

The Effects of Handwashing Education on Knowledge and Practice Among Primary School Children in Makkah City

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Abstract: Objectives: The study objectives to assess the effects of health education on knowledge and practice of handwashing among school children, in addition to emphasize the importance of including handwashing lessons in primary school curriculums, and to stress the need for providing the related facilities. Methods: This randomized control trial, 139 participants were recruited after their parents' consent and demographic data was acquired. They were randomly allocated to education (n=67) and control (n=72) arms. The school children were evaluated by a self administered questionnaire for knowledge, and an observation-checklist by the research team for practice. They were assessed at baseline, post-intervention, and follow up. The education arm received a learning session consisting of a presentation, a video tutorial, and a practice session. The collected data was analyzed using Mann-Whitney test via SPSS software version 25. Results: The response rate was (92%). The knowledge assessment displayed significant improvement in the education arm's scores at post-intervention and follow up (p value <0.001). Similarly, the practice assessment showed a marked enhancement in the education arm's scores that was statistically significant (p value <0.001) at both post-intervention and follow up. Conclusion: The intensive progress in handwashing knowledge and practice among school children was demonstrated through provision of handwashing education.

Keywords: Handwashing, School Children, Knowledge, Practice, Childhood, Handwashing Practice, Handwashing Knowledge

1. Introduction

Diarrhea and respiratory conditions are responsible for half of the yearly mortality in children, and handwashing remains the best preventive measure for most infectious diseases in comparison with other means and newer methods of hand hygiene; that is, alongside proper sanitation which is an essential requirement for controlling the spread of such conditions. [1-4] In a Cochrane review by Regina et al., handwashing promotion has been shown to decrease the episodes of diarrhea by 30%. It is an efficient way to prevent

many widespread communicable diseases. [5-6] However, many researchers have found that the prevalence of such illnesses is still high, and not surprisingly, have found high loads of pathogens on the studied participants' hands. [7-9] Which either means little adherence to handwashing or improper practice. [7-9] Whereas various health organizations and individuals have put a marked effort in promoting the handwashing behavior, little has been done to enforce the message of the correct application of handwashing method. [2-6] The proper method and knowledge of handwashing both are aspects that almost always need more emphasis, especially in

childhood. [2-10-11] As well, it is also highly significant to point out the importance of the role of raising awareness and educating parents about the correct way to wash hands on their children. [12]

2. Objectives

This study Pre-intervention objectives to assess the effects of health education on knowledge and practice of handwashing among school children, in addition to emphasize the importance of including handwashing lessons in primary school curriculums, and to stress the need for providing the related facilities.

Conversely, Post-intervention objective to determine the effectiveness of handwashing education at primary schools in the improvement of school children's handwashing knowledge and practice.

3. Methodology

3.1. Study Design

This study is a randomized control trial.

3.2. Type of Participants

Children attending primary schools.

3.3. Inclusion and Exclusion Criteria

The Inclusion criteria was a fourth-grade children attending urban primary schools in Makkah Al-Mukarramah city, both males and females.

The schools in rural areas were not included due to the difficulty of access for the research team.

On the other hand, exclusion criteria was Schools that do not teach the Saudi Ministry of Education's curriculums, Schools with no regular water supply or unavailable facilities for handwashing. Also, School children with hand conditions such as wounds and casts, they were excluded from the

calculated sample size and analysis but allowed to benefit from the intervention as much as possible and School children with special needs.

3.4. Study Area and Location

The city of Makkah, It is a metropolitan city with all governmental services available. There are government, private, and foreign schools which offer primary, middle, and secondary level education to both males and females. [13]

Precisely, Male and female primary schools which are located in the urban areas in the city of Makkah.

3.5. Sample Size

There are 703 schools in Makkah city. They are further classified into two main clusters: male and female schools. (13) One hundred of these schools were excluded due to not fitting the criteria as shown in figure 1.

With the G Power® sample size calculating software, a confidence level of (95%) error of (5%), power of (80%), effect size of (20%) and a constant of (0.2), a sample size was calculated to be groups of 60 school children for intervention and another 60 school children for control divided equally in males and females.

3.6. Sampling Technique

Lists of schools names were obtained from the ministry of education.

Two male and similarly 2 female schools were chosen using the online website Research Randomizer®. The schools were then randomly allocated to the education and control arms. In each selected school one class was chosen at random from the fourth grade. All school children in the selected class were invited to participate regardless of the required sample size as calculated; this measure was carried out due to ethical reasons. The average number of school children in each class was 40 school children.

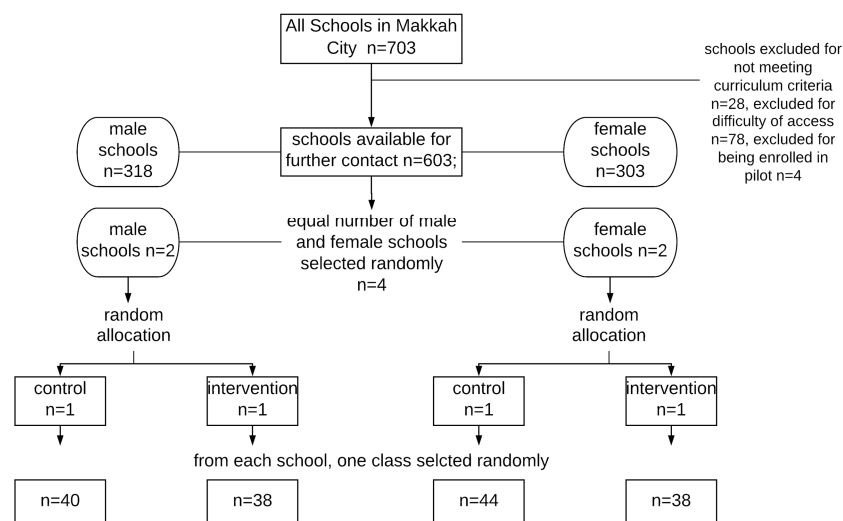


Figure 1. Sampling technique.

3.7. Study Tools and Procedures (Description of Intervention)

A tailored presentation along with an educational video professionally filmed for the study to avoid copyrights violation and to provide high definition, slow paced tutorial in the native language: Arabic. After that, a demographic data form was used and was addressed to the parents had they consented their children's participation and questionnaire was used to test the knowledge of school children. Moreover, standard checklist was used to test the appropriateness of handwashing practice. Precisely, the questionnaire, checklist, and demographic data form were developed by the researcher and evaluated and validated externally by three family medicine consultants.

The questionnaire and checklist were printed and attached together, color coded for both genders and for baseline, immediate post-intervention, and follow up assessment (yellow or bage, pink or blue, and green). The research protocol was approved from the Institutional Review Board of Security Forces Hospital Makkah and number of approval (0162-220118). Higher authority approvals in both ministry of health and ministry of education were acquired. They were informed that they had the complete rights to refuse or withdraw from the study at any time without any academic or other consequences. The research data is stored with the researcher with access provided to the authorities only.

The Ministry of education was contacted via The Joint Program of Family Medicine and The Ministry of Health to provide the research team permission and access to the schools. Moreover, The research team consisted of the researcher herself handling the female schools, and a male intern handling the male schools, along with 4 male medical students and 5 female medical students. Then, Schools were invited to take part in the study and the invitations were accepted. A class was chosen randomly and school children were introduced to the research team. Consent forms were sent to parents before recruitment of children, and the child's demographic data was requested if willing to participate. They were informed that they had the complete rights to refuse or withdraw from the study at any time without any academic or other consequences. The list of class children's names was requested from school administration for sorting and coding the data. To minimize interviewer's bias the team practiced together the points to stress on in the presentation, and in the evaluation of handwashing practice, as well as unifying the method of teaching handwashing. The same liquid soap was used for all schools and all visits, and the brand name was removed from all dispensers. Verbal consent was acquired from the children willing to participate. Questionnaires were distributed among the participating school children by the research team and collected shortly after. The school children were then taken to the sinks where the liquid soap and paper towels were supplied earlier, and each child's washing practice was observed for the points in the checklist. For the education group, a presentation about

handwashing was given, a video tutorial was played, and the correct practice was taught. Questionnaires were redistributed immediately after, and school children were observed again for the application of handwashing, questionnaires and practice observation was repeated on all participating school children after one month. Certificates were distributed among the school children at the end.

The forms collected at every stage were kept together for each school child separately for coding and data management. All forms and data collected from each school were kept in separate coded folders. To minimize co-intervention and contamination all school children in the study will be directed to report any exposure to education about handwashing during the study.

3.8. Study Variables

Dependent variables: The scores from the questionnaires, the appropriateness of handwashing practice (the scores from the checklist).

Independent variables: age, gender, school, number of siblings, birth order in siblings, number of household members, parents' education and occupation, previous exposure or lessons about handwashing, type of soap used at home.

3.9. Data Entry and Analysis

1. Once collected, the data was entered and managed manually by the researcher.
2. IBM SPSS Statistics trial version 25 was used for data entry, management and analysis. The analysis was carried out with intention to treat protocol. The statistical analysis was carried out using Mann-whitney test due to an abnormal distribution of data; with a significant level of a P-value < 0.05.

3.10. Relevance, Expectations and Budget

This study will contribute to the community by emphasizing the need to include handwashing lessons in young children's school curriculum.

The main expenses of the budget including liquid soap, paper towels, folders, labels, printing paper and ink were provided by the researcher. Therefore is study was self-funded.

4. Results

According to the study protocol, all school children of chosen classes were invited to participate. A total number of 139 school children were recruited and 128 of them were followed up to the end. The high response rate (92%) is attributed to a few key factors such as the confined school environment, dedicated time with class for data collection and education session, and the effort of implementing both baseline and post-intervention assessments on the same day. Figure 2 shows the details of participating school children with the follow up and analysis.

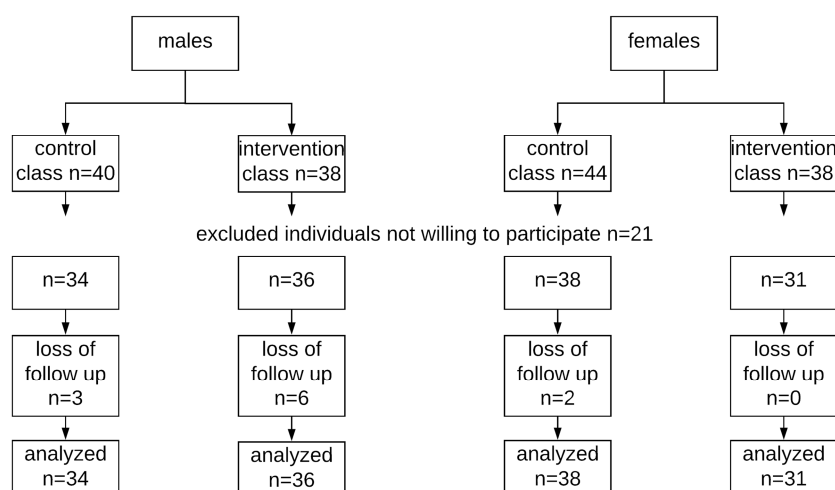


Figure 2. Participant recruitment, follow up, and analysis flow chart.

Table 1. Study sample characteristics (n=139).

Variable	Control N=72 (51.7%)	Hand washing education N=67 (48.2%)	P value
Median age	10	10	NS
Male gender	34 (47.2%)	36 (53.7%)	NS
Saudi nationality	60 (83.3%)	47 (70.1%)	NS
Median number of house members	6	6	NS
Median number of siblings	4	4	NS
Median of child's order in siblings	2	2	NS
Father's education bachelors or greater	32 (44.4%)	32 (47.8%)	NS
Father's healthcare worker occupation	3 (4.5%)	5 (7.7%)	NS
Mother's education bachelors or greater	29 (43.3%)	35 (53.8%)	NS
Mother's healthcare worker occupation	2 (2.9%)	6 (9.1%)	NS
Liquid soap use at home	54 (76.1%)	50 (74.6%)	NS
Previous exposure to handwashing information	64 (90.1%)	60 (89.6%)	NS

Table 1 shows that the median age of school children in the control and handwashing education groups was 10 years. Males constituted 47.2% of school children in the control groups and 53.7% in the handwashing education groups. Most school children in both groups were Saudi (83.3% and 70.1%, respectively). The median number of household members was 6 in both groups, while the median number of siblings was 4 and the median of participant school children' birth order was 2 in both groups. University educated fathers of participant school children were 44.4% in the control groups and 47.8% in the handwashing group, while fathers' occupation of 4.5% of school children in the control group was provision of healthcare compared with 7.7% of school children in the handwashing education group. On the other

hand, university educated mothers of participant school children were 43.3% in the control groups and 53.8% in the handwashing education group, while mothers' occupation of 2.9% of school children in the control group was provision of healthcare compared with 9.1% of school children in the handwashing education group. Liquid soap was used at 76.1% of homes of school children in the control group, compared with 74.6% of those in the handwashing group. The majority of school children in the control group (90.1%) previously received information on handwashing, compared with 89.6% of school children in the handwashing education group. There were no statistically significant differences between school children in both groups according to their personal characteristics.

Table 2. Handwashing level of knowledge among primary school children in Makkah. (n=139).

Assessment of level of knowledge	Control group mean rank (IQR)	Handwashing education group mean rank (IQR)	P value
Baseline pre-intervention	71.90	67.96	NS
Immediate post intervention	44.46	96.04	<0.001
Four weeks follow up	45.23	85.66	<0.001

Table 2 shows that levels of knowledge of school children in both groups about handwashing did not differ significantly at baseline before intervention. However, immediately after intervention, levels of knowledge of school children in the handwashing education group were

significantly better than those in the control group, as indicated by the higher mean ranks among those in the intervention group than those in the control group (96.04 and 44.46, respectively, $p<0.001$). Follow up after four weeks, levels of knowledge of those in the intervention

group were significantly better than those in the control group, as indicated by the higher mean ranks among those

in the intervention group than those in the control group (85.55 and 45.23, respectively, $p < 0.001$).

Table 3. Handwashing level of practice among primary school children in Makkah. ($n=139$).

Assessment of level of practice	Control group mean rank (IQR)	Handwashing education group mean rank (IQR)	P value
Baseline pre-intervention	70.20	69.78	NS
Immediate post intervention	47.70	92.60	<0.001
Four weeks follow up	52.76	77.39	<0.001

Table 3 shows that handwashing practices of school children in both groups did not differ significantly at baseline before intervention. However, immediately after intervention, practices of school children in the handwashing education group were significantly better than those in the control group, as indicated by the higher mean ranks among those in the intervention group

than those in the control group (92.60 and 47.70, respectively, $p < 0.001$). Follow up after four weeks, practices of those in the intervention group were significantly better than those in the control group, as indicated by the higher mean ranks among those in the intervention group than those in the control group (77.39 and 52.76, respectively, $p < 0.001$).

Table 4. Scores' mean ranks of handwashing knowledge and practice baseline, post-intervention, and 4 weeks follow up according to gender of primary school children in Makkah. ($n=139$).

Time-point of assessment		Control		P value	Handwashing education		P value
		male	Female		male	female	
Knowledge	Baseline	36.94	36.11	NS	40.75	26.16	<0.01
	Post-intervention	34.77	37.07	NS	27.43	41.63	<0.01
	Follow up	34.11	33.90	NS	31.95	30.08	NS
Practice	Baseline	42.82	30.84	<0.01	36.89	30.65	NS
	Post intervention	43.61	29.39	<0.01	32.03	36.29	NS
	Follow up	42.47	26.71	<0.01	26.15	35.69	0.03

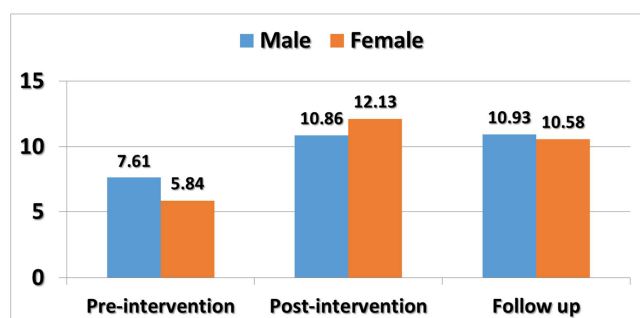


Figure 3. School children's mean scores of handwashing knowledge at baseline, post-intervention, and four weeks follow up according to their gender.

Table 4 and Figure 3 show that, regarding the intervention group, at base line, knowledge of female school children was significantly lower than that of male school children ($p < 0.01$), but immediately after intervention, female school children had significantly better knowledge than those of male school children (mean knowledge scores were 12.13 and 10.86, respectively and mean ranks of 41.63 and 27.43, respectively, $p < 0.01$). However, school children's knowledge did not differ significantly according to their gender at follow up. School children's knowledge in the control group did not differ significantly at base line, immediately after intervention or at follow up.

Table 5. Scores' mean ranks of handwashing knowledge and practice baseline, post-intervention, and 4 weeks follow up according to mother's education of primary school children in Makkah. ($n=139$).

Time-point of assessment		Control		P value	Handwashing education		P value
		\leq high school	\geq post graduate		\leq high school	\geq post graduate	
knowledge	Baseline	27.79	42.14	<0.01	27.82	37.44	0.04
	Post-intervention	27.72	41.34	<0.01	36.03	30.40	NS
	Follow up	26.26	39.26	<0.01	25.16	35.50	0.02
practice	Baseline	33.87	34.17	NS	32.48	33.44	NS
	Post intervention	32.82	34.43	NS	30.89	34.73	NS
	Follow up	30.58	32.86	NS	31.72	29.35	NS

Table 5 shows that knowledge of school children in the control group regarding handwashing was significantly better according to their mothers' educational level ($p < 0.01$ for all stages), with better knowledge among school children whose mothers were more educated. Knowledge of school children in the intervention group was significantly better at baseline and at follow up among school children whose mothers who

were university educated or higher ($p=0.04$), but it did not differ significantly immediately after intervention according to their mothers' educational level. On the other hand, practice of school children in the control and intervention groups regarding handwashing did not differ significantly according to their mothers' education all through the three stages of study.

Table 6. Correlation coefficient between scores of handwashing knowledge and practice at baseline, post-intervention, and 4 weeks follow up and age of primary school children in Makkah. (n=139).

Time-point of assessment		Control	P value	Handwashing education	P value
		Correlation coefficient		Correlation coefficient	
Knowledge	Baseline	0.143	NS	0.138	NS
	Post-intervention	0.040	NS	0.015	NS
	Follow up	-0.017	NS	0.002	NS
Practice	Baseline	0.125	NS	-0.022	NS
	Post intervention	-0.023	NS	0.048	NS
	Follow up	0.065	NS	0.300	0.02

Table 6 shows that knowledge and practice scores of school children in both the control and intervention groups regarding handwashing did not correlate significantly according to their age all through the three stages of study,

except the practice follow up among school children in the intervention group, which correlated positively and significantly ($r=0.3$ and $p=0.02$).

Table 7. Correlation between scores of handwashing knowledge and practice baseline, post-intervention, and 4 weeks follow up and number of household members of primary school children in Makkah. (n=139).

Time-point of assessment		Control	P value	Handwashing education	P value
		Correlation coefficient		Correlation coefficient	
knowledge	Baseline	-0.055	NS	0.156	NS
	Post-intervention	-0.038	NS	0.120	NS
	Follow up	-0.010	NS	-0.062	NS
practice	Baseline	-0.041	NS	0.084	NS
	Post intervention	-0.034	NS	0.106	NS
	Follow up	-0.263	0.04	0.177	NS

Table 7 shows that knowledge and practice scores of school children in both the control and intervention groups regarding handwashing did not correlate significantly according to their number of household members all

through the three stages of study, except the follow up among school children in the control group, which correlated negatively and significantly ($r=-0.263$ and $p=0.04$).

Table 8. Scores' mean ranks of handwashing knowledge and practice baseline, post-intervention, and 4 weeks follow up according to previous exposure of primary school children to hand hygiene topics generally in Makkah. (n=139).

Time-point of assessment		Control		P value	Handwashing education		P value
		Yes	No		Yes	No	
knowledge	Baseline	35.97	36.29	NS	34.79	27.21	NS
	Post-intervention	35.60	34.57	NS	34.28	31.64	NS
	Follow up	33.08	37.00	NS	31.15	29.86	NS
practice	Baseline	34.24	52.07	<0.02	34.31	31.36	NS
	Post intervention	35.09	39.21	NS	34.19	32.36	NS
	Follow up	32.85	39.00	NS	32.01	23.21	NS

Table 8 shows that mean rank of knowledge and practice scores of school children in both the control and intervention groups regarding handwashing did not differ significantly according to their previous exposure to hand hygiene topic all through the three stages of study, except the baseline practice scores among school children in the control group, which correlated positively and significantly ($p=0.02$).

5. Discussion

Despite thoroughly searching databases using the following keywords and search strategy: ("hand wash" OR "hand hygiene") AND ("children" OR "primary school students"), obtained relevant studies in Saudi Arabia or the Gulf Region were very scarce. Only one study could be obtained in Abha City, Saudi Arabia. (9) and only one in Sharjah, United Arab Emirates (Ghanim et al., 2016). [7]

Hazazi study a structured questionnaire was used to collect data about knowledge attitude and practices of school children' personal hygiene. Results showed that more than 95% of the school children were aware that diseases can spread from one person to another person and more than 90% wash their hands with soap before and after eating and also after toilet. There was a positive linear correlation between the knowledge score with practice score and also attitude score with practice score. The study concluded that knowledge attitude and practices concerning personal hygiene among primary school children were satisfactory but still lacking in several aspects. [9]

Person-to-person contact, especially through the hands, constitute a common mode of transmission for several types of Infections. Therefore, good hand hygiene is considered an important infection-control measure. In primary schools, hand hygiene is a key measure for infection control. Improving hand hygiene reduces transmission of infections

and lowers absenteeism of both teachers and school children at their schools, and can potentially prevent secondary infections in the whole community, save health service costs, and decrease the burden on families, some of whom may need to take time off work to care for their children. [14]

The present study aimed mainly to evaluate the effects of health education on knowledge and practice of handwashing among primary school children.

Liquid soap was used at 76.1% of homes of school children in the control group, compared with 74.6% of those in the handwashing group. The majority of school children in the control group (90.1%) previously received information on handwashing, compared with 89.6% of school children in the handwashing education group.

These findings are in accordance with those reported by Ghanim *et al.* (2016), in Sharjah, United Arab Emirates, who reported that 71% of primary school children wash their hands with soap. [7]

Results of the present study showed that at base line both knowledge and practice of primary school children regarding handwashing did not differ significantly. However, immediately after intervention, both knowledge and practice of school children in the handwashing education group were significantly better than those in the control group ($p < 0.001$ for both). Moreover, at follow up (after four weeks), knowledge practices of those in the intervention group remained significantly better than those in the control group ($p < 0.001$ for both).

These findings are in accordance with those reported by several studies. In Perambalur district, the study reported that, after intervention, there was an improvement among school children in adequate handwashing, knowledge about importance of handwashing and knowledge about steps of handwashing at the end of one and two months. In Mugalivakkam village, Kancheepuram District, India, Rubanprem Kumar *et al.* (2014) reported that primary school children' knowledge improved significantly ($p < 0.001$) at post-test. [15]

Results of the current study showed that knowledge and practice of primary school children regarding handwashing differed according to some personal characteristics (i.e., gender, nationality, age, type of commonly used soap).

This study showed that at base line, knowledge of female school children in the intervention group was significantly lower than that of male school children, but immediately after intervention, their knowledge significantly improved to become better than those of male school children. However, school children' knowledge did not differ significantly according to their gender at follow up. On the other hand, school children' knowledge in the control group did not differ according to school children' gender.

Handwashing practices of male school children in the control group were significantly better than those of female school children all through the three study stages. On the other hand, handwashing practices did not differ significantly according to school children' gender before and immediately after intervention, except at follow up, where female school

children had significantly better practices than male school children.

It is to be noted that the very few studies which compared the handwashing knowledge and practice according to gender reported different findings. Sarkar noted that female school children were more knowledgeable than the male school children regarding the maintenance of personal hygiene. [16] Moreover, Taylor argued that behavioral differences related to washing hands according to gender showed that females had higher tendency to wash their hands more often as compared to males. [17, 18]

The observed better practice regarding handwashing of male school children in the present study may be attributed to earlier and the more frequent outdoor ablution for prayers that are usually practiced by boys who accompany their fathers to the mosques, an activity that is more practiced by boys than girls. Moreover, with exposure to educational intervention about handwashing, female school children showed better and quicker knowledge absorption and a higher learning curve than male school children, perhaps like a dry sponge that absorbs more water than a slightly wet one. However, after 4 weeks, the two knowledge curves met at follow up and there was no observed difference according to school children' gender.

Findings of the current study showed that knowledge and practice levels of school children in the control group regarding handwashing did not differ significantly according to their nationality all through all stages of study. On the other hand, knowledge levels were significantly better among Saudi school children before intervention. However, immediately after intervention and at follow up, their knowledge did not differ significantly according to their nationality. School children practices in the intervention group did not differ significantly according to their nationality.

It would be a possibility that Saudi school children, who are native to the study area and have higher living standards, have clearer concepts regarding their personal hygiene than non-Saudi school children, who may be living substandard with limited resources; as suggested by some teachers. Regardless, the differences according to school children' nationality were mostly not significant.

Both knowledge and practice scores of school children in both the control and intervention groups did not correlate significantly according to their age through all three stages of study, except the follow up among school children in the intervention group, which correlated positively and significantly, indicating that older school children are better learners than younger ones.

This finding is in accordance with the study that was conducted in Vietnam, who reported that school children' performance of handwashing with soap was 34% among 1st grader school children and 67% among the older 7th grader school children. As well, they noted that the participation of school teachers in handwashing with soap teaching practices to their primary school children improves child hygiene behavior. However, hygiene behavior of school children

cannot be expected to change unless schools develop and implement practical teaching methods and that health promotion programs have a stronger focus on creating handwashing with soap routines in schools as well as in homes. [18]

The current study showed that school children's knowledge and practice in both the control and intervention groups did not differ significantly according to type of soap used through all three stages of study. These findings document that school children's knowledge and practice of handwashing with soap does not depend on type of used soap. Unfortunately, no study could be found that explored type of used soap as an independent determinant of primary school children's knowledge and/or practice of handwashing.

Results of the current study showed that knowledge and practice of primary school children regarding handwashing differed according to some family characteristics (i.e., primary school children's parents' occupation and education, number of household members and birth order within siblings).

School children's knowledge and practices regarding handwashing in both study groups did not differ significantly according to their fathers' occupation or education. Similarly, school children's knowledge did not differ significantly according to their mothers' occupation, but school children whose mothers were highly educated had significantly better knowledge than those whose mothers were less educated. Knowledge of school children in the intervention group was significantly better at baseline and at follow up among school children whose mothers were highly educated, but it did not differ significantly immediately after intervention according to their mothers' educational levels. Nevertheless, practice levels of school children in the control and intervention groups regarding handwashing did not differ significantly according to their mothers' education all through the three stages of study.

Furthermore, the favorable impact of parents' guidance was shown in the present study by the finding that knowledge scores of school children in the intervention group were better among those who were exposed to parents' guidance, but did not differ significantly at post-intervention and follow up.

Although it might be more logical in this study to expect that school children's knowledge and/or practices regarding handwashing should be significantly better among those with parents whose occupation is related to health-care, yet no significant differences were observed. This may be explained by the fact that parents whose occupation is health-care related may have less free time to spend with their children to guide them regarding personal hygiene.

Surprisingly, Song and his colleagues stressed that the time spent with parents affects children's engagement in handwashing practices. Shared time between parents and children has a positive effect on health and mental well-being of children. Shared time leads to children having more positive health behaviors. Moreover, as parents spend more time with their children, they may have more chances to

guide their children regarding their health-related hygiene. Although, since the lives of children at their primary school age are mainly dependent on their parents and families, they are likely to be affected by examples presented to them at both home and schools. Therefore, it is suggested that children's health-promoting behaviors and positive habits can be established by managing environmental elements, including parents; according to so, promoting handwashing practices as a health behavior can be more effective when the parent factor is utilized. [19]

The present study showed that knowledge and practice scores of school children in both the control and intervention groups regarding handwashing did not correlate significantly according to their number of household members all through the three stages of study, except the follow up among school children in the control group, which correlated negatively and significantly. However, knowledge and practice scores of school children in both the control and intervention groups did not correlate significantly according to their number of household members or their birth order among their siblings all through the three stages of study.

Tremendously, findings of the present study showed that knowledge and practice scores of school children in both the control and intervention groups regarding handwashing did not differ significantly according to their previous exposure to hand hygiene topic generally by any means, except the baseline practice scores among school children in the control group, which correlated positively and significantly. Moreover, knowledge and practice scores of school children in both groups regarding handwashing did not differ significantly according to their previous exposure to health education campaigns. In addition, school children's knowledge in the control group regarding handwashing did not differ significantly according to their previous exposure to health education campaigns before intervention and at post-intervention. However, those who were exposed to health education by their parents had significantly less knowledge than those who were not exposed. School children's practice scores of in both groups did not differ significantly according to their previous exposure to health education by their parents. In addition, school children's knowledge scores in the control group regarding handwashing differed significantly according to their exposure to mass media. School children practice scores in the control group differed significantly according to their exposure to mass media only at post-intervention. Regarding the intervention group, mean rank of knowledge and practice scores of school children regarding handwashing did not differ significantly according to their exposure to mass media all through the three stages of study.

6. Study Limitations

Due to time constraints, this interventional study was conducted over a short period of time. Therefore, further studies to assess long-term behavior change following handwashing with soap intervention and development of

innovative teaching methods are still needed.

Nevertheless, findings of this study can provide potentially effective active teaching methods for improving knowledge and practices related to handwashing for primary school children, which can be further developed in future school health programs.

7. Conclusion

The present randomized control trial displayed the strong progress in handwashing knowledge and practice among school children achieved by education. Personal attributes such as female gender demonstrated the ability to learn quicker; while male gender and having previous exposure to handwashing subject demonstrated better knowledge and practice at baseline. Saudi nationals started off with better level of knowledge. Mothers' higher education, older age, lesser number of household members, and exposure to topic via mass media were associated with better learning. Exposure to education by parents previously had a strong impact and was affected by the correctness of parents' knowledge and practice. Parents' occupation, number of siblings, birth order in siblings, and exposure to campaigns effected neither baseline, nor retention of learning.

8. Recommendations

1. Inclusion of handwashing lessons among multiple years of primary schools as part of curricular activities, respectively with COVID-19 pandemic precaution.
2. Education of parents via virtual school meetings, mass media, and leaflets to create a complete environmental support of correct practices.

List of Abbreviations

P value	Probability of chance
N	Number of individuals, schools, classes
OR	Odds ratio
CI	Confidence interval
CDC	Centers of Disease Control
WHO	World Health organization

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