

Prevention dental caries by improving oral hygiene through a high-fiber diet in children with mixed dentition: Experimental study in Kediri, East Java, Indonesia

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Abstract

Aim: This study was aim to analyze the effect of chewing high-fiber food (fresh pears/ *Pyrus bretshneideri*) to improve oral hygiene as an effort to prevent dental caries in children with mixed dentition.

Materials & Methods: A quasi-experimental, pretest-posttest, non-equivalent control group design was used to investigated 40 children attending a private school in Kediri, East Java, Indonesia. Subjects who were present on the day of examination, does not have calculus covering more than 2/3 of the crown of the tooth, has moderate to poor debris index criteria, is physically and mentally healthy, and is not on treatment were included in this study. The outcome was the children's oral hygiene, so debris index (DI) was measured according to the Greene and Vermilion debris index (The simplified OHI). The research data obtained were analyzed using SPSS-software, with the normality test using the Kolmogorov Smirnov test and the paired T-test to compare quantitative data.

Results: The mean debris index of children after chewing high-fiber food decreased showing a significant reduction by 0.73 (t 23.086, p-value < 0.001).

Conclusion: In this present study showed that the level of debris index among children decreased after chewing high-fiber food, indicating that consuming high fiber food can improve children's oral hygiene, and is a major factor in the prevention of dental caries.

Keywords: Children; Diet; Oral hygiene; Mixed dentition

1. Introduction

Dental caries is a multifactorial disease that needs a comprehensive preventative strategy because it cannot be effectively managed by a single preventive method.¹ Although caries is a preventable disease, it is still the most common chronic disease in children.^{2,3} Oral diseases affect close to 3.5 billion people worldwide, with caries of permanent teeth being the most common condition. Globally, it is estimated that 2 billion people suffer from caries of permanent teeth and 520 million children suffer from caries of primary teeth.² Children's manual skills as well as the motivation to maintain oral hygiene are still poor. It is one of the causes of the high prevalence of dental caries in children, also due to the increased availability and resultant frequency of ingestion of refined carbohydrates and sugar.⁴

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The typical characteristic of children aged 6-14 years old is the critical age with special characteristic, which was the mixed dentition stage or the beginning stage of replacement from deciduous teeth into permanent teeth. In the age of 6 years old, permanent molars usually begins to erupt and becoming more vulnerable towards caries exposure.⁵ Dental caries of primary teeth can lead to malocclusion by adversely affecting the correct guidance of the permanent dentition. An untreated caries primary tooth is often associated with a higher risk of the new carious lesion in the other primary teeth and succeeding permanent dentition. In time, the mixed dentition stage with malocclusions, allows increase food retention and difficult to be cleaned, leads to dental caries in permanent dentition.^{5,6}

Dental caries mainly related to the eating habits and lifestyle. Dental caries develops when bacteria in the mouth metabolize sugars to produce acid that demineralizes the hard tissues of the teeth (enamel and dentin).^{2,5} Simple sugars and starches provide substrate for oral bacteria to synthesize extracellular polysaccharides that enhance plaque mass, which in turn harbors cariogenic and irritates oral tissue.⁷ Children who have more dental caries have a higher intake of free sugars. In many countries, sugars-sweetened beverages, including fruit-based and milk-based sweetened drinks and 100% fruit juices, are a primary source of free sugars. Unlike whole fresh fruits, fruit juices contain free sugars and also contain more calories.²

Childhood period is a crucial time when eating habits and oral health lifestyle are established⁶ Therefore, oral health education should be given based on the child's level of preparation for cleaning their teeth, and they should also involve systematic teaching and reinforcement, due to poor manual dexterity and lack of sufficient motivation.^{8,9} Providing oral health education about the importance of a high-fiber diet is an important factor in overcoming these limitations. Importantly, chewing whole fresh fruit (a high-fiber food and not containing free sugar) is one method of the mechanical removal of plaque beside toothbrushing, which can be done easily by children, leads oral hygiene improvement and dental caries prevention. Thus, this study was aim to analyze the effect of chewing high-fiber food (fresh pears/ *Pyrus bretshneideri*) to improve oral hygiene as an effort to prevent dental caries in children with mixed dentition.

2. Materials & Methods

A quasi-experimental, pretest-posttest, non-equivalent control group design was used to investigated 40 children attending a private school in Kediri, East Java, Indonesia. This study was conducted with children aged from 9-10 between March and April 2019. Purposive sampling technique was used for selection of study subjects. The required sample size was calculated based on the slovin's formula with alpha 5%.

$$n = \frac{N}{1 + N(d^2)}$$

Inclusion criteria of the subject: Subject did not have calculus covering more than 2/3 of the crown of the tooth on the day of examination, has moderate to poor debris index criteria, was physically and mentally healthy, and was not on medical treatment were included in this study. Exclusion criteria: Aged under 9 and over 10 years old, refused to participate, had calculus covering over 2/3 of the crown tooth, has a good debris index, feeling unwell, and on the medical treatment.

Previously, all the participants who met the inclusion criteria were instructed to brush their teeth using the roll method combined with the horizontal method. Participants were asked to consume chocolate biscuits weighing 32 grams and chewed 32 times. Three minutes after consuming chocolate biscuits, the first debris accumulation (pretest) was measured for all participants. Then, they were instructed to consume 100 grams of high-fiber food (peeled pear / *Pyrus bretshneideri*) by chewing it 32 times. Five minutes later, the participant was measured the second debris accumulation (posttest).

To examine the level of children's oral hygiene, the debris index (DI) was measured using a dental explorer and dental mirror according to the Greene and Vermilion debris index (The simplified OHI).¹⁰ After using disclosing agent, the surface area covered by debris is estimated. If no debris or stain present, it was given score zero, soft debris covering not more than one third of the tooth surface being examined or the presence of extrinsic stains without debris regardless of surface area covered, score one. If soft debris covering more than one third but not more than two thirds of the exposed tooth surface, it was score two, and if soft debris covering more than two thirds of the exposed tooth surface, score three. For each child, the average level of debris for all teeth scores was taken into account. The research data obtained were analyzed using SPSS (Statistical Product and Service Solutions) software. Paired T- Test was performed to compare the level of debris before and after high fiber food consumption.

2.1. Ethical and Humane Considerations

The study received ethical approval by the institutional review board of the Bhakti Wiyata Institute of Health Sciences, Kediri (137/PP2M-KE/Maret/2019). Written informed consent was collected from the school authorities and parents, and verbal consent was obtained from the subjects.

3. Results

The participant's characteristic is showed on the Table 1. Among all participants (n=36), the number of male and female participants was equal (50:50) and the majority age of the participants was 9 years old (69,4%).

Table 1 Participant's characteristics

Characteristic	Frequency (n)	Proportion (%)
Gender		
Male	18	50.0
Female	18	50.0
Age		
9 Years Old	25	69,4
10 Years Old	11	30.5

The result of debris index measurement is showed on table 2. Before chewing high-fiber food, the mean of debris index was 1.69 but the mean after chewing high fiber food was 0.97 (p-value < 0.001), showing a significant reduction by 0.73 of debris index.

Table 2 Debris Index Measurement

Characteristic	Before Chewing High Fiber Food (mean)	After Chewing High Fiber Food (mean)	t	p-value
Debris Index	1.96	0.97	23.086	< 0.001

After chewing high-fiber food, participants had better intra oral conditions as indicated by a decrease in plaque accumulation on the tooth surface. Figure 1 shows the intra oral condition of the participants before and after chewing high-fiber food. Meanwhile, figure 2 shows the use of a disclosing agent to estimate the debris covering the tooth surface.



Figure 1 Intra oral condition before and after chewing high-fiber food

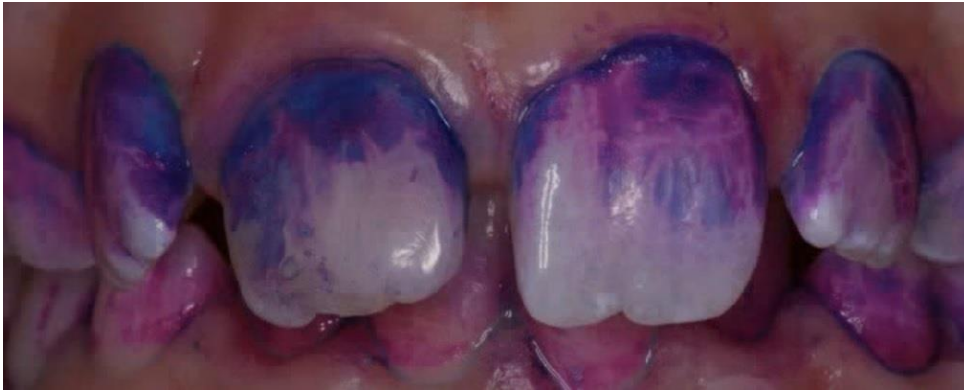


Figure 2 The use of a disclosing agent

4. Discussion

This Study found that after parametric test, there is a significant difference between the groups before and after chewing of high-fiber food (pears). It can be concluded that chewing of high-fiber food has an effect on the debris index in children with mixed dentition. The mean debris index of children after chewing high-fiber food decreased 0.73 compared to before chewing high-fiber food, indicating that chewing high fiber food practice could improve children's oral hygiene. This finding in the current study of inverse relationship between dietary high-fiber intake and number of debris accumulation, independent of tooth brushing frequency, support the notion that dietary high-fiber food helps to cleanse the teeth. Diet rich in fiber, fruits, and vegetables may protect against oral disease through several mechanical actions, including cleansing the tooth surfaces of plaque and forcing more chewing, which stimulates the parotid salivary gland to increase salivary flow and remove harmful bacteria, and that protects against demineralization of tooth substance.^{2,7}

Tooth brushing is thought to be a more effective means of cleaning the teeth than consuming a high-fiber diet.¹¹ But, the possibility remains that fiber intake is a marker of overall dietary quality or healthy lifestyle, which in childhood period is an important time to develop oral healthy lifestyle, and this is an easy way to apply among children in maintaining oral hygiene.⁶ Fibrous fruit based on analogy analysis says that the fibers in fruit will help clean the teeth and food debris that sticks to the cervical region of the teeth that may be difficult to clean by a toothbrush. Basically, when chewing fruit, fruit works like a toothbrush that will remove food residue on the surface of the teeth and gums and provide vitamins to the gums to keep them healthy.¹²

The result of this study indicated that before chewing high-fiber food, 41,7% poor debris index score among children, while there was no good debris index. Meanwhile, after chewing high-fiber food 30,6% children have a good debris index, and no poor debris index. It is indicating that chewing high-fiber food can improve oral hygiene among children. High-fiber foods will provide a stimulated salivary reflex that occurs when chemoreceptors/pressure receptors in the oral cavity respond to the presence of fiber, water, and the process of mastication. These receptors initiate impulses in afferent nerve fibers that carry information to the salivary center in the brainstem medulla so that the salivary center will send impulses through the autonomic nerves to the salivary glands to increase salivary secretion.¹² Saliva will secrete substances such as antibacterial substances, glycoprotein compounds, calcium, and fluoride which are very useful in protects against demineralization of tooth substance.^{7,13}

Demineralization of tooth substances can lead dental caries characterized by loss of tooth structure or complete destruction of the crown, a process of dynamic and active decay characterized by various periods of destruction and repair.¹⁴ Because dental caries is the result of lifelong exposure to a dietary risk factor (i.e. free sugars), even a small reduction in the risk of dental caries in childhood is of significance in later life; therefore, to minimize lifelong risk of dental caries, free sugars intake should be as low as possible.² In this present study showed that the level of debris index among children decreased after chewing high-fiber food, indicating it is can improve children's oral hygiene, and is a major factor in the prevention of dental caries. However, these results could lead to more extensive and diverse research in this area, but was not possible in this study due to limited sampling time. As the limited sample size was a limitation of this study, conducting similar studies with higher sample sizes is recommended. According the results of the analysis that improving oral hygiene is a major factor in dental caries prevention, the results of this study recommend measuring the long-term effects of a high-fiber diet on the formation of dental caries and develop oral healthy lifestyle among children.

Conclusion

The present results showed that chewing of high-fiber food has a positive effect on the debris index in children with mixed dentition. Chewing high-fiber food can improve children's oral health by decreasing debris index. Furthermore, this is a major factor in the prevention of dental caries.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors of this manuscript do not have any financial or personal conflicts of interest.

Statement of ethical approval

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Statement of informed consent

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