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Submission date: 06-Jun-2021 09:17PM (UTC-0400)

Submission ID: 1601707292

File name: Arbi_Care_application_increases_preschool_children_s.docx (410.02K)

Word count: 2697

Character count: 14908



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Arbi Care application increases preschool children's hand-washing self-efficacy among preschool children

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KEYWORDS

Educational;
Game;
Self-efficacy;
Hand-washing;
Preschool;
Diarrhea

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Abstract

Objective: This research aimed to examine the effectiveness of an Android mobile game application called Arbi Care as a means to prevent diarrhea and build self-efficacy in hand washing among preschool children.

Method: This research used a pre- and post-test control group and time series design approach. Respondents were chosen randomly from a group of four to six years children. The intervention group (n = 60) received Arbi Care intervention for 25 minutes, twice a week, for five weeks while the control group (n = 60) received standard education. Self-efficacy was measured by using questionnaire and observation. Measurement was carried out three times in the sixth, eighth, and tenth week post-intervention. The data was analyzed using the GLMRM test.

Results: There was a significant increase in the average score of self-efficacy in hand washing for the intervention group versus the control group. Moreover, there were significant differences in the results of average scores in which the intervention group showed much better self-efficacy improvement over the control group during the first, second, and final post-test after the intervention was given (p < 0.001).

Conclusions: An Android-based educational game can be an effective medium to improve hand washing self-efficacy among preschool children, thus helping to prevent diarrhea.

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Introduction

Diarrhea is an infectious disease that is a common cause of death among children under five years. According to the United Nations Inter-agency Group for Child Mortality Estimation, the estimated number of children's deaths in 2015 was 5.9 million and diarrhea was the second deadliest disease after pneumonia¹. Diarrhea is generally caused by children's behavior, poor sanitation, and unhealthy lifestyles². Some factors that may affect children's lifestyle in school

are education, awareness, skills, hygiene and sanitation training, joining a club related to hygiene and sanitation, visiting model schools, and the status of their parents' health³. Good sanitation and intervention in forming children's behavior to adopt a healthy lifestyle can reduce the risk of diarrhea by 36%-48%⁴. Hand hygiene is one of the most important elements of a healthy lifestyle. The World Health Organization states that washing hands with soap can reduce the risk of diarrhea up to 50%⁵. However, hand hygiene practice among children remains low, due to lack of

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education and the willingness to practice good hand hygiene³. Therefore, it is important to increase children's willingness to wash their hands through education to the children.

Based on Nola J. Pender's theory, to encourage healthy lifestyles, an intervention must occur to motivate people to improve their knowledge, self-efficacy and behavior⁴. Self-efficacy is an assessment of an individual's ability in to take action to gain something as it is expected like healthy lifestyle⁷. Self-efficacy, in terms of a healthy lifestyle among children, can also promote healthy behavior in the future. According to Erickson, preschool children's psychosocial development involves creating a sense of initiative. In addition, preschool children are likely to be enthusiastic about learning something new. Children often play and learn as they struggle to accomplish something, and they derive satisfaction from doing their regular activities⁸. At this point, it is recommended to educate children about good behavior through educational video games.

Arbi Care is a game based android for 25 minutes long developed by researcher and game developer. It can play by mobile phone, and helpful preschool children learn about how to prevent diarrhea. Video game is one form of educational media that can be used to change children's behavior and broaden their knowledge by stimulating their imagination and creativity⁹. Moreover, children love to play video games. Thus, video games can be a potentially an interesting medium to educate children about healthy behavior. This study was conducted to identify the effectiveness of educational video games to improve children's self-efficacy in hand-washing.

Method

This research used a pre- and post-test control group with a time series design approach. One hundred and twenty children were involved in the pre-test. All of the participants were then divided randomly using random table into an intervention group of 60 children, with 60 children in the control group. Some respondents who did not attend the second or third measurement were eliminated. Therefore, the researcher processed 57 respondents from the intervention group and 59 respondents from the control group. The intervention group received healthy lifestyle education via the Arbi Care game while the other group only received standard health behavior education at school. The intervention of Arbi Care was given for 25 minutes, twice a week for five weeks. Post-test observation was conducted to measure self-efficacy in the two groups of children, and it was carried out three times: during the sixth, eighth, and tenth weeks following the intervention.

The research was conducted from January to April 2016 in three different kindergartens in Manggala District, Makassar, and South Sulawesi, Indonesia. The location was selected due to the fact that it has the main landfill, which has higher risk of diarrhea. South Sulawesi province, where Makassar is located, is also has the second highest prevalence of diarrhea in Indonesia.

The sample size was determined with sample size formula to compare two independent means. The inclusion criteria for this research were children aged four to six

years, able to play mobile games, willing to be respondents, and having permission from their parents to participate. Children lacking attention and/or with misbehavior problems were excluded from the study. This research was conducted with ethical clearance from the Nursing Faculty of Universitas Indonesia. Informed consent was obtained from the parents, while the children also received a brief explanation of the research.

The independent variable of this study was the Arbi Care application, which is an Android-based game to introduce healthy habits, particularly relating to hand hygiene to prevent diarrhea. The game features a main character of a child-like figure that needs to go to the toilet. However, he should wash his hand before he left the toilet. A similar series events occurs when he is ready to eat food. In order to perform hand-washing, the player must follow the five steps of hand-washing, which are recommended by the nation's health department. The steps of hand-washing are suitable for the short attention spans of preschool children.

The dependent variable used in this study was the self-efficacy of the children, which measured the relevance between their statements and their ability to do standard hand-washing. The measurement tool used in this research was a questionnaire that includes two major topics about self-efficacy, as well as observation of the five steps of hand-washing practice with soap. The observation consist of soaking hands with running water, applying soap to the palms, back of the hands, and fingers, cleansing the fingernails, rinsing the hands, and drying the hands. The questionnaire was developed by the researchers, and its validity and reliability were tested beforehand ($r = 0.833$). The scoring of self-efficacy was measured with a score ranging from 0 to 10.

The intervention procedure began with conducting a meeting with headmasters and teachers of the kindergartens to explain the research. Then, the research assistant gave training on using the measurement tools as well as the procedure of demonstrating the educational game. Children and their parents received informed consent to do the pre-test in both the intervention and control groups. Intervention was carried out by showing educational video game about diarrhea prevention to the intervention group only, for five weeks. Subsequently, the post-test was conducted in the sixth, eighth, and tenth weeks in both group. In order to ensure quality of the intervention, the researcher conducted weekly meetings with the research assistants. Research assistants were fresh graduate from bachelor of nursing who passed the training and have a good score in inter-rater reliability.

The data was analyzed using statistical software. Univariate analysis was applied to obtain the self-efficacy score on each item before and after giving the intervention in both groups. In addition, the bivariate analysis was also applied to detect the differences between the time of measurement of intervention the intervention and control groups by using the General Linear Model Repeated Measure test.

Results

The results showed an improvement in hand hygiene self-efficacy after the intervention was given. The average score

for the intervention group was 2.6, while the other group's score was 0.9. The improvement in the average score for the intervention group can be seen in both the statements on self-efficacy and hand washing practice. However, the most significant improvement was seen in hand-washing practice. The complete scores of both groups are reported in Table 1.

The results of this research also showed significantly different scores of self-efficacy within the three measurement times in the sixth week, eighth week, and tenth week in both groups ($p < 0.001$). The group that received Arbi Care intervention showed an increased score of self-efficacy up to 50.07%, while the control group only increased by 25.19%. The results also showed continuous improvement in self-efficacy two weeks and on month post-intervention, although the average score was slightly decreased compared to the first measurement. The children's sustained self-efficacy indicates that hand-washing education was still intact even after a month post-intervention. However, even though self-efficacy increased, the effect of the intervention was likely to diminish the more time that passes after the intervention. The complete results of the research are shown in Table 2.

Discussion

The results of this research demonstrate that the educational game; Arbi Care; is effective at improving preschool children's self-efficacy of performing hand-washing. These results correspond to another study on the influence of the type of exercise video game referred to as "exergaming" which improves the self-efficacy of elementary school children's performance of physical exercise. The aforementioned study reveals that exergaming intervention was effective at improving self-efficacy, and was more significant for group of overweight children, whom the researcher continued to monitor 12 weeks and 24 months post-intervention⁷. Therefore, both studies suggest that video games

can affect self-efficacy in adopting a healthy lifestyle, not only for the short term, but also over the longer term.

The effectiveness of video games at changing behavior is also determined by the presence of a mediator. A mediator, in this sense, refers to an individual quality of being caring, knowledgeable, able to self-regulate, able to experience self-efficacy, self-motivated, competent, autonomous, and harmonious¹⁰. Self-efficacy is a basis of motivation, happiness, and accomplishment¹¹, and it can affect someone's behavior. However, the best time to improve an individual's self-efficacy is within the preschool period because preschool children tend to have high self-efficacy, to be optimistic, and to be willing to learn something new¹².

Preschool children can increase self-efficacy using video game. Symbolic interactionism theory implies that video games allow children to understand the world. A video game can educate children by allowing them to take on a different role, giving them an opportunity to understand other roles that are present in society in real life. Furthermore, video games encourage children to develop empathy by understanding other's feelings and seeing things from another perspective. Video games are, therefore, not solely forms of amusement, but are also media that can have a positive effect on children¹³.

Moreover, video games can improve children's self-efficacy in changing their behavior. They may improve children's motivation to study, as they offer challenging storylines and provide information in fun ways¹⁴. This also corresponds to a previous study which demonstrated that the game-based e-book learning model was also effective at improving elementary school children's learning accomplishment, self-efficacy and motivation in studying math¹⁴. Furthermore, video games also offer positive influences, especially in terms of health care¹⁵. Currently various video games are available that are related to health, prevention of certain diseases, and disease management that can educate, train, and change behavior¹⁰. For instance, there is a game called "Re-Mission" which educates players about cancer. The research using "Re-Mission" which is aimed at adolescent and

Table 1 Illustration of average score of self-efficacy of hand-washing before and after the intervention of Arbi Care applied to the intervention group and the control group*

Self-efficacy of hand hygiene	Intervention group			Control group		
	Pre	Post	Δ	Pre	Post	Δ
<i>Self-efficacy statement</i>						
1. Ability	9.8	10.0	-0.2	9.5	10	-0.5
2. Confidence	6.2	7.5	-1.3	6.2	6.4	-0.2
<i>Hand washing practice</i>						
1. Soaking hands with running water	6.5	9.5	-3.0	7.0	9	-2.0
2. Applying soap to the palms, back of the hands, and fingers	4.5	7.5	-3.0	4.0	3.3	0.7
3. Cleansing the fingernails	0.4	3.1	-2.7	0.3	0.6	-0.3
4. Rinsing the hands	4.6	9.6	-5.0	5.6	9.1	-3.5
5. Drying the hands	2.2	5.1	-2.9	0.2	2.3	-2.1
<i>Average score of self-efficacy</i>	4.7	7.3	2.6	4.7	5.6	0.9

*The scale of the score ranges from 0 to 10.

Table 2 Differences of average scores of self-efficacy of hand-washing between time of measurements in the intervention and control groups. Makassar, January-April 2016

Group	Pre-test		1st post-test		2nd post-test		3rd post-test		Δ (%)
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Intervention	6.55	0.28	10.26	0.29	10.13	0.28	9.83	0.25	50.07
Control	6.55	0.28	7.81	0.29	7.88	0.28	8.20	0.26	25.19
p	0.982		< 0.001		< 0.001		< 0.001		

GLMRM test < 0.001.

adults, shows good result, including significant improvement in respondent's knowledge of cancer and self-efficacy at preventing cancer, versus respondents who played another video game¹⁶. This suggests that video games that are designed to educate people about health care tend to affect people positively versus games that contain no educational elements.

Most video games provide narrated information which encourages players to learn from the narrated experience. Narrative-centered learning theory implies that there is a cognitive process from narrated information in which the reader enjoys the story, draws a conclusion, and then gains an emotional experience as a result¹⁷. Self-efficacy is an important component in the learning process. It can affect an individual's understanding and appearance, behavioral adaptation and certain conditions that need to be achieved. Self-efficacy refers to an individual's self-perception of skills and ability to take effective action, which is created through tolerance changes in every step of behavioral changes. Therefore, self-efficacy is the main precondition that needs to be optimized in order to achieve behavioral changes.

The effectiveness of video games at improving knowledge and behavior to adopt a healthy lifestyle can also be applied as a form of nursing care intervention. The result of this study shows a direct implication of a video game's ability to improve self-efficacy in children's hand-washing. Children are confident at informing perform hand-washing as part of their daily habits. Moreover, the indirect implication of Arbi Care is that it can help prevent diarrhea, which often infects preschool children.

This research carries a possible bias, in that there was direct interaction between both the intervention and control groups outside of the researcher's supervision, because both groups were in the same school. Thus, future research is suggested that minimizes the biased interaction between interventions the two groups.

In conclusion, Arbi Care is an effective way to improve self-efficacy of hand-washing for preschool children. Giving children education about health through video games can be implemented to reduce the risk of diarrhea and its attendant risk of being hospitalization. This educational video game can be further developed for elementary school children and young adults for different aims and topics.

Acknowledgement

Acknowledgements awarded to Direktorat UI which has provided funding for this research publication.

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