

The Effectiveness of Electric Toothbrushes and Conventional Toothbrushes in Reducing Plaque Scores on School-Aged Children with Mental Impairment: Pilot Study

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ABSTRACT

Introduction: Improving the quality of life of children is one of the goals of the health development program. The growth of children's health is not discriminated against in this scenario. All children with special needs or impairments are covered by child health services, whether at Special Schools (SS), other institutions, or in the community. This study aimed to evaluate the effectiveness of using an electric toothbrush, compared to conventional toothbrushes, in the reduction of dental plaque score.

Methods: This study was designed as a quasi-experimental study with a pretest-posttest design. All school-aged children with mental impairment in SS Jambi City, Indonesia were included in this study. Overall, 20 children were assigned to the intervention group (n=10) and to the control group (n=10). The Personal Hygiene Performance-Modified (PHP-M) was used to examine plaque index for the assessment of dental and oral hygiene.

Results: In the pretest-posttest, mean difference values in plaque scores were statistically significant in both the intervention (19.50 ± 3.89 , $p < 0.009$) and control (17.90 ± 1.61 , $p < 0.001$) groups. A statistically significant reduction was shown in mean post-test plaque index ($p < 0.001$) in the intervention group compared to the control group (14.50 ± 7.83 ; 32.80 ± 13.14 , respectively).

Conclusion: When compared to conventional toothbrushes, electric toothbrushes are more effective in reducing plaque scores in mentally retarded children at SS Jambi City.

Keywords: Conventional toothbrush, Electric toothbrush, Plaque score, Children, Mental impairment

INTRODUCTION

Overall health, well-being, and quality of life are all influenced by dental and oral health[1,2]. *Oral health* is a state of a person who is free of chronic oral diseases, facial pain, mouth and throat cancer, infections and sores, gum disease, tooth decay, tooth loss, and other diseases that impair the ability to bite, chew, smile, and talk[3].

Dental and oral health care are crucial components of comprehensive health care[4–6]. Dental and oral health indicators represent the Global Goals for Oral Health 2020. One of the technical activities of the WHO Global Oral Health Program (GOHP) is to offer advice to nations on how to build policies for preventing and promoting dental and oral illnesses[7].

Improving the quality of life of children is one of the goals of the health development program. In this situation, the development of children's health is not discriminatory, and child health services are available to all children with special needs or disabilities, regardless of whether they are in special schools (SS), other institutions, or the community[8–10].

According to the 2012 Susenas (National socio-economic survey for Indonesia), 2.45 per cent of Indonesia's population has impairments [11]. Mental retardation is one group of people with disabilities. Individuals with mental impairment are referred to as having mental retardation (mental retardation). Mental retardation, according to the American Association of Mental Deficiency (AAMD), is defined as a significant divergence from general intellectual functioning that coexists with adaptive behaviour impairments and manifests during the formative period [12].

Indahwati, et al [13] compared the dental and oral hygiene of mentally disabled and deaf students in SS-B and SS-C Tomohon City. According to the findings, mentally disabled kids had lower oral and dental hygiene than deaf students. According to Martens L et al. [14], mentally impaired children's motor abilities at the age of 12 are lower than that of normal children, and mentally disabled children have difficulties holding and using a toothbrush. Rosmawati's [15] study demonstrates that children with special needs have poor dental and oral health with an average Decay Missing Filled-

Teeth (DMF-T) score of three.

Because mentally retarded children endure physical and mental development delays, such as disruptions in sensorimotor coordination, children with special needs require particular health services, one of which is children with special needs for mental retardation [16–19]. According to an interview with the principal of the State Extraordinary School 2 in Jambi City, the students at the school have a joint tooth brushing program after recess directed by the teacher and use a conventional toothbrush. However, the prevalence of dental caries remains high [20].

Brushing the teeth prevents dental caries, and the toothbrush most usually used to remove plaque is a standard toothbrush. Traditional toothbrushes need motor coordination from users, but sensorimotor skills are limited in mentally disabled youngsters.

According to some authors, manual toothbrushing entails the application of much higher pressure than the use of power brushes. Powered toothbrushes appear to be helpful in improving the oral health of physically or mentally handicapped individuals because these devices require minimal hand motion and coordination skills. Some models are designed with each bristle rotating individually and are effective plaque removers [21,22].

Considering the benefits of an electric toothbrush, it can make it easier for mentally handicapped children to clean their teeth and mentally disabled children in SS Jambi City have never used an electric toothbrush, it is vital to investigate the usefulness of conventional and electric toothbrushes in them. This study aims to evaluate the effectiveness of using an electric toothbrushes, compared to conventional toothbrushes, in the reduction of dental plaque score.

METHODS

Study design

A monocentric pilot study, with pretest-posttest design, was carried out from February to July 2022 at State Special School 2 in Jambi City, Indonesia.

Sample size

The minimum sample size required for this study was calculated using the G*Power program, considering effect size of 0.82, α -value of 0.05, power of 0.80, and sample group ratio of 1 [23]. In public health research, the value of sample size strength is at least 80%, therefore, we choose an effect size of 82% (lowest).

Participants

Eligible subject were selected according to the following inclusion criteria: all children in SS Jambi, diagnosed with mild mental retardation [24], aged 10-16 years, Dental caries index ≥ 6.6 , unkempt teeth, Dental plaque score 1, bracesless. Children with moderate and severe mental retardation who were unwilling and under ten years old, Dental caries index < 6.6 , Dental plaque score > 1 , kempt teeth, braces and were excluded. Overall, 20 children participated in the study and were split into Intervention (n=10) and Control groups (n=10) which were randomly defined.

Intervention

After enrollment, participants were randomly assigned into a control group (n=10), in which they used a conventional toothbrush, and in the intervention group (n=10), in which they used an electric toothbrush. In both groups, the dental plaque score was evaluated at baseline (T0) and after seven days (T1). On the day 7th (T1), all participants were advised to brush their teeth and not eat food for 30 minutes before the oral health examination was conducted. All participants were instructed to brush their teeth in the morning after getting up, lunch, and dinner using the same toothpaste for

both study groups. The DMF-T index is an index to assess dental and oral health status in terms of permanent dental caries [25,26]. The DMF-T index is an assessment of the total number of teeth or surfaces that are Decayed/Carious (D), Missing (M), and Filling (F) for everyone. The severity of dental caries at the age of 12 years or older is categorized into five categories, including very low severity with a DMF-T value of 0.0 – 1.0. Then the low severity level with a DMF-T value of 1.2 - 2.6. Moderate severity with a DMF-T value of 2.7 – 4.4. And a high severity level with a DMF-T value of 4.5 – 6.5, and a very high severity level with a DMF-T value of ≥ 6.6

Outcomes

Disclosing solution was used to carry out the procedure for measuring plaque scores. It works by putting a disclosing solution on the subject's tooth surface and recording the findings. Dental and oral hygiene was assessed using PHP-M (Personal Hygiene Performance-Modified). The assessment begins by making imaginary lines on the teeth to form 5 imaginary lines. The lingual and labial surfaces of the teeth were examined. If a plaque was observed in one area, it was given a score of 1. Otherwise, a score of 0 or a sign was provided (-). Plaque assessment findings were calculated by summing each plaque on each tooth surface, resulting in a plaque score for each tooth ranging from 0-to 10. Plaque scores for all teeth can range from 0 to 60, with 0-20 indicating good criteria, 21-40 indicating moderate criteria, and 41-60 indicating poor criteria.

Ethical Consideration

In this study, parents of the children had given their consent to the study. Before carrying out data collection, the researcher first took care of ethical permission. The authors state that this study followed all ethical clearance processes and was approved by the health research ethics committee of Jambi University Faculty of Medicine and Health Sciences, with number: LB.02.06/2/04/2022.

Statistical methods

For categorical variables, data were presented as numbers or percentages. The mean, standard deviation (SD), or median with Interquartile Range are used to express continuous data (IQR). Before the statistical test was carried out, the data normality test was first carried out using Shapiro Wilk test.

The non-parametric test used was Wilcoxon to assess pre vs post conventional groups, while the Mann Whitney test was used to assess pre vs pre both study groups. The non-parametric tests were used for non normal data. The Paired T-Test was employed in data analysis to see if there was a difference in mean plaque scores before and after using a traditional toothbrush versus an electric toothbrush. The difference in plaque scores before and after treatment between the conventional toothbrush group and the electric toothbrush group was investigated using the independent T-Test. All tests with a p-value (p) of less than 0.05 were deemed significant. The SPSS version 16.0 application was used for statistical analysis.

RESULTS

Participants characteristics

The general characteristics of children, as shown in Table 1:

Characteristics	N	%
<i>Age (year)</i>		
[10-14[6	30
[14-17[14	70
<i>Gender</i>		
Male	9	45
Female	11	55

Table 1. *Characteristics of childrens*

The results of research on childrens with mental retardation SS Jambi City, as shown in Table 2:

Criteria	Control		Intervention	
	Pre	Post	Pre	Post
Good	0 (0.0)	2 (20)	1 (10)	9 (90)
Moderate	1 (10)	3 (30)	8 (80)	1 (10)
Poor	9 (90)	5 (50)	1 (10)	0 (0.0)

Table 2. *Frequency Distribution of Plaque Score Criteria Based on PHP-M Index*

Table 2 shows that before brushing their teeth, the criteria for plaque scores of children were one child (10%) with moderate criteria and nine children (90%) with poor criteria. After brushing their teeth, the criteria for plaque scores of children were two children (20%) with good criteria, three children (30%) with moderate criteria, and five children (50%) with poor criteria.

Before brushing their teeth with an electric toothbrush, the plaque score of children was eight children (80%) with moderate criteria, one child (10%) with good criteria, and one child (10%) with poor criteria. After brushing their teeth, the plaque score of nine children (90%) with good criteria and one child (10%) with moderate criteria.

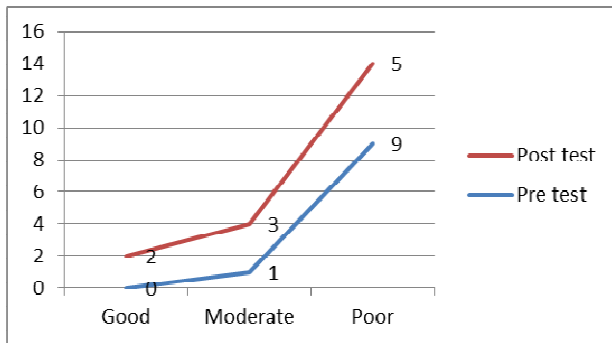


Figure 1. *Plaque score criteria for control group children*

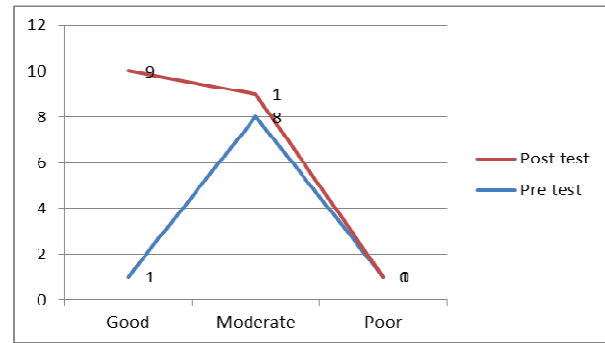


Figure 2. *Plaque score criteria for intervention group children*

Because the sample size was less than 50 children, the Shapiro Wilk test was employed to determine the normality of the data. The sample size in this study was 20 children, as shown in Table 3:

Groups	<i>Shapiro wilk test</i>	
	<i>Pre-test</i>	<i>Post-test</i>
Conventional Toothbrush	0.014	0.261
Electric Toothbrush	0.123	0.122

Table 3. *Normality Test Results of Plaque Score Data for Children with Mental Requirements in SS Jambi City*

The non-parametric test will be continued since the pre-test results in the conventional toothbrush group had an aberrant distribution of $0.014 < 0.05$, and the post-test data were typically distributed at $0.261 > 0.05$, as shown in table 3. In the meantime, the results in the electric toothbrush group were normally distributed, with a pre-test of $0.123 > 0.05$ and a post-test of $0.122 > 0.05$, respectively, followed by a parametric test.

Variables	N	Conventional Toothbrushes	Electric Toothbrush	<i>P-value</i>
		Median (IRQ) Mean±SD		
Before	10	55 (50.75-58) 52.30± 9.25	34.5 (29.75-38.25) 32.40 ± 9.44	0.001* (M)
After	10	36 (29-39.25) 32.80± 13.14	12.5 (9.5-17.5) 14.50 ± 7.83	
Difference Value plaque	10	19.50 ± (3.89)	17.90 ± 1.61	
Before vs After				
<i>P-value</i>		0.009 (W)	0.001 (T)	

Description: M (Mann Whitney), W (Wilxocon), T (dependent T-test), I (Independent T-Test)

Table 4. *Test of the Effectiveness of Using Conventional Toothbrushes and Electric Toothbrush on Decreasing Plaque Scores in SS Jambi City*

Table 4 shows that the mean score of plaque before brushing teeth is 52.30, whereas the mean score of children's plaque drops to 32.80 after brushing, indicating a 19.50 decrease in the mean value. The p-value for the paired data effectiveness test is < 0.009 , indicating that using a conventional toothbrush to reduce plaque scores in mentally disabled children at SLBN 2 Jambi City is thriving. The mean score of plaque before cleaning teeth is 32.40, that the mean score of children's plaque falls to 14.50 after brushing, and that the mean value decreases by 17.90. The findings of the paired data effectiveness test show that the p-value is < 0.001 , indicating that using an electric toothbrush to reduce plaque scores in mentally disabled children in SS Jambi City is beneficial.

The mean post-test value for the conventional toothbrush group is 32.80, while the electric toothbrush group is 14.50, with a P-Value of < 0.001 . It indicates the difference in plaque score reduction effectiveness between conventional and electric toothbrushes in mentally disabled children.

The use of electric toothbrushes is more effective in reducing plaque scores in mentally retarded children at SS Jambi City, based on this description.

DISCUSSION

The current study is based on the theoretical basis of the physical condition of children with mental retardation. It has been known that children with mental disorders have mobility limitations, specifically in their extremities. This situation raises question marks about their ability to brush their teeth. Some studies have proven that mentally impaired children's motor abilities are lower than normal children, and mentally disabled children have difficulties holding and using a toothbrush. Children with special needs have poor dental and oral health with an average Decay Missing Filled-Teeth (DMF-T). So in this study, we evaluated the effectiveness of using an electric toothbrushes, compared to conventional toothbrushes, in the reduction of dental plaque score.

We reported that the use of conventional toothbrushes helped lower plaque scores in children with mental retardation in SS Jambi. These findings are in line with research conducted by Sitepu et al. [27] that using soft toothbrushes reduces plaque scores in mentally disabled children and a study conducted by Basith et al. [28] on 40 kids with Down syndrome in India. They observed manual or conventional toothbrushes to eliminate plaque and reduce gingivitis in children with Down syndrome for two months in each group.

In this study, it was also found that electric toothbrushes reduced the number of plaque scores in mentally disabled children in SS Jambi. Electric toothbrushes are effective in reducing OHI-S rates in children with Down syndrome, according to research conducted by Az Zahra et al. [29] and research conducted by Vandana et al. [30] on 30 people with mental problems who were observed for 45 days showed that brushing teeth with an electric toothbrush can reduce the number of mycobacteria in the oral cavity of mentally disabled children.

Plaque removal is the most critical activity for maintaining good teeth and oral health. The most popular tool for eliminating supra-gingival plaque is a toothbrush. However, most people do not clean their teeth correctly, and there is still a lot of plaque on the surface of their teeth [31].

Although electric toothbrushes are more expensive, because of the numerous designs and colors,

they are thought to be more effective in raising the interest of mentally challenged youngsters in brushing their teeth. Electric toothbrushes are also good teeth cleaning equipment for preventing biofilm or plaque from forming on the surface of the teeth [32].

After brushing their teeth with an electronic toothbrush, the growing criteria for plaque scores in youngsters improve. This is due to the fact that the movement utilized in electric toothbrushes is better and more successful in reaching all parts of the mouth, as it is a systematic movement [33].

Mentally retarded children usually have difficulty in imitating the way of brushing their teeth that has been shown because their fine motor development is worse than normal children in general. Furthermore, mentally retarded children's eye and hand coordination is severely impaired. As a result, the child will have difficulties with fine motor movements, which will prevent the youngster from executing actions that demand concentration and complex hand movements [34]. Electric toothbrushes are more effective for intellectually impaired youngsters because of this. Because electric toothbrushes move automatically and children can feel the proper vibration to massage the gum and gingival area, they are a good choice for youngsters. As a result, using an electric toothbrush is more efficient and effective [29].

Although the results of this study have reported that electric toothbrushes are very suitable for use by children with mental retardation, the role of parents is highly expected. Parents or companions are required to take a more active role in encouraging mentally challenged youngsters to clean their teeth twice a day, in the morning after breakfast and at night before bed. We really hope that in the future the production of electric toothbrushes will be further improved at a price that can be affordable by all circles of society.

Based on the results of this study, we strongly recommend the use of an electric toothbrush, especially for students with mental retardation.

CONCLUSION

When compared to electric toothbrushes, electric toothbrushes are more effective in reducing plaque scores in mentally retarded children at SS Jambi City.

Study Limitations

One of the limitations of this study is the very small sample size (a pilot study), we collected data at only one center in Indonesia, which may limit the generalizability of our results to the larger population, so that in the future it is necessary to conduct similar studies in a larger population. Another limitation of the study was that the genders were not matched in the second group, which may have influenced the study results.

Authors' contribution

All authors equally contributed to preparing this article.

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Conflict Of Interest

The authors declare that there was no conflict of interest in this research.

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