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Original Research Article

The effect of tooth brushing before and after eating on salivary pH of elementary school students

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ABSTRACT

Background: According to studies in Asian countries, including Indonesia, 80-90% of children under the age of 18 are affected by dental caries. Dental caries is caused by factors: food, bacteria, teeth and saliva. The state of saliva that is acidic, at a pH of 5.5 will result dental caries. To overcome the overly acidic condition, brushing teeth right after eating and before sleeping is necessary. Brushing teeth properly and correctly can increase salivary pH and it help the remineralization process of small lesions in the enamel layer.
Methods: This research was conducted using pre-test and post-test quasi-experimental with control group design. The sample is all students of Nglahar public elementary school, Sumbersari, Moyudan, Sleman, Yogyakarta, Indonesia, with a total of 85 students using total sampling technique. The data was collected with examine the effect of brushing teeth before and after eating on the salivary pH.
Results: The elementary school students' salivary pH was 7.59 (alkaline) when the students brushed their teeth before eating, whereas tooth brushing within 20 minutes after eating resulted in elementary school students' salivary pH of 7.82 (alkaline). This showed that brushing the teeth 20 minutes after eating can return salivary pH as before eating.
Conclusions: Brushing teeth 20 minutes after eating can increase the salivary pH as a before eating.

Keywords: Tooth brushing, Salivary pH, Elementary school student

INTRODUCTION

Tooth brushing is the easiest and cheapest preventive measure to do. Although the mechanical tooth cleaning activity is considered easy, so far it is difficult to obtain maximum results, both from the aspect of dental hygiene and other damage factors; the ability to brush teeth properly and correctly is an important factor for maintaining oral and dental health. The success of maintaining oral and dental health is also influenced by various factors, such as the use of tools, the method of brushing teeth and the right brushing frequency and time.[1] Brushing teeth properly and correctly can remove debris and plaque, the causes of dental caries. Dental and oral diseases that are commonly found in the society are caries and periodontitis.

According to research in European, American and Asian countries including Indonesia, 80-90% of children under the age of 18 are affected by dental caries.[2] Dental caries is caused by several factors such as food, bacteria, teeth and saliva. The condition of saliva that is too acidic in the mouth at a pH of 5.5 will result in demineralization and then dental caries. To overcome the condition that is too acidic in the mouth is to brush the teeth after eating and before going to bed at night.[3] According to the literature[4] on brushing teeth, tooth brushing techniques must be considered. One of the good techniques for children is the circular technique/fone's technique. The bristles are placed perpendicular to the surface near the cheek/buccal and side of the tongue/lingual with the teeth closed/occluded.

The brush is moved in large circles; therefore, the teeth and gums of the upper jaw and lower jaw are brushed at the same time. Cleaning all surfaces of teeth and gums efficiently, especially the gum pocket and between teeth, does not cause gum tissue damage. Toothbrushing is done for a maximum of 2 minutes. The way of brushing teeth starts from the posterior/back to the anterior/front and ends at the posterior part of the other side. According to the research, it is stated that the horizontal brushing method is suitable to use for children.[5] A good toothbrush according to the literature is the one with a straight handle, small, no more than 1 inch in length, easy to hold with a small brush head so that it easily fits in all types of mouths; the bristles of the brush are about 1 cm and the hardness is medium/soft.[6] In addition, it should be easy to clean. According to the research, saliva is one of the components contributing to the level of acidity (pH) of the mouth.[7] Saliva acts as a buffer system to maintain optimal pH mouth-the pH tends to be alkaline. Without saliva, every meal will form an acidic environment which supports the growth of bacteria that damage teeth.

Saliva also contains ions such as calcium and phosphate, which are components of tooth structure. Another function of saliva is to assist in the remineralization of small lesions in the tooth enamel. The aim of this study was to investigate the effect of tooth brushing before and after eating on the salivary pH of elementary school students.

METHODS

The research was quasi experimental with pre-test and post-test control group design.[9] This method was used to examine the effect of brushing teeth before and after eating on the salivary pH of elementary school students. The location of this research was a Nglahar Public elementary school, Sumbersari, Moyudan, Sleman, Yogyakarta, Indonesia. The sample was 85 students from grade 1 to grade 5, with total sampling technique. Respondents were divided into 2 groups; First group was the intervention group and Second group was the control group. Before the initial pH measurement, all respondents were given an explanation on how to brush their teeth. Then, both of the group doing brush their teeth for making the condition of salivary pH was similar (alkaline).

For the first group, after brushing the teeth, followed by measuring the salivary pH using pH strip. After that, respondents were given the intervention of eating 100 grams of rice and 100 grams of chicken slice, followed by brushing the teeth after 20 minutes. Then, the pH of saliva was measured by using the pH strip. For the second group, the method was the same as the first group, but without intervention by eating. The data were analysed Wilcoxon test for determination the salivary pH difference of pre and post intervention. Mann-Whitney test was used for determination the salivary pH difference of intervention group and control group. This research was approved by health research ethics committee of the health polytechnic of the ministry of health Yogyakarta, Indonesia.

RESULTS

Table 1 provided the distribution of respondent in the intervention group and in the control group, including gender, age and salivary pH before intervention. This research showed that the sample consists of 47 students in the intervention group, while 38 students in the control group. The description of the intervention group was mostly female (53.2%) with the age of 6-9 years (68%). Whereas, in the control group was male (52.6%) with the age of 6-9 years (65.8%). The salivary pH after teeth brushing, in the intervention group was 7.59 and in the control group was 7.36.

Table 1: Distribution of age, gender and salivary pH of respondents.

Characteristics		Intervention group		Control group	
		N	%	N	%
Gender	Male	22	46.8	20	52.6
	Female	25	53.2	18	47.4
Age (Year)	6-9	32	68.0	25	65.8
	10-13	15	32.0	13	34.2
Salivary pH	Average	7.59		7.36	

Before decided the significance test will used in this study, the data were analysed by using Kolmogorov-Smirnov test for identified the normality of data. Table 2 showed the result of the normality test. The data in this study had p=0.000, it means the data was not normally distributed. Therefore, the statistical test will use in this study was non parametric test, namely, Wilcoxon test for determining the salivary pH difference of pre and post intervention. Mann Whitney test was used for determining the salivary pH difference of the intervention group and control group.

Table 2: The results of normality test.

Groups	Kolmogorof-Smirnov test		
	Statistic	Df	Sig
Intervention	0.269	47	0.000
Control	0.352	38	0.000

Sig=0.000<0.05 The distribution of the data is not normal

The average pH of respondents' saliva, brushing their teeth before and after eating can be seen in the Table 3. According to this table, the salivary pH value in the intervention group who brushed their teeth after eating, increased compared to the one who tooth brushing before eating from 7.59 to 7.82 with a difference of 0.23. The control group experienced an increase after the second salivary pH examination was carried out, namely from 7.36 to 7.55 with a difference of 0.19. Table 3 also

illustrates that the p value of the Wilcoxon test in the intervention group was 0.707, that means there was no significant difference between brushing teeth before and after eating on the salivary pH of the elementary school students, meaning brushing the teeth 20 minutes after eating can increase the salivary pH almost same as before eating. Eating can cause the salivary pH decrease to acidic, after teeth brushing, the salivary pH increase to alkaline. The p-value of the Wilcoxon test in the control group was 0.059, that means there was no significant difference between brushing teeth before and after without eating treatment. It is, normally, without eating, the pH salivary was constant to alkaline. Mann Whitney statistical test between the average salivary pH of teeth brushing before and after eating with the salivary pH of respondents who brushed their teeth without eating treatment shows the p=0.350. It means, brushing the teeth 20 minutes after eating can increase salivary pH same as control groups.

Table 3: The results of salivary pH of respondents brushing teeth before and after eating.

Groups	Salivary pH			P value	
	Before	After	Difference	Wilcoxon test	Mann-Whitney test
Intervention	7.59	7.82	0.23	0.707	0.350
Control	7.36	7.55	0.19	0.059	

DISCUSSION

The results (Table 3) show that the average salivary pH of respondents who brushed their teeth 20 minutes after eating increased compared to the one who brushed their teeth before eating from 7.59 (alkaline) to 7.82 (alkaline). It means brushing the teeth after eating, can increase salivary pH, similar to salivary pH before eating. Usually, when eating, salivary pH will decrease to acidic conditions. After brushing the teeth, the salivary pH increase to alkaline conditions. The ability to brush the respondent's teeth properly and correctly is an important factor to maintain oral and dental health. The success of maintaining oral and dental health is also influenced by other factors, such as the use of tools, the method of brushing teeth, as well as the frequency and timing of tooth brushing. The time for tooth brushing that frequently occurs is after eating and before going to bed.

It is best to brush one's teeth after eating, therefore, bacteria from food residue do not have time to stick and damage the teeth. However, it is recommended to wait for a while before brushing the teeth, because brushing teeth immediately after eating can actually damage the teeth. The results of this study are also in accordance with the opinion[10], that "It is recommended to wait 15 or 20 minutes after eating, therefore, the pH of the saliva returns to normal". In the mouth there is saliva, which functions as a buffer effect or balancing agent. When eating, the normal pH of saliva, which is originally 6.8, will drop until it reaches a critical pH, namely 4. If one brushes the teeth immediately after eating, the natural structure of the saliva will be damaged and affect its function in the digestive process.

In addition, brushing the teeth immediately after eating can also weaken tooth enamel. It is acidic. Acids can 'burn' tooth enamel and the layer beneath it, which is called dentin. Brushing teeth at the wrong time can push higher levels of acid on the teeth, which causes corrosion or erosion to occur faster than tooth decay. It is suggested to rinse the mouth with boiled water after each meal. This accelerates the pH of the saliva in the mouth back to normal, therefore, it did not have time to weaken tooth enamel. The results of this study are also in accordance with research, that immediately brushing teeth after eating yields many complaints of pain, primarily starting with pain due to tooth abrasion or erosion.[7] This cannot be ignored because many patients who have these complaints reached the stage of pulp tissue treatment.

It is also in accordance with study, that tooth decay can be caused by decreased salivary pH due to the production of acid from bacteria after consuming carbohydrates.[11] It is also in agreement with this study, that consuming food and drinks, especially those containing high carbohydrates, will be fermented by *Streptococcus mutans* bacteria, therefore an acidic state is formed.[13] It is also in conformity with the opinion, that plaque bacteria will ferment carbohydrates (i.e., sucrose) and produce acid, thus causing plaque pH to decrease within 1-3 minutes to the pH of 4.0-5.0.[14] Acidic pH will cause demineralization process.

In study, it is stated that saliva is a complex oral fluid consisting of a mixture of secretions of the major and minor salivary glands in the oral cavity.[14] Food can cause saliva to be acidic or alkaline. The role of saliva in the caries process depends on the composition, viscosity, pH, and microorganisms in the saliva. In the control group, namely respondents who brushed their teeth, but were not given food treatment, there was also an increase in the salivary pH value of 7.36 (alkaline) to 7.55 (alkaline). The results of the analysis using the Wilcoxon test (Table 3), illustrating that there was no significant difference between the salivary pH values of elementary school students brushing their teeth before and after eating (p=0.707>0.05), meaning that brushing the teeth after eating will increase salivary pH as it before eating. The Mann-Whitney statistical test between the average salivary pH of teeth brushing before and after eating with the salivary pH of respondents who brushed their teeth without eating treatment shows the p=0.350. It means, brushing the teeth 20 minutes after eating can increase the salivary pH same as control groups.

The increase in salivary pH is probably the effect of baking soda and fluoride in the toothpaste used during tooth brushing. This study is in accordance with studies and, which state that as antibacterial, baking soda and fluorine have a plaque-removing effect and act as antibacterial agents.[15,16] As an antibacterial, fluorine affects the activity of cariogenic *Streptococci* by inhibiting acid and glucosyltransferase (Gtf) production. Fluorine works by inhibiting the metabolism of plaque bacteria that can ferment carbohydrates through the change of hydroxyapatite in enamel to fluorine apatite which is more stable, especially when exposed to acid.[17]

It is also consistent with the results of the study, that the effect of fluorine in increasing salivary secretion depends on the concentration of fluorine itself.[18] Giving fluoride with a high enough concentration (e.g., in toothpaste) can stimulate salivary secretion. The result of this research is in accordance with research stating that the ability of fluorine and baking soda to increase salivary secretion greatly affects its ability to increase salivary pH.[19] The rate of salivary secretion can directly affect the degree of acidity in the oral cavity. When there is an increase in the rate of salivary secretion, it will cause an increase in salivary pH. On the contrary, a decrease in the rate of salivary secretion will cause a decrease in salivary pH. Many toothpastes contain 0.1% (1000 ppm) fluoride, usually in the form of sodium mono-fluorophosphate (MFP). The 100 gm of toothpaste contains 0.76 g of MFP (equivalent to 0.1 gm of fluoride).

According to the opinion, bacteria in the mouth live on sugar and starch that stick to the teeth after eating.[20] Fluoride helps protect teeth from the acids released by bacteria when they eat these sugars and starches. This is done in two ways.
First, fluoride makes tooth enamel stronger, making it less likely for tooth decay to occur due to the acids released by bacteria. Second, fluoride can re-mineralize the area of the tooth that has begun to decay therefore tooth decay does not occur quickly. Excess fluoride content in toothpaste can also damage teeth. Tooth decay caused by exposure to very high levels of fluoride is called fluorosis.
Fluorosis usually occurs in children. It occurs because the child's teeth are exposed to high levels of fluoride in toothpaste when the child is 8 years old when the permanent teeth are just starting to grow. Another thing that can cause fluorosis in children is the child intentionally swallows the toothpaste, because it tastes delicious like candy.

The impact of fluorosis is a change in the color of the child's teeth, the color of the teeth can be darker ranging from yellow to brown or the presence of white marks/spots on the teeth. There are toothpastes that are made specifically for children. Usually, such toothpastes contain lower fluoride than usual toothpaste, which is less than 600 ppm. However, toothpaste that contains very low fluoride, which is 250 ppm, is considered less effective in preventing caries in permanent teeth. In addition to baking soda and fluoride, toothpaste also contains detergent. The results of the study, showed that the increase in the salivary pH of those who brushed their teeth using the toothpaste containing detergent (1.0813) was higher than the increase in the salivary pH of those who brushed their teeth with toothpaste that did not contain detergent (0.7247).[21] Toothpaste that contains detergent is called detergent toothpaste. The detergent used is sodium lauryl sulphate (SLS). It is a chemical that works by lowering the surface tension and causing foam to form. SLS also has antibacterial and antimicrobial properties, that means it can help reduce the acidic atmosphere produced by bacterial fermentation which can directly increase the pH of saliva.

The pH of the saliva of those brushing teeth before and after eating did not differ significantly (alkaline), the difference is 0.23. Brushing teeth 20 minutes after eating gives saliva an opportunity to help the digestive process because alpha amylase and other enzymes are released after eating. There is saliva in the mouth which has a buffer effect or balance. Between the two brushing times, namely after eating and before going to bed, it is recommended to always rinse the mouth with water after every meal. This can accelerate the pH of saliva in the mouth back to normal, therefore it does not have time to weaken tooth enamel.

The results of the study, stated that after chewing simple carbohydrate foods, then gargling with water, the average pH of saliva would increase.[22] The average pH of saliva after gargling has increased from the pH of saliva after chewing simple carbohydrate foods, this proves that gargling vigorously over the entire surface of the mouth can remove the remnants of food debris in the oral cavity thereby reducing bacterial activity and providing a mechanical effect which is able to influence saliva's conditions.

CONCLUSION

The salivary pH of elementary school students who brushed their teeth before eating was 7.59 (alkaline), whereas the salivary pH of elementary school students who brushed their teeth 20 minutes after eating is 7.82 (alkaline). Brushing teeth 20 minutes after eating can increase the salivary pH as a before eating.

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