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Research Article

# Changes in Salivary Fluoride Levels with a 2-minute Toothbrush Timer

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**Abstract**

The duration of tooth brushing deserves special attention since it is a factor that affects oral hygiene. The recommended duration for tooth brushing is 120 seconds, yet many people do not follow this suggestion. The relationship between the duration of tooth brushing and the fluoride level in saliva after brushing is still debatable. The study aims to determine the effectiveness of brushing teeth for 2 minutes on fluoride levels in the saliva of children aged 7-8 years. This experiment employed a pretest-posttest design with the control group. This single-blind study involved students from SDN 03 Pagi Pasar Minggu as a group with a manual toothbrush (control group) and SDN 19 Cempaka Putih as a group brushing teeth with a timer (intervention group), each of which consisted of 20 students selected using simple random sampling. Measurement fluoride level in saliva using UV-VIS Spectrophotometer TECAN Infinite M200 Pro®. The study lasted for approximately 3 weeks. The results of the independent t-test indicated no significant difference in fluoride levels between the intervention and the control group ($p>0.05$), although the mean score of the intervention group was higher than the control group. In conclusion, a 2-minute toothbrush timer had the same ability as a manual toothbrush to increase the fluoride level in the saliva of children aged 7-8 years.

**Keywords**: brushing teeth; fluoride; duration; toothbrush; children; saliva

## INTRODUCTION

According to Indonesian Basic Health Research, the prevalence of Indonesian who have adopted the practice of brushing their teeth twice a day is 94.7 %. However, only 2.8 % of those above three years of age use the correct brushing technique.[1] The duration of brushing teeth, which is 120 seconds, should get special attention since it influences oral hygiene to avoid dental caries. Based on some research results, good brushing lasts 2-3 minutes, as it can reduce plaque scores and increase the bioavailability of fluoride in the mouth. However, the duration of brushing teeth for 3 minutes is often not the duration that most patients can do routinely as it is considered a very long duration. Thus, the experts agreed to brush teeth for 2 minutes, even if it is such a low bioavailability compared to 3 minutes. However, it is still considered effective compared to under 2 minutes.[2,3] Research done in Jakarta revealed that it takes an average of fewer than 2 minutes for the eldest kid in a family to brush their teeth, which is 51.19 seconds. Meanwhile, it takes 44.35 seconds for the youngest kid.[4] Early childhood is crucial for educating on the importance of maintaining good oral and dental health. Elementary schools have become a strategic group in addressing dental and oral health. The best time to develop a child's motor abilities is while they are in elementary school.[5]

There is a shortage of research on the effect of brushing duration on fluoride

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levels in saliva. Although it has been established that brushing for longer durations increases the amount of fluoride in saliva, there is still debate on whether the ideal duration should be 45, 120, or 180 seconds.[6, 7] Newby et al. argued that there are differences in fluoride levels in saliva in children between the ages of 4 and 5 who brush their teeth for 40 seconds and 120 seconds. Compared to children who brushed their teeth for 40 seconds, children who brushed theirs for two minutes had higher fluoride levels.[8] The role of fluoride intake in the saliva is very important as it can protect against caries by producing fluoridated apatite that is more resistant to acids produced by oral bacteria. It also increases the remineralization process and inhibits bacterial enolase activity.[9] The study offers recommendations on the advantages of increasing brushing time, which influences the fluoride levels in caries prevention especially using a toothbrush with a 2-timer feature to make it easier for users to finish brushing their teeth. The use of a timer toothbrush can be an innovative idea in the prevention of dental caries as other toothbrush innovations that have been found.[10]

In light of the previous explanation, this study examines how fluoride levels sourced from toothpaste vary in children, especially those between the ages of 7-8, following counseling and training about brushing teeth for two minutes. In terms of the link between fluoride level and the duration of tooth brushing, this study can serve as a guide and a standard for maintaining oral and dental health.

## MATERIALS AND METHODS

This experimental study employed a single-blind method. A pretest-posttest control group design was used in the study. The samples involved in the study were first and second-grade students at SDN 03 Pagi Pasar Minggu and SDN 19 Cempaka Putih, who met the inclusion criteria of the purposive sampling. Inclusion criteria in this study were children aged 8 years, physically and mentally healthy, willing and obtaining permission from their parents to become research subjects, not using a timer toothbrush at home, and not currently receiving fluoride supplementation, both topical and systemic. Simple random sampling was utilized to determine the sample of students in the class. This study involved 40 students; 20 were put into the control group, which received a manual toothbrush. A manual toothbrush is a conventional toothbrush that does not have a 2-minute timer feature, and the time the control group brushed their teeth was less than 2 minutes. The other 20 students in the intervention group received a 2-minute toothbrush timer, namely a toothbrush with a timer feature. Both groups received the same type of toothpaste with the same brand and amount of fluoride content.

This research has obtained ethical approval from the YARSI University ethics committee with letter number 279/KEP-UY/BIA/XII/2019. Informed consent was given by the child's parents prior to this research. The research lasted for around 21 days and included two measurements, one on the first day and one on the 21$^{st}$ day (3rd week). First, the sample children received instruction on the proper technique for brushing teeth, following which the saliva was collected in test tubes both before and after brushing as much as 5 ml without using stimulation and then brought to the YARSI University laboratory for measurement of fluoride levels using a UV-VIS Spectrophotometer TECAN Infinite M200 Pro® (Männedorf, Switzerland). Statistical analysis used in this study compared the mean test of normal data: the independent T-Test and the dependent T-Test.

## RESULT

The frequency distribution of research subjects by treatments and gender is depicted in Table 1. Table 1 shows 20 children (50.0%) in the intervention group and the remaining 20 children (50.0%) in the control group. By gender, the

proportion of females is 65.0%, and male is 35.0%.

Table 2 shows the difference in fluoride levels (fluoride scores after brushing teeth are subtracted by scores before brushing teeth) between the intervention and control groups at baseline and in the third week. The results showed no significant difference (P>0.05), although the mean increase in fluoride scores in the intervention group was slightly higher than in the control group.

In Table 3, the dependent t-test shows that the intervention and control groups statistically differ significantly in the level of fluoride in saliva before and after brushing their teeth at two different measurement times. (p<0.05).

**Table 1. Frequency distribution by treatment group and gender**

| Variable | Group | | | | Total | |
|---|---|---|---|---|---|---|
| | Intervention | | Control | | | |
| | N | % | N | % | N | % |
| Group | 20 | 50.0 | 20 | 50.0 | 40 | 100 |
| Gender | | | | | | |
| Male | 5 | 35.7 | 9 | 64.3 | 14 | 35.0 |
| Female | 15 | 57.7 | 11 | 42.3 | 26 | 65.0 |

**Table 2. Results of Independent T-Test**

| Time | Δ Fluoride Scores | | P |
|---|---|---|---|
| | Intervention (Mean±SD) | Control (Mean±SD) | |
| Baseline | 0.55±0.34 | 0.38±0.37 | 0.096 |
| 21 days | 0.36±0.29 | 0.22±0.13 | 0.054 |

**Table 3. The Results of the Dependent T-Test**

| Group | | Δ Fluoride Scores | | P |
|---|---|---|---|---|
| | | Before (Mean±SD) | After (Mean±SD) | |
| Intervention | Baseline | 0.72±0.45 | 1.27±0.40 | 0.0001 |
| | Week 3 | 0.96±0.31 | 1.32±0.43 | 0.0001 |
| Control | Baseline | 0.79±0.40 | 1.17±0.42 | 0.0001 |
| | Week 3 | 0.88±0.40 | 1.10±0.40 | 0.0001 |

## DISCUSSION

The results of the independent t-test (Table 2) showed that the fluoride level in saliva between the children who brush their teeth with a toothbrush timer and those who brush their teeth without a timer indicates no significant difference (p> 0.05) although the increase in fluoride level in the intervention group is more than the control group. Thus, it can be concluded that 2 minutes of tooth brushing might not result in a substantial difference in the amount of fluoride in a person's saliva. It is in line with a previous study revealing that although the duration of 2 minutes and 3 minutes had a more noticeable increase, brushing for 45 to 60 seconds was considered to enhance the level of dissolved fluoride in either saliva or teeth. The children in the control group might have been able to brush their teeth properly as they had previously received an education, which might have affected how long they brushed their teeth. However, the results of this study are in contrast with other studies that claimed a length of 120 seconds could significantly increase fluoride levels.[8, 11]

Furthermore, Table 3 displays that both groups that brushed their teeth with a 2-minute timer and brushed their teeth without a timer showed a significant difference in fluoride (p<0.05). It proved that brushing teeth using fluoride toothpaste increases the level of fluoride in saliva, although the brushing duration is less than 120 seconds. After brushing teeth, the fluoride level is higher than before tooth brushing. This study's results align with Newby et al.'s research that brushing teeth

for 40 seconds to 120 seconds increased fluoride levels.[6]

In addition to increasing fluoride levels, the duration of tooth brushing is crucial for effectively removing dental plaque. The longer the duration of brushing the teeth is, the less the plaque score will be.[12,13] Another study showed that the concentration of fluoride in saliva could be an indicator of a person's risk of dental caries.[14] The relationship between the prevalence of dental caries and fluoride concentrations is inverse (negative), indicating that the lower the fluoride concentration in saliva is, the higher the prevalence of dental caries will be.[15] Preventive dental caries programs for children need to be informed concerning tooth brushing instruction for two minutes. This study's results are still inconsistent with the 120-second tooth-brushing recommended by theory. [(2, 16)] It is because fine motor skills in children aged 7-8 years are still not optimal so their ability to hold a toothbrush, move the brush and open their mouth will affect the results of brushing their teeth[17]. Moreover, it might have to do with inadequate research design; specifically, this study should have been conducted using a crossover design to minimize subject variation. Research by Albahrani et al. and other studies stated that what affects the concentration of fluoride in the saliva is not only the duration and type of toothpaste but also the duration and technique of rinsing, which is not controlled in this study.[18,19] The correct rinsing technique to maintain fluoride retention longer is to use as little water as possible and only spit out for less than 1 minute.[20] Future study is also expected to involve more sufficient research samples to generate more reliable results.

## CONCLUSION

A two-minute toothbrush timer had the same ability as a manual toothbrush in increasing fluoride levels in the saliva of children aged 7-8.

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