Research article

Personal Hygiene Practices: Impact of Hygiene Education on Preschool Students in Phnom Penh, Cambodia

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Abstract Pathogenic microorganisms that cause severe infections in humans are primarily spread due to poor personal hygiene practices, such as inadequate handwashing and toothbrushing. Proper handwashing with soap and effective toothbrushing are recognized as essential defences against upper respiratory, gastrointestinal, and diarrheal diseases, as well as dental plaque, periodontal disease, and dental caries. This study implemented a comprehensive personal hygiene program aimed at preschool students, focusing on delivering hygiene education and incorporating pre- and post-education surveys to assess the program's effectiveness and impact. The personal hygiene activities were specifically defined as handwashing and oral hygiene. Participants included preschool students aged three to five years from Samdach Hun Sen Dangkor Primary School. The findings showed that pre-education personal hygiene scores for handwashing were below 1%, which significantly increased to 93% following the educational intervention, as verified by the "Hand washing training unit LED UV light." Similarly, pre-education scores for toothbrushing were 9%, with a notable improvement to 57%, as measured by the Qscan Plus device. An awareness survey conducted with 10 selected preschool students who participated in the training indicated a substantial enhancement in daily handwashing and toothbrushing practices post-training, with an improvement rate exceeding 50% for each question in the hand hygiene session (except for two questions) and over 80% for tooth hygiene after waking and post-meals. These results underscore the effectiveness of the training program in enhancing students' daily hygiene practices.

Keywords hygiene, hand wash, teeth cleaning, survey of awareness, preschool student

INTRODUCTION

The implementation of hand and oral hygiene among preschool students is crucial for promoting overall health. In Cambodia, improving handwashing and oral care for children is a priority, especially by raising awareness of the importance of proper hand hygiene and oral care. According to a previous report (UNICEF Cambodia, 2020), during the COVID-19 pandemic, hand hygiene plays an important role in protecting children from viral infection. However, the lack of handwashing facilities and appropriate washing methods are significant barriers. These challenges lead to children rarely washing their hands and ending up being infected with the virus. In 2020, contributing to improving handwashing for preschools in Cambodia, UNICEF Cambodia provided hygiene supplies and other safety education materials to 13,482 schools and 3,064 preschools throughout Cambodia (UNICEF Cambodia, 2020).

From the perspective of the researcher, washing hands with soap using the correct method could reduce the incidence of diarrhea by up to 50% (WHO,2001) and the risk of respiratory illnesses, such as colds, by 16–21% (Rabie et al., 2006; Aiello et al., 2008). In alignment with the Sustainable Development Goals (SDG 4.3 and SDG 4.7), the "Leading University Project for International Cooperation" (LUPIC project) established the Department of Food and Nutrition at the Royal University of Agriculture in 2022. This initiative focuses on acquiring knowledge and skills by strengthening the university's educational and teaching capacities. Therefore, supported by the LUPIC project, this research aims to develop a personal hygiene model for schools across Cambodia, promoting better personal hygiene practices nationwide.

OBJECTIVES

Following objectives were set in this research.
1. To define the current knowledge and practice of hand hygiene and oral care in a sample of preschool students
2. To deliver context / age-appropriate education and training programs for hand hygiene and oral care for the preschool students
3. To measure post-education knowledge and practices for hand hygiene and oral care in the preschool students
4. To provide recommendation how this program may be implemented throughout Cambodia

METHODOLOGY

Sampling and Scope of the Study

A randomized selection was made to select primary schools very close to the RUA. As a result, Samdach Hun Sen Dangkor Primary School in Phnom Penh was selected for the training. A total of 180 registered preschool students were selected as respondents and invited to participate in the training (personal hygiene education). Approximately 50% of the total respondents (100 students of 180 students) were selected for the pre-testing and post-testing to evaluate the improvement of the respondents' awareness of hand and teeth hygiene using the prepared questionnaire.

For this reason, a 3-sessions series training was conducted with preschool students in Samdach Techo HUN SEN Dangkor Primary and Secondary School in 2023 under the teaching and instruction from department staff and assisted by the 1st generation student from this department. The training aimed to link the department staff and students to share hygiene knowledge with the students in the hope of improving the hand hygiene and oral hygiene situation of the preschool students and guide them to keep this good habit for protecting them from infection of the disease and other pathogens that penetrate through the dirty hand or unhealthy teeth. The training provided the children with the theory and real practice of correct way for hand washing and teeth cleaning and verified the kids result practice with the equipment as a tool for strengthening their acceptance of the knowledge from the training.

Survey on the Awareness of Body Hygiene

A "personal hygiene awareness questionnaire for preschool students" was designed by the research team to evaluate the awareness level of personal hygiene (hand, teeth, and mouth hygiene) of the respondents. The questionnaire consisted of two main questions: (1) Knowledge of hand hygiene at different times, such as before and after meals, after sneezing, after toilet time, after play time, after touching with pet, and before helping the mother to prepare food were used for the pre- and post-evaluation of the research. Two additional questions about hand hygiene, how often they washed their hands, and how well they knew about the correct washing step, were also included (asked and confirmed the result of their practices with both devices for post-test). (2) Knowledge of oral hygiene at different times, such as before sleep, after sleep, after meals, how often they brush their teeth, and how well they know about correct brushing of their teeth were used in the questionnaire.

During the survey, 18 students from the Department of Food and Nutrition were assigned as facilitators to a group of 40-45 students. Facilitators responded by asking and collecting answers from students.

Education on Hand Hygiene

A series of educational programs of the "personal hygiene education" contained 4 weeks session. The details of the activities in each session are described as follows.

Session 1 Conduct pre-testing: For the academic year 2022-2023 students, the total number of kindergarten students was 180, which were divided into four classes and selected for personal hygiene education. Pretesting was conducted with approximately 50% of the total number of kindergartens (100 students). The pre-test aimed to show how well the students knew about personal hygiene before the training was provided. The results from this pre-testing were used for comparison with the post-testing results.

Session 2 Conduct hand hygiene training: The respondents watched a video illustrating the relationship between germ and disease. The video was designed using content related to the children and the current real situation of personal hygiene. The other activity was to teach which part of our hand should perform hand hygiene. This session focused on the awareness of the right time to perform hand hygiene. Facilitators play an important role in explaining the right region of the hand for performing suitable hand hygiene practices. Then, a traditional Khmer game called "hot potato" was played to enhance the children's learning effect. The "Hot potato" refers to the penalty paper ball made by rolled several papers together and each paper contained a question (the question related content just learnt). The game was played by letting the kids gather in the cycle and listen to the music while passing the ball from one to another. The kid passing the ball when the music stopped the one who got the ball received the penalty by answering the question (right part of the hand to perform hand hygiene).

In the same section, the facilitator demonstrated the correct conduct of handwashing with soap. After the class demonstration, the trainers divided the students into groups and conducted real demonstrations using tap water and soap on the school campus. Then, all students followed the trainer's steps one by one. Then, the knowledge was stimulated with practice using an LED UV light hand wash training unit. In order to assume a virtual bacterium, per the unit's best practice methodology, a fluorescent lotion for plant testing that is harmless to the human body to act as bacteria was used. Similar to real bacteria are invisible to the naked eye, the lotion used for testing is also invisible to the naked eye. However, when the hand is placed into the equipment, contamination can be detected with the naked eye. These conditions were assumed to represent the presence of infectious bacteria.

The practices of hand wash with the LED UV light hand wash training unit were practiced as follows.

(1) Apply the lotion evenly to the hands as much as a bean and let it dry for a while
(2) Put the hand on the viewpoint to check the level of contamination
(3) Wash your hands as usual
(4) Put the washed hand on the checker again, check the residual contamination level

(5) Wash the hands properly and wash hands with the method just learnt
(6) Check the result can compare with (4)

In addition to the demonstration by hand LED UV light wash training unit, I-stand, poster, and leaflet showing the right hand washing and when they should conduct it were also used to enhance the understanding. After all students finished their performance with the equipment, a post-test survey was conducted. The awareness survey used the same questionnaire as the pretest survey.

Session 3 Conduct oral hygiene training: Before starting the new section, the facilitator reviewed the "right practices" for hand hygiene and then started oral hygiene education. After that, the facilitator taught how to practice correct tooth brushing. The facilitator showed a video on "Brush Your Teeth" and explained it using the I-stand, poster, and leaflet. The contents of all the teaching materials showed how to brush our teeth correctly and how often they should be brushed. Moreover, some students were invited to demonstrate the correct method of cleaning their teeth in front of their friends. Subsequently, the facilitator provided them with toothpaste and toothbrushes and allowed them to do it by themselves. Then, the Qscan Plus Device was used to demonstrate and check their practices. This device was used to check the oral hygiene status. According to the device's best practice method, four steps were performed as follows.

(1) The device was positioned on the mouth so that the LED could illuminate the respondent's teeth
(2) Turn on the device
(3) The respondents' teeth were checked through a filter. During self-inspection, check the teeth using a mirror
(4) Turn off the device

Data Analysis

The data were analyzed using SPSS statistical software (version 25). The data of the pre-test and post-test surveys were expressed as percentages (%) through "Cross-tab analysis. Differences in the outcomes of each question between the two groups ("pre-test" and "post-test") were tested using Pearson's chi-square test. The significance of all results was set at $p < 0.05$.

Fig. 1 Hand sanitation check-up before/after hand wash training with Unit LED UV light (A) and teeth sanitation check-up with Qscan Plus equipment (B)

RESULTS AND DISCUSSION

Hand Hygiene

The hand hygiene training provided aimed to guide the students on the proper method of handwashing and make it a habit for their lives. Because actual germs are invisible, many people overlook them and wash their hands roughly in their daily lives or even avoid hand washing.

From the pre-test results (Table 1), seven situations were raised to observe how much the respondent was aware of the right time for washing hands. As a result, before and after eating and after sneezing, only 25%, 10%, and 18% of the respondents washed their hands, respectively. After

toilet time, playing time, touching the pet, and food preparation, 5%, 7%, 5%, and 8% washed their hands before food preparation, respectively. During the pre-test survey, respondents were less likely to wash their hands because they did not know when to do so. They mentioned that they washed their hands whenever they saw dirt on their hands or were asked by their parents/teachers. Surprisingly, some respondents even washed their hands before and after eating or after sneezing, but the chance of them using soap every time they washed their hands was very low. Only 4% of them used soap every time they washed their hands because they did not see any dust or dirt on their hands, so they used only water without soap most of the time. Moreover, the pre-test results showed that only 4% of the respondents knew the correct way of washing their hands. In addition, the results showed that the respondents had very low awareness of handwashing.

Table 1 Result of the awareness of hand hygiene from pre-test and post-test survey

N	Questions: When do you need to wash your hands?	Respondents answer (n=100)			
		Yes (%)	No (%)	Don't know (%)	*p* value
1	Before eating				0.000***
	Before training	25.00	75.00	0.00	
	After training	99.00	1.00	0.00	
2	After eating				0.000***
	Before training	10.00	90.00	0.00	
	After training	93.00	6.00	1.00	
3	After sneezing				0.000***
	Before training	18.00	81.00	1.00	
	After training	94.00	6.00	0.00	
4	After toilet time				0.000***
	Before training	5.00	95.00	0.00	
	After training	91.90	7.10	1.00	
5	After play time				0.000***
	Before training	7.00	93.00	0.00	
	After training	99.00	1.00	0.00	
6	After touching pet				0.000***
	Before training	5.00	61.00	34.00	
	After training	63.00	3.00	34.00	
7	Before preparing food (for helping mother)				0.000***
	Before training	8.00	69.00	23.00	
	After training	74.00	3.00	23.00	
8	Using soap every time for washing hands				0.000***
	Before training	4.00	96.00	0.00	
	After training	98.00	2.00	0.00	
9	Washing hands correctly				0.000***
	Before training	4.00	96.00	0.00	
	After training	95.00	5.00	0.00	

*Note: Pearson Chi-square test for p value: *** Statistically significantly different at p < 0.001.*

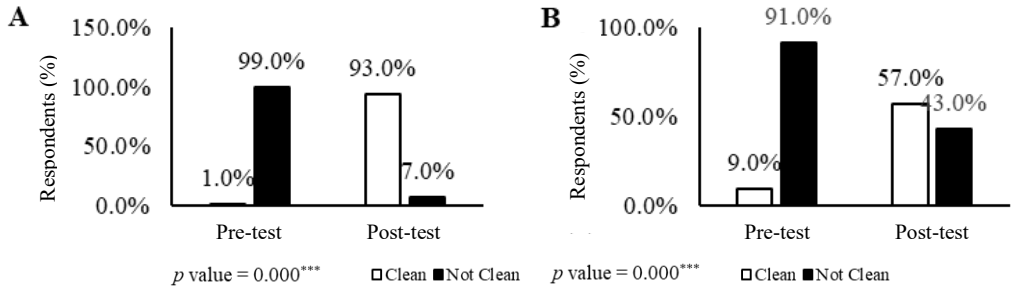
Handwashing training was provided to improve respondents' awareness of hand hygiene. After the training, a post-test survey (Table 1) was conducted to evaluate the effectiveness of the training on respondents' perception of hand washing. Consequently, their awareness of handwashing changed dramatically in all aspects. Before and after eating, and after sneezing, up to 99%, 93%, and 94% of the respondents washed their hands, respectively. Moreover, after toilet time, after playing time, after touching the pet, and before food preparation, the results showed that 91.9%, 99%, 63%, and 74% of the participants, respectively, washed their hands correctly.

According to the chi-square test table, the p-value of Pearson chi-square was < 0.001, providing evidence of significantly difference in each question (question 1-7) between the pre-and "pre-test" result and "post-test" results. The training resulted in 74% the improvement in hand wash awareness before eating, 83% after eating, 76% after sneezing, 86.9% after using the toilet, 92% after playing, 58% after touching pets, and 66% before preparing food (help their mother). Additionally, in the "after touching pet" situation, 34% of respondents did not show any improvement because they did not raise any pets at home or play with pets in their free time. In the "before preparing food" situation,

23% of respondents still did not show any improvement because they did not help their mothers prepare food because they were too young to cook.

The demonstration of hand washing with LED UV light in the hand wash training aimed to allow the respondents to clearly see how germs contact their hands. As shown in Fig. 2A, before learning the correct handwashing method, up to 99% of the respondents had unclean hands. This result indicates that with respondents' own habit of hand washing, there is a very high chance of germs still attached to their hands, which easily leads to many infections. A total of 99% of the respondents showed unclean hands when displayed with the equipment because they did not wash their hands with soap or used soap but did not scrub their hands correctly. By following the correct hand washing method from the trainers, the respondents practiced and checked the equipment again. The results showed that the number of unclean hands was only 7%, and that of clean hands increased to 93% of total respondents.

According to chi-square tests, the p value of Pearson chi-square is < 0.001 give the evidence of significant difference of "Hand sanitation check-up" between "pre-test" and "post-test" results. With a 92% improvement in clean hands, the outcomes showed a positive effect of the training on the respondents' hand hygiene habits. The demonstration with this equipment also correlated with the increase in their habit of using soap every time of washing and awareness of the correct way of hand washing.



*Note: Pearson Chi-square test for p value: *** Statistically significantly different at p < 0.001*

Fig. 2 Results of checking before/after hand wash training with Unit LED UV light (A) and of checking with Qscan Plus equipment (B)

Teeth Hygiene

The mouth-teeth hygiene training aimed to guide the students on the proper method of mouth-teeth cleaning and make it a habit for their life. Neglecting mouth-teeth cleaning can lead to many mouth-teeth health problems.

Table 2 Result of the awareness of teeth hygiene from pre-test and post-test survey

N	Questions: when do you need to wash your hand?	Respondents answer (n=100) Yes (%)	No (%)	Don't know (%)	*p* value
Situations to clean the teeth					
1	After waking up				0.000***
	Before training	4.00	96.00	0.00	
	After training	94.00	6.00	0.00	
2	After meal				0.000***
	Before training	9.00	91.00	0.00	
	After training	89.00	11.00	0.00	
3	Before bedtime				0.100
	Before training	87.00	11.00	2.00	
	After training	95.00	5.00	0.00	
Awareness of teeth cleaning					
4	Do you know how to brush teeth correctly?				0.000***
	Before training	0.00	100.00	0.00	
	After training	96.00	4.00	0.00	

*Note: Pearson Chi-square test for p value: *** Statistically significantly different at p < 0.001.*

From the pre-test survey (Table 2), three situations were raised to test the respondents' awareness of mouth-teeth cleaning. The results showed that 4% of the respondents cleaned their teeth after waking up, 9% cleaned their teeth after meals, and 87% cleaned their teeth before going to bed. The low result of cleaning after waking up and after meals is because the respondents only brush their teeth when their parents told them to do so, or their parents sometimes cleaned their teeth for them. Additionally, before mouth-teeth hygiene training was provided, none of the respondents (0%) knew the correct method of tooth cleaning.

After the training, a post-test survey was conducted to evaluate the effectiveness of the training on respondents' awareness of mouth-teeth cleaning. As a result, their awareness of mouth-tooth hygiene dramatically changed in all three situations. The post-test results in Table 2 show that 94% of respondents brushed their teeth after waking up, 89% brushed their teeth after meals, and 95% brushed their teeth before going to bed.

According to the chi-square test table, the p-value of Pearson's chi-square for cleaning teeth after waking up "after waking up" and "after meal" situation is < 0.001 give the evidence of significantly different between "pre-test" result and "post-test" results. However, the p-value of Pearson's chi-square for cleaning teeth at "before bedtime" situation is > 0.05 give the evidence of non-significantly different between "pre-test" result and "post-test" results. Comparing the results of the pre- and post-tests, the training effect on mouth and teeth hygiene awareness showed an improvement in cleaning teeth after waking up (90 %), cleaning teeth after meals (80 %), and cleaning teeth before bedtime (8 %).

Checking teeth after cleaning with the Qscan Plus Device provides evidence of how respondents can acquire knowledge from training. As shown in Fig. 2B, before receiving training, 9% of the respondents were able to clean their teeth correctly, and 91% of the respondents cleaned their teeth incorrectly. After receiving training, 57% of respondents had clean teeth.

According to the chi-square test table, the p-value of Pearson's chi-square for "teeth check-up" result is < 0.001 give the evidence of significantly different between "pre-test" result and "post-test" result. Comparing the results between the pre- and post-tests, a 48% improvement was found among the respondents regarding tooth cleaning. The demonstration with this equipment also correlated with an increase in the frequency of tooth cleaning before and after training.

When asked, 'How many times do you brush your teeth per day?' Twelve% of students said that they did not or rarely brush their teeth, and 79% brushed once per day (some brushed in the morning, while some brushed in the evening as ordered by their parents). Only 9% of the students brushed their teeth twice daily before the training. Moreover, none of the respondents brushed their teeth three times per day or did not know about tooth cleaning.

Table 3 Result of frequency of cleaning teeth from pre-test and post-test survey

Questions:	Respondents answer (n=100)	
How many times do you brush your teeth in a day?	Pre-test (%)	Post-test (%)
None	12.00	1.00
1 time	79.00	1.00
2 times	9.00	17.00
3 times	0.00	81.00
4 times	-	-
P value	0.000^{***}	

Note: Pearson chi-square test for p value: *** Statistically significantly different at $p < 0.001$.

According to chi-square tests table, the *p* value of Pearson chi-square for "frequency of cleaning teeth" result is < 0.001 give the evidence of significant difference between "pre-test" and "post-test" results. There were 81% improvement for brush teeth 3 times per day and 8% improvement for brush teeth 2 times per day, and these were very positive results from the training for changing the habit of the student from not clean their teeth or clean in a very low frequency (1 time per day) to clean their teeth in high frequency (2 or 3 times per day).

According to the "Piaget's four stages of cognitive development" raise by Swiss philosopher and psychologist, children at the age of 4-7 are categorized into "Intuitive thought" of the second stage (pre-operational). In this stage, the children can learn the object through "image, word, and

drawing" and able to build the stable concepts, reasoning, and magical beliefs (The Neurotypical Site, 2023). By using the poster, I-stand, video for teaching the correct way of hand wash and real demonstration by the trainer made the respondents easy to understand well about the content of the teaching. This can be verified by the increasing data for "clean hands" from hand sanitation check-up. The increasing data of cleaning hand is the evidence that the respondent agreed that the using soap and water equipped with correctly way of hands wash is the best way for them to protect their hands from germs, these results were consistent with some other previous studies (Lopez-Quintero et al, 2009; Hazazi et al, 2018; Assefa and Kumie, 2014; O'reilly et al., 2008; Aziz et al., 2012) . This result showed that training had a positive effect on student awareness regarding hand hygiene. Furthermore, evidence from a previous study (Leal et al, 2022) showed that children at the age–5-6 years old can perform the ability to wash their teeth better than younger children. This evidence could explain why the children improved their awareness regarding teeth hygiene in a very short period after receiving the lecture from the training. This result showed that training had a very positive effect on student awareness of mouth-teeth hygiene

CONCLUSION

After 3 sessions of three training sessions, the results showed improvement in hand washing for all aspects (before eating for 74%, after eating for 83%, after sneezing for 76%, and after playing time for 92%, after touching pets for 58%, and before preparing food for 66%). As for the improvement in teeth hygiene awareness, the results showed a positive increase for all three raised situations (cleaning teeth after waking up for 90%, cleaning teeth after meals for 80%, and cleaning teeth before bedtime for 8%). These results showed that training had positive effects on improving students' awareness regarding hand hygiene and teeth hygiene. This program should be considered as a way to reduce the burden of infectious diseases in Cambodia. The program could be used to reduce the incidence of infectious diseases by teaching children the importance of handwashing, proper food handling, and personal hygiene. However, owing to the evaluation of the improvement conducted after the training was completed, ensuring long-term effectiveness remains difficult to prove. Therefore, further research should focus on the sustainable effectiveness of training and spread to rural areas in Cambodia. Furthermore, for this education to be effective and sustainable, personal hygiene education should be the same for parents and teachers, as it plays a key role in monitoring and motivating children to practice properly and consistently.

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