997; 105 (2): 170 - 7.
- [11] Roberts MC, Riedy CA, Coldwell SE, et al. How xylitolcontaining products affect cariogenic bacteria. J Am Dent Assoc 2002; 133 (4): 435 - 41.
- [12] Tanzer JM, Thompson A, Wen ZT, Burne RA. Streptococcus mutans: Fructose transport, xylitol resistance, and virulence. J Dent Res 2006; 85 (4): 369 - 73.
- [13] Trahan L. Xylitol: A review of its action on mutans streptococci and dental plaque: its clinical significance. Int Dent J 1995; 45 (1 Suppl 1): 77 - 92.
- [14] Loesche WJ, Grossman NS, Earnest R, Corpron R. The effect of chewing xylitol gum on the plaque and saliva levels of Streptococcus mutans. J Am Dent Assoc 1984; 108 (4): 587 - 92.
- [15] Autio JT. Effect of xylitol chewing gum on salivary Streptococcus mutans in preschool children. ASDC J Dent Child 2002; 69 (1): 81 - 6.
- [16] Thaweboon S, Thaweboon B, Soo - Ampon S. The effect of xylitol chewing gum on mutans streptococci in saliva and dental plaque. Southeast Asian J Trop Med Public Health 2004; 35 (4): 1024 - 7.
- [17] Mäkinen KK, Isotupa KP, Mäkinen PL, et al. Six - month polyol chewing - gum programme in kindergarten - age children: A feasibility study focusing on mutans streptococci and dental plaque. Int Dent J 2005; 55 (2): 81 - 8.

- [18] Holgerson PL, Sjöström I, Stecksén - Blicks C, Twetman S. Dental plaque formation and salivary mutans streptococci in school children after use of xylitol - containing chewing gum. *Int J Paediatr Dent* 2007; 17 (2): 79 - 85.
- [19] Ly KA, Riedy CA, Milgrom P, Rothen M, Roberts MC, Zhou L. Xylitol gummy bears snacks: A school - based randomized clinical trial. *BMC Oral Health* 2008; 8 (Jul): 20.
- [20] Mäkinen KK, Alanen P, Isokangas P, et al. Thirty - nine month xylitol chewing - gum programme in initially 8 - year - old school children: A feasibility study focusing on mutans streptococci and lactobacilli. *Int Dent J* 2008; 58 (1): 41 - 50. Age Xylitol Product Dosage
- [21] Almeida AG, Queiroz MC, Leite AJM. The effectiveness of a novel infant tooth wipe in high caries - risk babies 8 to 15 months old. *Pediatr Dent* 2007 Jul - Aug; 29 (4): 337 - 342
- [22] Raj R, Vaibhav V. Maternal factors and child oral health. *Int J Health Sci Res* 2012; 8; 102-6.
- [23] Kiwanuka SN, Astrom AN, Trovik A. Dental caries experience and its relationship to social and behavioral factors among 3 - 5 year old children in Uganda. *Int J Pediatr Dent* 2004; 14: 336-46.
- [24] Mascarenhas AK. Oral hygiene as a risk indicator of enamel and dentin caries. *Commun Dent Oral Epidemiol* 1998; 26: 331-9.
- [25] Sharma S, Parashar P, Srivastava A, Bansal R. Oral health status of 9 - 12 year old school going children in Urban Meerut. *Indian J Commun Health* 2013; 25: 61-5.
- [26] Li Y, Caufield PW. The fidelity of initial acquisition of mutans streptococci by infants from their mothers. *J Dent Res* 1995 Feb; 74 (2): 681 - 685
- [27] Zhan L, Cheng J, Chang P, Ngo M, Besten PKD, Hoover CI, Featherstone JDB. Effects of xylitol wipes on cariogenic bacteria and caries in young children. *J Dent Res* 2012 Jun; 91 (7): 855 - 896.
- [28] Milgrom P, Kiet A, Ohnmar LY, Tut K, Mancl L, Roberts MC, Briand K, Gancio MJ. Xylitol pediatric topical oral syrup to prevent dental caries: a double blind randomized clinical trial of efficacy. *Arch Pediatr Adolesc Med* 2009 Jul; 163 (7): 601 - 607.
- [29] Goval CR, Qaqish JG, Sharma NC, Warren PR, Cugini M, Thompson MC. Plaque removal efficacy of a novel tooth. *J Clin Dent* 2005; 16 (2): 44 - 46.
- [30] Kiet A, Milgrom P, Rothen M. Xylitol, sweeteners, and dental caries. *Pediatr Dent* 2006 Mar - Apr; 28 (2): 154 - 163
- [31] Giertsen E, Emberland H, Scheie AA. Effects of mouth rinses with xylitol and fluoride on dental plaque and saliva. *Caries research*.1999; 33 (1): 23 - 31.
- [32] Honkala S, Runnel R, Saag M, Olak J, Nömmela R, Russak S, Mäkinen PL, Vahlberg T, Falony G, Mäkinen K, Honkala E. Effect of erythritol and xylitol on dental caries prevention in children. *Caries research*.2014; 48 (5): 482 - 90.