

The Effectiveness of the ‘My Hands Are Clean Program’ Based on the Health Promotion Model Conducted with Virtual Reality Method

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ABSTRACT

Objective: Hand hygiene is very important as the hand is the organ that contains the most microorganisms. On the other hand, the school environment is an important environment for raising awareness of hand hygiene and acquiring handwashing behavior. This research was conducted to determine the effectiveness of the ‘My Hands are Clean Program’, which is carried out with the virtual reality method based on the health promotion model.

Methods: This research is a quasi-experimental study with a pre-test and post-test model. The research population is 4th-8th grades in a school. Data were collected by socio-demographic characteristics form, hand hygiene observation form, and decision scale. Measurements were made before the training, after the training, the first follow-up after one month and the second follow-up after two months. Data were analyzed using IBM SPSS 26.0, Kolmogorov-Smirnov, Wilcoxon Test, Fridman Test, Mann Whitney U test, Kruskal Wallis test, and Bonferroni-corrected pairwise comparisons in further analysis. The “TREND checklist” was used to report it.

Results: The students got the highest score on the hand hygiene observation form at the first follow-up. It was determined that students’ post-test, first follow-up and second follow-up mean scores were significantly higher than the pre-test mean scores. In Gpower Post hoc power analysis, the power of the study was determined to be 99%.

Conclusion: It can be said that the use of technology-based methods in developing handwashing behavior, which will affect lifelong health, is effective for school-age students.

Keywords: Hand hygiene, virtual reality, health promotion model

1. INTRODUCTION

School is an ideal environment for preserving and maintaining the physical, social, and spiritual well-being of children, preventing diseases, promoting health, and providing positive behavioral changes. Various health problems seen in school-age affect the learning process negatively. Childhood is a suitable period to change health habits in a positive way. Hygiene, which is the most important way to protect health, is defined as the purification of polluted substances in the environment (1). Hand hygiene is of great importance as we use our hands the most in daily life, transporting contaminated materials, preparing food, and cleaning goods (2–5).

Studies emphasize that hand washing is very effective in preventing infection transmission. According to a study conducted in the daycare center, it was found the use of disinfectant during hand washing decreased and fewer

antibiotics were prescribed for children hospitalized in the care center due to infection (6). In a study examining the effectiveness of the comprehensive hand hygiene module on preschool children, it was emphasized that the hand hygiene scores of the children increased significantly after the training compared to before (7). As a result of the hand hygiene activity, which was organized with a semi-experimental design for kindergarten children, it was concluded that the knowledge level of the children increased and they could use the appropriate hand washing technique (8).

It is aimed to provide clean water and personal hygiene in primary health services for school health. Personal hygiene behaviors are those that should be acquired in the family environment at an early age before coming to school. At school, under the supervision of school health professionals, it is necessary to eliminate the deficiencies, to acquire and

maintain these behaviors (9). Thus, health professionals working at the school have unique opportunities to diagnose students with handwashing deficiency in the early stages, for reasons such as general health screening, school entrance examination, regular follow-up of the child throughout the school term, and so on. School health professionals can plan interventions to take precautions by observing the potential risks that may occur due to not washing the hands of students or not washing their hands with the right technique based on behavior change models. These initiatives may also be based on behavior modification models (eg health promotion model etc.). With the behavior change plan they have prepared, they try to facilitate the change by providing education and counseling to the student, their families, and teachers, by conducting motivational interviews, and by applying/enforcing the right-hand washing technique. With the education to be given by a health professional that students know and trust, students can increase their compliance and commitment to the behavior change plan (4,10). In our country, health education is mostly given by a teacher assigned to the school. However, the health knowledge of teachers and the health education they provide are limited. Therefore, health education in schools needs to be provided by a health professional raising the permanence of the information, and the student's attitudes toward the subject (11).

Even if children know and applies the importance of handwashing as taught in the lessons, it is unclear whether they know and apply effective handwashing steps. As a result of hand washing, the hands appear clean, which makes them believe that their hands are clean. However, as a result of many studies, it has been revealed that there are many health problems due to ineffective hand washing (5,12–14). As a result of the fact that hand washing is not performed at the desired level in accordance with the correct hand washing techniques in ensuring hand hygiene, various innovative training approaches should be developed and the effectiveness of the training should be increased (15–18). Microorganisms on hand are made visible with virtual reality technology, which is one of the innovative educational approaches, and offers individuals an experiential learning opportunity (19,20). It is thought that the presence of gel residues under ultraviolet light after using soap and water with the help of a fluorescent gel will help the behavior to occur more carefully and following the principles in the next hand washing behaviors (21,22).

This research, it was aimed to determine the effectiveness of the Health Promotion Model (HGM)-based My Hands are Clean Program carried out with the virtual reality method in ensuring the effective implementation of hand hygiene and its effect on the handwashing behaviors of the students.

2. METHODS

2.1. Type of Research

This research is a quasi-experimental study with a pre-test and post-test model.

2.2. Research Hypothesis

In the pre-test, follow-up, and post-tests of the students who participated in the 'My Hands are Clean Program'; There is a significant difference in hand hygiene effectiveness between the total hygiene scores of the palm, fingertip, interdigital, thumb, back of the hand, and wrist regions.

2.3. Variables of the Study

The observation form score showing the effectiveness of hand hygiene was taken as the dependent variable, and the 'My Hands are Clean Program' based on the EGM given by the virtual reality method was taken as the independent variable.

2.4. Research Place and Time

This study was conducted with students at a school in Istanbul between December 2021 and March 2021.

2.5. Population and Sampling of the Research

The research population is 4th-8th grades in a school. It consisted of 228 students studying in classrooms. 169 people participated in the pre-test of the study, and the post-test was completed with 156 people. Since the study was conducted during the pandemic, the first follow-up was completed with 115 people and the second follow-up with 85 people due to dropout and absenteeism. After the study, in the G power post hoc power analysis, when the eta square, effect size, and number of participants obtained from our data were 85, the alpha value was 0.05, and the correlation coefficient was 0.202, the power of the study was determined to be 99% as a result of the power analysis.

2.6. Data Collection Tools

The data were collected by the researcher and observers using a socio-demographic characteristics form and a hand hygiene observation form.

2.6.1. Socio-Demographic Characteristics Form

Developed by the researchers. Students' age, class, education level of parents, hand washing habits, access to water and soap, etc. It was composed of 24 questions questioned (1,6,12).

2.6.2. Hand Hygiene Observation and Decision Form

This form was developed by the researchers to evaluate the effectiveness of virtual reality training on hand washing. The observation form was structured in such a way that the observation result could be evaluated quantitatively and to ensure correct decision-making among the observers. Before the application, a pilot application was made to 10 students and the application was started after the observers were harmonized. Observers were trained on how to use the observation form. This form was used before and after the hand washing training and in follow-ups. For this purpose, the hand area was divided into 6 sections. These were; palm, fingertip, inter-finger, thumb, back of the hand and wrist. Scoring was done as follows: In the evaluation of the washing efficiency of the hand divided into 6 regions, 2 points were given to the region where the Glo Germ material was cleaned and 1 point was given to the region where it was not cleaned. As a result of the 6 regions observed, the maximum score was $6 \times 2 = 12$ points, indicating that hand washing was complete and effective. The lowest score was $6 \times 1 = 6$ points, indicating that handwashing was quite ineffective. In the evaluation; all scores below 12 points indicated that the hand washing technique should be improved and the training should be repeated. A score of 1-6 points indicated completely inadequate handwashing, 7-11 points indicated that there were areas to be improved in handwashing behavior, and 12 points indicated correct handwashing behavior. Expert opinions were obtained from 3 faculty members who are experts in the field of public health for the observation and decision form.

Student's sociodemographic characteristics, handwashing behavior and perceptions specific to its output, form of handwashing experiences;

A form containing questions about age, gender, income level, handwashing frequency, previous handwashing behavior, whether they had received handwashing training, knowledge of the harms of not washing hands, whether they had their own towel, self-confidence in correct handwashing, handwashing behaviors of people around them, situations in which they wash their hands frequently, and willingness to receive handwashing training was used.

Behavior Output is the result of the Hand Hygiene Observation and Decision Form.

2.7. My Hands are Clean Program

Hand hygiene training developed by the researchers was explained to all classes in a three-week period by the senior nursing students in a 40-minute school lesson period with video and demonstration methods. The training program was prepared by considering the basic components of Pender's Health Promotion Model. Health Promotion Model has three basic components: individual characteristics and experiences, perceptions specific to behavior, and behavioral outcomes. In this study, all interventions were conducted taking into account the components of the model. In the first

week of the program, the presentation and announcement of the study were made and pre-tests were applied. My Hands are Clean training program was implemented for three weeks. Post-tests were administered in the fourth week. Two follow-ups were conducted to determine the effect of the "My Hands are Clean Program". Handwashing behaviors were repeated at one-month intervals and scored by the same independent observers. (Figure 1).

Initiatives for the 'individual characteristics and experiences' component of the Health Promotion Model;

Experiences are behavioral factors that have direct and indirect effects. The success or failure of the previous behavior affects the outcome of the next behavior (23). In this scope, students were helped to understand the effect of hand washing behaviors with the virtual reality method so that they could see the difference between their previous and subsequent behaviors. Glo Germ bacteria simulation gel was applied for virtual reality. When the hands are washed with the correct technique, a spotless clean hand appearance is obtained when viewed with a special lighted lamp. On the other hand, bright and colorful bacteria are seen on hands that are not washed with the correct technique. This gel was squeezed a little on the students' hands and they were allowed to apply it all over their hands like hand cream. They were made to wash their hands in the same way as they did in the pre-test before the training and the effectiveness of their washing with light was checked and scored. The areas that were not washed well were shown to the students and explained.

Attempts towards the 'behavior-specific perceptions' component of the Health Promotion Model;

The Health Promotion Model is influenced by the perceived benefit specific to the behavior, barriers to performing the behavior, social norms and self-efficacy to perform the behavior (23). In this context, the stages of this model were implemented in the "My Hands are Clean" program as follows; in the training program for 'perceived benefits' and 'perceived barriers'; the focus was on the benefits and advantages of hand washing behavior. Individual measures (such as creating a hand hygiene kit and keeping it in the bag) were discussed to overcome the barrier of lack of hand washing materials at school. In order to increase self-efficacy; the effectiveness of hand washing was discussed with the students through the concrete colored view obtained with virtual reality. Good washes were praised for receiving high scores, and the washing process was repeated with the observers for the hand areas that were not washed well and received low scores. Students were given motivating messages such as "you can do it", "you were able to clean the bacteria when you washed with the right technique". For the social norms part of the model; students who washed their hands with the correct technique and scored high became peer role models in the classroom and provided motivation for others to develop correct handwashing behavior. For the situational factor of the model, teachers in the school

community gave positive feedback and reminders by showing the videos in their lessons from time to time.

Initiatives for the ‘Behavioral outcomes’ component of the Health Promotion Model; After the “My Hands are Clean Program” and at the follow-up, the previous hand washing behavior scores and the current ones were compared with the observers for hand washing behavior with the correct technique with the hand hygiene observation form and the areas that needed to be improved were discussed with the student.

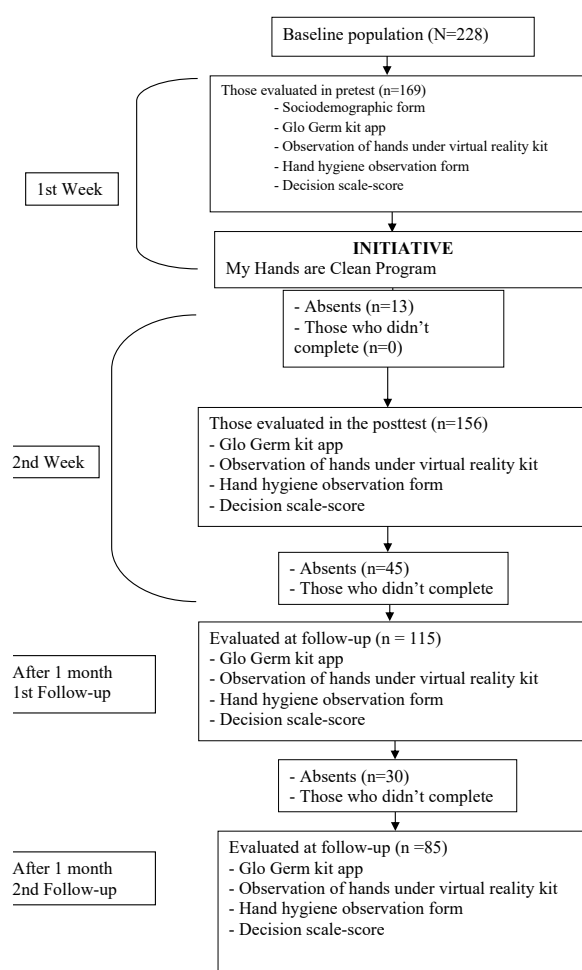


Figure 1. Flow diagram of the Study

2.8. Statistical Analysis

Statistical evaluation of the data database was created in IBM SPSS 26.0 program and percentage, mean, and median were looked for descriptive statistics. The Kolmogorov-Smirnov test used the Kolmogorov-Smirnov test to check for compliance with the normal distribution of the data, and the Wilcoxon Test, Fridman Test, Mann Whitney U test, Kruskal Wallis test, and Bonferroni-corrected pairwise comparisons were used to compare the hand hygiene observation form scores.

2.9. Ethical Considerations

Ethics Committee approval numbered 09.2019.975 (date: 07.02.2020) and written consent from students and parents were obtained from Marmara University Interventional Ethics Committee for this research. Institutional permission from the school where the study was conducted (number: E-16911314.900.00000143273, date: 28.05.2021) and permissions from the researchers who adapted the scales into Turkish were obtained. Verbal and written consent was obtained from each participant before the study, and they were asked to fill in the informed consent form, and only the participants who gave consent were included in the study.

3. RESULTS

It was determined that 26% of the students participating in the study were in the 4th grade (n=44) 52.1% of students were male (n=88), 66.3% of the parents were in secondary school or below-educated (n=112). 45 % of the students were 12-13 years old (n=76). 78.1% of the students stated that they have the necessary materials for hand hygiene at home (n=132) and the materials required for hand hygiene at school 47.9% (n=81). 93.5% of the students reported they were confident in washing their hands with the correct technique (n=158).

The mean scores of the students' Hand Hygiene Observation Form are presented in Table 1, and it was observed that there was a significant difference according to time ($p < 0.001$). According to the results of the Wilcoxon test with Bonferroni correction, which was performed to determine between which groups the difference was, it was determined that the post-test, first follow-up and second follow-up mean scores were significantly higher than the pre-test mean scores. In addition, the mean scores of the Hand Hygiene Observation Form at the first follow-up and at the second follow-up were significantly higher than the mean scores of the post-test (Table 1).

Table 1. Comparison of the scores of the students from the hand hygiene observation form

	Duration	X±SS (Med)	χ^2	p
Hand Hygiene Observation Form	Pre-test ^a	6.46±0.96 (6)	147,731	0.000 a<b<c,d*
	Final test ^b	8.61±1.58 (8)		
	First Follow-up ^c	10.25±1.40 (10)		
	Second Follow-up ^d	9.80±1.70 (10)		

χ^2 : Fridman Test, *Wilcoxon Test with Bonferroni correction

A significant difference was found between pretest-posttest-follow-up tests between socio-demographic variables (gender, age, parental education level) and students' self-confidence in washing their hands with the right technique, and the availability of hygienic materials at home and at school ($p < 0.001$) (Table 2).

Table 2. Scores from the hand hygiene observation form according to socio-demographic variables and time

Variables	Pre-Test	Final Test	First Follow-up	Second Follow-up	Statistics	
	X±SS	X±SS	X±SS	X±SS	$^1\chi^2$	p
Gender						
Female (n=81)	6.44±0.92	8.45±1.4	10.53±1.14	9.73±1.63	80.757	0.000
Male (n=88)	6.47±1.03	8.75±1.72	10.02±1.57	9.86±1.77	69.068	0.000
Z	-0.225	-1.029	-1.585	-0.636		
p	0.822	0.303	0.113	0.525		
Age						
8-9 (n=26)	6.46±1.17	8.23±1.56	9.47±1.37	10.06±1.64	24.829	0.000
10-11 (n=56)	6.34±0.84	8.53±1.57	10.2±1.26	9.45±1.86	45.037	0.000
12-13 (n=76)	6.54±1.04	8.68±1.6	10.58±1.32	9.93±1.56	75.924	0.000
14 and above (n=11)	6.45±0.69	9.5±1.43	9.83±2.23	10.25±2.36	6.536	0.088
$^2\chi^2$	2.393	5.46	9.153	2.293		
p	0.495	0.141	0.027	0.514		
Parent educational background						
Middleschool and below (n=112)	6.58±1.1	8.74±1.55	10.31±1.44	9.9±1.68	102.501	0.000
Highschool and above (n=57)	6.21±0.59	8.37±1.63	10.15±1.35	9.58±1.73	45.899	0.000
Z	-2.379	-1.465	-0.716	-0.950		
p	0.017	0.143	0.474	0.342		
Confidence in washing your hands with the right technique						
Not sure (n=11)	6.45±1.51	9.11±2.03	10.71±1.38	10.43±0.79	13.800	0.003
Sure (n=158)	6.46±0.93	8.58±1.56	10.22±1.41	9.76±1.73	134.247	0.000
Z	-1.065	-0.841	-1.021	-0.805		
p	0.287	0.400	0.307	0.421		
Availability of hygienic materials at home						
Yes (n=132)	6.42±0.91	8.55±1.63	10.14±1.43	9.9±1.66	135.160	0.000
Sometimes (n=37)	6.57±1.19	8.83±1.42	10.79±1.13	9.28±1.84	18.714	0.000
Z	-0.151	-1.066	-1.816	-1.409		
p	0.880	0.286	0.069	0.159		
Availability of hygienic materials at school						
Yes (n=81)	6.44±0.97	8.58±1.56	10.3±1.45	9.84±1.65	83.079	0.000
No (n=38)	6.37±0.88	8.67±1.71	10.12±1.42	9.5±2.02	19.583	0.000
Sometimes (n=50)	6.54±1.05	8.6±1.55	10.27±1.35	9.91±1.58	45.902	0.000
$^2\chi^2$	0.471	0.113	0.316	0.343		
p	0.790	0.945	0.854	0.842		

$^1\chi^2$: Fridman Test, $^2\chi^2$: Kruskal Wallies Test, Z: Mann Whitney U Test

4. DISCUSSION

In this study, hand hygiene behaviors of students aged 8-14 years, whose parental education level was middle school or below and who were studying in a primary school with low school attendance, and behavioral changes after the training were examined. The results of the study showed that the 'My Hands are Clean Program' was effective in improving hand washing behaviors in school children. In addition, desired

behavior change was observed not only in the post-test conducted two weeks later but also in the first follow-up conducted one month later. We think that the interventions made for the "behavior-specific perceptions" component of the Health Promotion Model were effective in this success of the program. Although there was a minimal decrease in the mean score at the second follow-up according to the hand hygiene observation form, statistical significance did not change. We can say that the 'My Hands are Clean Program'

is effective in maintaining the behavior not only in the short term but also in the long term. According to the Health Promotion Model used in this study, perception is affected by the perceived benefit specific to the behavior, barriers to performing the behavior, social norms and self-efficacy to perform the behavior (23). In this scope, the interventions made in line with the stages developed based on the model in the 'My Hands are Clean Program' were effective. We think that the model-based interventions may have increased children's perception of self-efficacy in both short and long term effectiveness of the expected behavioral outcome. In addition, the implementation of the application in the classroom environment may be the desire of peers to be role models for each other. Moreover, the fact that the teachers at the school ensured the reinforcement of hand washing behavior by watching the hand washing videos once a week during class hours may have affected the process. Most importantly, it was observed that the students immediately saw the difference in hygiene before and after hand washing with the virtual reality kit and instantly saw the effect of effective hand washing or not washing and increased the effect on concrete situation perception and behavior. It is known that the acquisition of effective hand washing behavior provides significant benefits especially in the protection of primary school children from infections (24,25). In similar studies conducted with school-age children reported that a large proportion of students practiced the correct hand washing steps in their study conducted to improve hand hygiene practices with a social robot-assisted intervention in a school in India (26). In another study, Arbi Care, an android-based educational intervention, was implemented twice a week for five weeks for children aged 4-6 years. It was found that the self-efficacy development scores of children in the intervention group increased significantly over time compared to the control group (27). In order to prevent diarrhea in vulnerable children, a handwashing intervention was carried out by means of soaps with toys in them. The control group was given a normal soap with traditional expression. After the intervention, it was found that children in the control group were four times more likely to get diarrhea compared to children in the intervention group (28). In another quasi-experimental study titled 'Hand hygiene Fun Month' for kindergarten students, it was found that after an intervention focusing on the right time, right duration and right steps, the intervention group's knowledge level on the subject increased significantly compared to the control group, and the intervention group had significantly higher levels of left palm, back of hand, right palm and general hand hygiene compared to the pre-intervention group (8). In a study examining parent-child interaction and children's hand washing behaviors during a STEM activity at home, the importance of using soap in hand washing was conveyed. In the measurements made one week after the parent-child participated in the intervention together, it was reported that the use of soap supported children to gain the belief that they could protect themselves from certain diseases (29). One of the studies in the literature implemented an intervention to improve hand hygiene in children with digital

intervention, including animated instructions triggered by the use of soap and water and a symbolic reward displayed on the screen during and immediately after hand washing. After the intervention, they concluded that children's time to soap their hands increased by 5.30 seconds (30). Similar to the results of this study, it has been concluded in the literature that the interventions carried out to implement the hand hygiene trainings given to children with the right steps in digital environments and with an embodied system are more beneficial for children to ensure hand hygiene. Although the absence of a control group in our study constitutes a limitation, when the literature is examined, it is concluded that it is very important to teach the event by concretizing the event with technological tools in the acquisition of hand washing behavior with the correct technique, especially in school-age children. It can be said that peer and family support is very useful in maintaining the behavior. In the absence of correct handwashing behaviors, it is known that reinforcing the correct handwashing behavior with demonstration, giving encouraging feedback, and providing social and peer support are important in teaching the correct behavior (31,32). In a systematic review of adolescents aged 12-15 in eighty countries, the low rates of inappropriate handwashing behavior and especially after the toilet in countries with low socioeconomic status are similar to the data of this study. In addition, it was emphasized that handwashing with water and soap provides effective protection for the improvement of handwashing behavior, especially during the pandemic process, and they stated that there are few studies on adolescents (33). In this study, it can be said that although the majority of the sample consisted of adolescent students and they had knowledge about the importance of hand washing, they had difficulty in putting it into behavior. One study of the literature, it was determined that although students' awareness of the importance of handwashing in the prevention of infectious diseases was high, their behavior towards handwashing was low (34). There are studies in the literature that emphasize the necessity of transforming knowledge about hand washing into behavior (35-37). In the study conducted with the virtual reality method applied to primary school children in Budapest, statistical significance was found when the scores they got from the pretest-posttest and first follow-up-second follow-up after the handwashing training supported by visuals were compared. In addition, in the same study, students' self-efficacy in effective hand washing was found to be statistically significant (38). In a study conducted using a prospective design, the effect of handwashing on self-efficacy was found to be significant when the relationship between students' handwashing and self-efficacy was examined (39). In this study, it can be said that the handwashing skills of the students improved and their self-efficacy on this subject improved. In this study, it can be said that it was observed that students' hand washing skills improved and their self-efficacy in hand washing improved.

In this study, it was observed that the results of the Health Promotion Model-Based 'My Hands are Clean Program'

conducted with the Virtual Reality Method were similar to other studies in terms of results, but it was more motivating in learning because it provided visual feedback in teaching effective hand washing. The most important factor that distinguishes our study from other studies is that the virtual reality method and model-based education process was carried out. We think that it would be useful for researchers who will work on a similar subject to use innovative technology-based methods and model-based interventions that increase concrete learning with a control group to develop behaviors and make a qualified contribution to the literature.

5. CONCLUSION

As a result of the 'My Hands are Clean Program' carried out with the virtual reality method based on the health promotion model, it was determined that the scores of the students from the hand hygiene observation form increased compared to the scores obtained before the program and this continued to increase over time. It can be said that the use of technology-based methods in developing handwashing behavior, which will affect lifelong health, is effective for school-age students. The results of this study point to several implications and recommendations for school health professionals; proper handwashing prevents diseases, and protects and improves health. Therefore as school health professionals, we must provide students with information and counseling about hand washing. Health professionals should take the initiative to increase the handwashing levels of students, parents, and school administration.

This research is limited to the findings obtained after the 'My Hands are Clean Program' was applied to students in the relevant school. It is thought that conducting follow-up tests by the randomized controlled research design while planning health education provided with virtual reality technology in the future will increase the level of evidence of the research.

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Author Contributions:

Research idea: SY

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Acquisition of data for the study: SY, TÖ, KG

Analysis of data for the study: KG

Interpretation of data for the study: SY, TÖ, KG, KBTÇ

Drafting the manuscript: SY, TÖ, KG, KBTÇ

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REFERENCES

- [1] Çelik EY, Yüce Z. Investigation of the Awareness and Habits of Secondary School Students about Cleanliness and Hygiene from Various Variables. *International Education Studies* 2019;12(4):173. DOI: 10.5539/ies.v12n4p173
- [2] Iyasu A, Ayele M, Abdissa B. Hand Hygiene Knowledge, Perception and Practices among Women of 'Kirkos' Locality in Addis Ababa, Ethiopia. *Health Science Journal* 2017;11(6):1–8. DOI: 10.21767/1791-809X.1000537
- [3] Jess RL, Dozier CL. Increasing handwashing in young children: A brief review. *J Appl Behav Anal* 2020;53(3):1219–24. DOI: 10.1002/jaba.732
- [4] Luby SP, Halder AK, Huda T, Unicomb L, Johnston RB. The Effect of Handwashing at Recommended Times with Water Alone and With Soap on Child Diarrhea in Rural Bangladesh: An Observational Study. *Bhutta ZA, editor. PLOS Medicine* 2011;8(6):e1001052. DOI:10.1371/journal.pmed.1001052
- [5] Öncü E, Vayisoğlu SK. Duration or technique to improve the effectiveness of children' hand hygiene: A randomized controlled trial. *American Journal of Infection Control* 2021;49(11):1395–401. DOI: 10.1016/j.ajic.2021.03.012
- [6] Azor-Martinez E, Yui-Hifume R, Muñoz-Vico FJ, Jimenez-Noguera E, Strizzi JM, Martinez-Martinez I, Garcia-Fernandez, L., Seijas-Vazquez, M. L., Torres-Alegre, P., Fernández-Campos, M. A., Gimenez-Sanchez, F. Effectiveness of a Hand Hygiene Program at Child Care Centers: A Cluster Randomized Trial. *Pediatrics* 2018;142(5):e20181245. DOI: 10.1542/peds.2018-1245
- [7] Mohd DMR, Mohamed NA, Tengku Jamaluddin TZM, Ismail Z, Ramli S, Faroque H, Abd Samed FN, Ariffien AR, Amir Farid AARCA, Isahak I. Effectiveness of comprehensive hand hygiene module on preschool children in Klang Valley, Malaysia. *Clinical and Experimental Pediatrics* 2020;63(3):115–6. DOI:10.3345/cep.2019.01277
- [8] Suen LKP, Cheung JPL. Effectiveness of "Hand Hygiene Fun Month" for Kindergarten Children: A Pilot Quasi-Experimental Study. *International Journal of Environmental Research and Public Health* 2020;17(19):7264. DOI: 10.3390/ijerph17197264
- [9] Öncel S, Akcan A, Meydanlioğlu A. Health Promotion and Disease Prevention. In: Gözüüm S, editor. *Improving the Health of Children in School Period*. 1st ed. Ankara: Vize Yayıncılık; 2016. p. 221–3. (Turkish)
- [10] Dağhan Ş, Çobadak Çalt A, Konal Korkmaz E. Nursing Research Examples Based on Pender's Health Promotion Model: Systematic Review. *Journal Izmir Katip Celeb Univ Fac Heal Sci* 2022;7(1):87–97.
- [11] Şahinöz T, Şahinöz S, Kivanç A. The Easiest Way to Promote Health: School Health. *Gümüşhane Univ J Heal Sci* 2017;6(4):302–12.
- [12] Adane M, Mengistie B, Mulat W, Medhin G, Helmut K. The Most Important Recommended Times of Hand Washing with Soap and Water in Preventing the Occurrence of Acute Diarrhea Among Children Under Five Years of Age in Slums of Addis Ababa, Ethiopia. *J Community Health* 2018;43(2):400–5. DOI: 10.1007/s10900.017.0437-1.
- [13] Goel S, Chandrashekar B. Evaluating the efficacy of handwashing demonstration on hand hygiene among school students – An interventional study. *J Educ Health Promot* 2020;9(1):226. DOI: 10.4103/jehp.jehp_94_20
- [14] Kanwal DW, Edwin DCA, Ahmad DA, Rafaqat U. Creating Awareness about Cleanliness and Hand Hygiene among

- Students at Primary Level. *J Manag Pract Humanit Soc Sci* 2022;6(1):40–8. DOI: 10.33152/jmphss-6.1.5
- [15] Clack L, Hirt C, Wenger M, Saleschus D, Kunz A, Sax H. VIRTUE – A Virtual Reality Trainer for Hand Hygiene. 9th International Conference on Information, Intelligence, Systems and Applications (IISA). IEEE; 2018. p. 1–2. DOI: 10.1109/IISA.2018.863.3588
- [16] Désiron JC, Petko D, Lapaire V, Ullrich C, Clack L. Using virtual reality to train infection prevention: what predicts performance and behavioral intention? *Virtual Real* 2022 Oct 14;012.345.6789. DOI: 10.1109/IISA.2018.863.3588
- [17] Kang YS, Chang YJ. Using a motion-controlled game to teach four elementary school children with intellectual disabilities to improve hand hygiene. *J Appl Res Intellect Disabil* 2019;32(4):942–51. DOI: 10.1111/jar.12587
- [18] Yumru H, Koc Ş. Effect of Hand Hygiene Education Implemented through the Role-Play Method on Knowledge and Behavior of Primary School Students. *DEUHFED* 2021;14(3):188–98.
- [19] Dingman D, Wu J, Murphy HM. School-based, blacklight handwashing program can improve handwashing quality and knowledge among pre-school aged children. *Eval Program Plann* 2020;78:101731. DOI: 10.1016/j.evalprogplan.2019.101731
- [20] Grewal M, Krishna A, Chopra T. Interactive intervention on handwashing among elementary school children. *Heal Behav Policy Rev*. 2020;7(3):191–7. DOI: 10.14485/HBPR.7.3.3
- [21] Kısacık ÖG, Çiğerci Y, Güneş Ü. Impact of the fluorescent concretization intervention on effectiveness of hand hygiene in nursing students: A randomized controlled study. *Nurse Educ Today* 2021;97:104719. DOI: 10.1016/j.nedt.2020.104719
- [22] Konicki T, Miller E. Use of a simulation intervention to examine differences in nursing students' hand hygiene knowledge, beliefs, and behaviors. *Nurse Educ Today* 2016;45:96–101. DOI: 10.1016/j.nedt.2016.06.022
- [23] Pender NJ. *Heath Promotion Model Manual*. 2011;1–17. Available from: <http://deepblue.lib.umich.edu/handle/2027.42/85350>
- [24] Chittleborough CR, Nicholson AL, Young E, Bell S, Campbell R. Implementation of an educational intervention to improve hand washing in primary schools: process evaluation within a randomised controlled trial. *BMC Public Health* 2013;13(1):757. DOI: 10.1186/1471-2458-13-757
- [25] Klar K, Knaack D, Kampmeier S, Hein AK, Görlich D, Steltenkamp S, Weyland U, Becker K. Knowledge about Hand Hygiene and Related Infectious Disease Awareness among Primary School Children in Germany. *Children* 2022;9(2):190. DOI: 10.3390/children9020190.
- [26] Deshmukh A, Darda KM, Mhatre MM, Pandey R, Jadhav AR, Cross E. Enhancing Hand Hygiene Practices Through a Social Robot-Assisted Intervention in a Rural School in India. *Lect Notes Comput Sci* 2024;14453 LNAI:244–53. DOI: 10.1007/978-981-99-8715-3_21
- [27] Arbianingsih, Utario Y, Rustina Y, Krianto T, Ayubi D. Arbi Care application increases preschool children's hand-washing self-efficacy among preschool children. *Enfermería Clínica*. 2018;28:27–30. DOI: 10.1016/S1130-8621(18)30031-7
- [28] Watson J, Cumming O, Dreibelbis R. Nongovernmental Organization Practitioners' Perspectives on the Challenges and Solutions to Changing Handwashing Behavior in Older Children: A Qualitative Study. *Glob Heal Sci Pract* 2023;11(1):e2200231. DOI: 10.9745/GHSP-D-22-00231
- [29] Sobel DM, Stricker LW. Parent–child interaction during a home STEM activity and children's handwashing behaviors. *Front Psychol* 2022;13:1–16. DOI: 10.3389/fpsyg.2022.992710
- [30] Graichen J, Stingl C, Pakarinen A, Rosio R, Terho K, Günther SA, Salanterä, S., Staake, T. Improving hand hygiene of young children with a digital intervention: a cluster-randomised controlled field trial. *Sci Rep* 2024;14(1):1–10. DOI: 10.1038/s41598.024.56233-9
- [31] Watson J, Dreibelbis R, Aunger R, Deola C, King K, Long S, Chase, R. P., Cumming, O. Child's play: Harnessing play and curiosity motives to improve child handwashing in a humanitarian setting. *Int J Hyg Environ Health* 2019;222(2):177–82. DOI: 10.1016/j.ijheh.2018.09.002.
- [32] Richardson R, Collins AE. Infectious disease risk communication and engagement using puppetry and related approaches for improving handwashing with soap in an informal settlement of Nairobi. *Int J Disaster Risk Reduct* 2023;84:103477. DOI:10.1016/j.ijdr.2022.103477
- [33] Smith L, Butler L, Tully MA, Jacob L, Barnett Y, López-Sánchez GF, López-Bueno, R., Shin, J. I., McDermott, D., Pfeifer, B. A., Pizzol, D., Koyanagi, A. Hand-Washing Practices among Adolescents Aged 12–15 Years from 80 Countries. *Int J Environ Res Public Health* 2020;18(1):138. DOI: 10.3390/ijerph18010138.
- [34] Yalçın SS, Yalçın S, Altın S. Hand washing and adolescents. A study from seven schools in Konya, Turkey. *Int J Adolesc Med Health* 2004;16(4):371–6.
- [35] Hulland KRS, Leontsini E, Dreibelbis R, Unicomb L, Afroz A, Dutta NC, Nizame, F. A., Luby, S. P., Ram, P. K., Winch, P. J. Designing a handwashing station for infrastructure-restricted communities in Bangladesh using the integrated behavioural model for water, sanitation and hygiene interventions (IBM-WASH). *BMC Public Health* 2013;13(1):877.
- [36] Seimetz E, Slekiene J, Friedrich MND, Mosler H-J. Identifying behavioural determinants for interventions to increase handwashing practices among primary school children in rural Burundi and urban Zimbabwe. *BMC Res Notes* 2017;10(1):280. DOI: 10.1186/s13104.017.2599-4
- [37] Sun C, Wang Q, Poudel Adhikari S, Ye R, Meng S, Wu Y, Mao, Y., Raat, H., Zhou, H. Correlates of School Children's Handwashing: A Study in Tibetan Primary Schools. *Int J Environ Res Public Health* 2019;16(17):3217. DOI: 10.3390/ijerph16173217
- [38] Lehotsky Á, Falus A, Lukács Á, Füzi AR, Gradwohl E, Mészárosné Darvay S, Bihariné Krekó I, Berta K, Deák A, Feith HJ. Kortárs egészségfejlesztési programok közvetlen hatása alsó tagozatos gyermekek kézhigiénés tudására és megfelelő kézmosási technikájára. *Orv Hetil* 2018 Mar;159(12):485–90. DOI:10.1556/650.2018.31031
- [39] Zhang C-Q, Fang R, Zhang R, Hagger MS, Hamilton K. Predicting Hand Washing and Sleep Hygiene Behaviors among College Students: Test of an Integrated Social-Cognition Model. *Int J Environ Res Public Health* 2020;17(4):1209. DOI: 10.3390/ijerph17041209

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