

## Electrodermal Activity as an Indicator of Dental Anxiety Hearing Impaired Children After Educated by Pop-Up Books

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### Abstract

Dental anxiety can occur in children and adults. It can cause a child to be uncooperative during dental care. Children with hearing impairment have hearing loss, and therefore have barriers in interacting and communicating with others, especially during dental care procedures. "Aku dan Gigiku" pop-up books are an educational medium containing information about dental health and dental care. Measuring dental anxiety in children is important to improve the quality of clinical care. Measuring the electrodermal activity is one of the simplest ways to quantitatively measure the psychophysiological activity of patient anxiety.

The study was carried out on 42 children with hearing impairment (21 children each in the control and intervention groups) from 7–9 years of age. Children in the treatment group were educated with "Aku dan Gigiku" pop-up books. Dental anxiety was assessed by measuring electrodermal activity using galvanic skin response (GSR) at two time points: before and after education with the pop-up book "Aku dan Gigiku."

The results of both the groups were compared. Result: Statistical data were analyzed with the Mann-Whitney test. There was a statistically significant difference in the delta value of electrodermal activity between the intervention and control groups.

This study shows that "Aku dan Gigiku" has a positive effect on the dental anxiety of children with hearing impairment.

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### Introduction

Anxiety is a physiological phenomenon that occurs when a person experiences stress from unpredictable events, medical treatments, or unpleasant experiences.<sup>1</sup> Patient anxiety during dental care is a challenge faced by dentists in everyday practice.<sup>2</sup>

Dental anxiety can occur in both child and adult patients. Dental anxiety in children usually causes the child to be uncooperative during dental care.<sup>3</sup> Anxiety in patients, especially pediatric patients, can cause problems in

behavior management, as a result of which it takes longer to complete the treatment.<sup>1</sup> Thus, to reduce anxiety, it is advisable to inform or educate pediatric patients and their parents in a positive and fun way to make them aware of the conditions and maintenance procedures to be done.<sup>2</sup>

One approach to overcome dental care anxiety in children is via educational media such as pop-up books. A pop-up book is a type of book or card containing a cropped image that forms a three-dimensional layer when the page is opened.<sup>4,5</sup> The "Aku dan Gigiku" is one such pop-up book that contains information about the treatment involved in the dentist's clinic.<sup>6</sup>

The "Aku dan Gigiku" is used to inform and educate anxious children undergoing dental treatment.<sup>6</sup> Citrawuni et al. measured pulse delta values in intervention and control groups and reported that using the "Aku dan Gigiku" can significantly decrease dental care anxiety reflected by pulse delta values in the intervention

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group using the “Aku dan Gigiku” book compared to control groups without the intervention.<sup>6</sup>

Children with hearing impairment are children who experience partial or complete hearing loss, and this has a complex impact on their lives.<sup>7</sup> Children with hearing impairment are thus faced with a great obstacle to communicating and interacting with others.<sup>8</sup> This affects the child's behavioral patterns in general, and their psychological, emotional, and social functions.<sup>8</sup>

In dentistry, measurement of dental care anxiety in children, especially children with hearing impairment, is very important. The objective of measuring dental anxiety in children is to improve the quality of clinical care and research.<sup>3</sup> Dentists can identify anxious children to cope well with anxiety, so that the child will have good dental care and a positive experience with dental care.<sup>3</sup> The right way for a dentist to identify anxiety in children is to understand the anxiety level before treatment and the factors that influence it.<sup>3</sup>

During this time, many methods have been developed to measuring anxiety both subjectively and objectively.<sup>9</sup> Subjective measurement involves the child directly assessing what he or she felt when undergoing dental treatment.<sup>9,10</sup> Objective measurement is a method of directly measuring anxiety using physiological indicators in saliva, blood, and urine.<sup>10</sup> Objective measurement must be carried out through laboratory testing that is costly and time-consuming, so the method is less efficient to use.<sup>11</sup> Another simpler, more objective measurement method is measuring the pulse rate, breath frequency, salivary alpha amylase, and electrodermal activity. Measurement of electrodermal activity is one of the simplest tools to measure the psychophysiological activity of anxiety in a quantitative patient.<sup>12</sup> The principle of measurement by this method is by measuring the electrodermal activity through the activity of the sweat glands on the skin surface.<sup>11</sup> Measurement of electrodermal activity is a noninvasive technique, easy to use in children, very stable during child movement, easy to operate, and a very accurate objective measurement.<sup>13</sup>

### Materials and methods

The study protocol was independently reviewed and approved by the Ethics

Commission of Dentistry Research, University of Indonesia. The participants are 7- to 9-year-old children with hearing impairment who were enrolled in Santirama Extraordinary School, Jakarta, for the academic year 2017/2018.

The following criteria were considered for inclusion in the study: children with hearing impairment with grades 1-3 extraordinary school communication levels, deaf children who are have IQ 90–100, and deaf children who have never previously received dental treatment.

The study subjects first underwent an initial measurement of electrodermal activity, and the results were used as baseline data. The subjects were divided into two groups: an intervention group, which will be educated through pop-up books, and a control groups, in which no pop-up books will be used. The research team prepared a room simulating a dental clinic, equipped with tools to perform oral prophylaxis. After the room and tools were prepared, the subjects were individually called to the room for the measurement of electrodermal activity.

To measure electrodermal activity, the students were asked to sit, and their index and ring fingers were moistened with wet cotton. The two fingers were then affixed to electrodes (black electrode for the index finger and white electrode for the ring finger). The operator then connected the USB-200 module to the laptop. Then, the operator ensures the GSR sensor is connected to the USB-200 module. The operator runs the Neulog app and makes sure that the GSR sensor is identified, and clicks on the “Run experiment” icon. The graph will move up and down. The operator waits for a minute until the graph is stable, then clicks on the “Record” icon to start the measurement (experiment duration is 10 seconds). Then, the operator clicks the “Arrows” icon to see the results of the measurement. After completion, the condition of the teeth and mouth of the subjects was examined, and oral prophylaxis was carried out.

### Results

A total of 42 subjects 7- to 9-year-old children with hearing impairment (16 girls and 26 boys) were included in the study. These were deaf children who have never received dental treatment before and no distinction was made between boys and girls. The value of

electrodermal activity in the intervention group was measured twice, namely, before and after intervention with the “Aku dan Gigiku” pop-up book. The same was done in the control group, but without the pop-up book. Electrodermal activity was measured three times, then the average was calculated. The value analyzed is the difference (delta) between the value of electrodermal activity after and before intervention.

Prior to statistical analysis, the data obtained were tested for normality by using the Shapiro-Wilk test. The normality test of the interval electrodermal activity delta value of the intervention and control groups revealed abnormal distribution of the results ( $p < 0,05$ ); therefore, non-parametric testing was carried out using Mann-Whitney test.

Variable	n	Median (Minimum – Maximum) $\mu$ S			P
		AE <sub>1</sub>	AE <sub>2</sub>	$\Delta$	
Intervention group	21	3.33 (1.12 – 9.25)	2.35 (0.63 – 5.70)	-1.41 (0.02 – 4.31)	0.01*
Control group	21	4.28 (0.31 – 10.00)	5.34 (0.90 – 10.00)	1.34 (5.38 – 0.00)	

**Table 1.** Delta values of electrodermal activity between the intervention and control groups.

Mann-Whitney Test, \* $p \leq .005$ , EA: Electrodermal Activity.  $\mu$ S: micro Siemens, Intervention group: Children received intervention with “Aku dan Gigiku” pop-up books, Control group: No pop-up books were used for intervention.

Table 1 shows that the median and minimum – maximum values of electrodermal activity of the treatment group before and after intervention were 3.33 (1.12 – 9.25)  $\mu$ S and 2.35 (0.63 – 5.70)  $\mu$ S, respectively. This clearly shows that the electrodermal activity decreased after the intervention.

In the control group, the before and after values of median and minimum – maximum electrodermal activity were 4.28 (0.31 – 10.00)  $\mu$ S and 5.34 (0.90 – 10.00)  $\mu$ S, respectively. The electrodermal activity in the control group increased without intervention.

Table 1 also shows the delta mean  $\pm$  median electrodermal activities of the intervention and control groups were -1.41 (0.02 – 4.31)  $\mu$ S and 1.34 (5.38 – 0.00)  $\mu$ S, respectively. To test the hypothesis, the Mann-Whitney test was carried out at a p value of 0.01. The value of  $p < 0.05$  indicates that there is a significant difference in the delta value of electrodermal activity between the intervention and control groups.

## Discussion

Measurement of dental anxiety in children, especially in children with hearing impairment, is important to improve the quality of clinical care. Measurement of dental anxiety in deaf children through electrodermal activity is the simplest method due to its non invasive nature, ease of use in children, ease of operation, and accuracy. This study aims to analyze the effect of education through “Aku dan Gigiku” pop-up book on dental care anxiety in children with hearing impairment, measured using electrodermal activity.

In this study, there is a decline in the electrodermal activity in children with hearing impairment after education with the “Aku dan Gigiku” pop-up book. Education with “Aku dan Gigiku” is therefore the right strategy to reducing anxiety in children.

In this study, children with hearing impairment are selected because they are at a greater risk for dental disease because of greater neglect or poor oral hygiene and access to routine dental care.<sup>14</sup> Children with hearing impairment have the greatest obstacle to communicating and interacting with others.<sup>2</sup> This affects the child’s behavioral patterns in general, psychological, emotional, and social functions.<sup>2</sup> Samnieng (2014) and Singh (2012) reported that deaf patients in particular often fail to obtain the needed care because of the communication difficulties experienced in treatment situations.<sup>8,14</sup>

Dental anxiety in children usually causes a child to be uncooperative during the treatment procedure. Jimeno et al. (2016) reported that there is a connection between dental anxiety and uncooperative behavior in children.<sup>10</sup> Thus, knowing the degree of dental anxiety in children is important to guide them through their dental experience.<sup>10</sup> Their level of cooperation will also improve and anxiety will be reduced.<sup>10</sup>

The GSR logger sensor is a tool for measuring electrodermal activity. Emotional and sensory stimulation causes the production of sweat. The GSR logger sensor is used to measure sweat coming from the sweat glands of a hand.<sup>15</sup> As a result of the stimulation, the amount of sweat increases and so does the skin conductivity.<sup>15</sup>

Electrodermal activity measurement was selected in this study because it is one of the simplest tools to measure the psychophysiological activity of anxiety in a

quantitative. Najafpour et al. (2016) reported that the GSR is a reliable and valid measurement tool for assessing children's dental anxiety in the clinical setting. GSR may help identify clinically anxious children before dental treatment to provide appropriate interventions.<sup>12</sup>

Pop-up books are a form of interactive literature that are often used as an educational tool for children because it presents interesting illustrations and can be easy to understand.<sup>5</sup> Stark reported that pop-up book intervention has been used to decrease anxious and disruptive behavior and to teach children to be more adaptive.<sup>4</sup> The pop-up book "Aku dan Gigiku" was selected in this study because it contains information about the treatment involved in the dental clinic.<sup>6</sup> Citrawuni et al. (2016) reported that "Aku dan Gigiku" intervention was an appropriate strategy to reduce children's anxiety in younger children.<sup>6</sup> This is indicated by

In this study, there was a decrease in dental anxiety in children with hearing impairment after "Aku dan Gigiku" intervention. This was reflected by a significant difference in the electrodermal delta value between the intervention and control groups. Citrawuni, et al (2016) reported that there is a significant difference in the pulse rate between the "Aku dan Gigiku" intervention and control groups prior to oral prophylaxis procedure.<sup>6</sup>

## Conclusions

This study shows that the "Aku dan Gigiku" pop-up book has a positive effect in reducing dental anxiety of children with hearing impairment, as reflected by the decline in the value of electrodermal activity.

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## Declaration of Interest

The authors report no conflict of interest.

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