

# Impact of hand hygiene intervention on hand washing ability of school-aged children

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## ABSTRACT

**Background:** To assess the current knowledge related to hand washing and efficiency of intervention on hand washing techniques amongst school children. **Methodology:** A randomized control trial was conducted amongst class II students of a private school in Korangi, Karachi. Pre-intervention assessment including baseline knowledge and observed practices of hand washing in comparison with World Health Organization (WHO) standard hand washing techniques was done. This was followed by education and demonstration of proper hand washing steps by principal investigator utilizing visual aids. Participants were then randomized into two groups: Group A (education only group) and Group B (education along with glow gel application group). First post-intervention assessment was conducted on same day where both groups were observed for the hand washing steps and scored for hand washing technique. In addition, participants of group B were shown germs under Ultraviolet (UV) light. School was revisited after 1 week later and participants were reassessed for their hand washing technique along with cleanliness grade after applying glow gel and observing under UV light. Data was entered and analyzed using SPSS version 21.0. **Result:** No significant differences were found in median hand washing scores pre-intervention between both the groups (Group A vs B: 4 vs 5,  $P$  value = 0.659), while significant improvement in median hand washing scores was seen post intervention in group B as compared to group A (7 vs 6,  $P$  value = 0.011). However, no significant differences were seen in median hand washing scores at follow-up between both the groups (Group A vs B: 9 vs 8.5,  $P$  value = 0.715) but a significant improvement was observed in both the groups in the hand washing practices from baseline ( $P$ -value = 0.000). On the contrary, no significant differences were found in median cleanliness grade between both the groups (Median for both the groups was 5,  $P$  value = 0.695). **Conclusions:** Hand washing education utilizing various aids is an effective method to improve children's hand washing capability. This short-term intervention was effective even in absence of glow gel, but no cleanliness of hands was observed in both the groups.

**Keywords:** Glow gel and hand hygiene, hand washing techniques, school children

## Introduction

About 2.3 Billion people worldwide lacks do not have basic sanitation system and approximately 892 Million people lack indoor defecation system.<sup>[1]</sup> It is estimated that around 35% of

world's population don't have proper sanitation (WHO report 2012) and 7% of total disease burden globally is due to unhygienic and poor sanitation conditions.<sup>[2]</sup> which mainly include respiratory and diarrheal illness.<sup>[3]</sup> In human body, hands are the main carrier for the transmission of infection at home, restaurants, public transport,<sup>[4]</sup> currency notes<sup>[5]</sup> and even in hospitals.<sup>[6]</sup>

The main cause of diarrheal and respiratory diseases globally among children is improper and insufficient hand washing practices making it not only the leading cause of infectious disease burden globally but also being responsible for half of all

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child deaths per year.<sup>[7]</sup> Hand washing has been shown to reduce diarrhea morbidity and life threatening diarrhea by 42% to 48% and the prevalence of upper respiratory infections by 24%.<sup>[8]</sup>

Proper hand hygiene is regarded as prime element of infection control activities. Considering the ever increasing burden of health care associated infections, complexity of treatment, rise in severity of illness superimposed by multi-drug resistant pathogen infections, health care practitioners are referring back to basics of infection preventions by basic measures like proper hand hygiene. Same is due to the fact that abundant scientific evidences supports that if properly implemented, hand hygiene alone can greatly reduce risks of cross-transmission of infections.<sup>[9]</sup>

Most of these diseases are preventable through counseling and other means of interventions. Research shows that youngsters who wash their hands regularly (4 times a day) suffer 24%<sup>[10]</sup> fewer sick days because of respiratory illness and 51% fewer sick days because of gastrointestinal diseases<sup>[8]</sup> According to Nizame *et al.* people had poor hand washing habits, especially during food preparation.<sup>[11]</sup> Lack of habit and a convenient place for washing the hands while doing anything or eating food was observed as the common barriers. In the current era, COVID-19 pandemic has halted various sectors across the globe and put humanity at the highest level of risk in recent times. The foremost prevention against this menace is proper hand hygiene which is also very prominent to curb this virus in school going children. Even after building of anti-bodies and availability of appropriate vaccine, proper hand hygiene and hand washing will remain a key element in avoiding such diseases and pandemics in future.

According to Joshi *et al.* the benefits of hand washing appeared more important for the people who had the highest absences rates and low socioeconomic status with an important barrier to access of hand washing materials.<sup>[12]</sup> Education of hand washing at school level has been considered as a powerful tool to combat various infectious diseases.<sup>[3]</sup> The positive effects that good hand hygiene can have in reducing infection transmission have been known since Ignaz Semmelweis faced opposition for introducing hand-washing regimes in the 1840s.<sup>[13]</sup>

According to a UNICEF report, involving children themselves as active participants in promoting hand washing with soap in schools creates in the children a sense of ownership that make new behaviors more likely to be adhered, and taken, further to adulthood can be adopted by encouraging millions of school children to engage in these good repetitive behavior.<sup>[14]</sup>

The data regarding hand wash hygiene in different schools of Pakistan is insufficient to conclude,<sup>[15]</sup> so there exists a need to do more research to find out the actual figures which will be helpful for policy makers in future. Our idea to conduct this study was to see ground reality regarding hand hygiene in our children as not much data available in this important group of people so we will plan our future awareness program to eliminate a huge number of diseases. We used Glow gel technique to educate and

involve children in hand washing intervention. Glow gel glows in UV light and children can visualize bacteria and their location on hands physically. This technique has been used in different part of world in teaching hand hygiene and washing in children it will aid us in creating visual effect Visualization of bacteria drags the concentration of participant of the study and they concentrate more to see the results of hand washing by soap and other disinfectants.<sup>[16]</sup>

## Materials and Methods

In this randomized controlled trial, a total of 93 students of class 2 with an average age of 6 to 7 years from private co-education school at low social economical area in the largest city of Pakistan were included. All the children with allergy to latex, chronic condition that impaired their ability of hand washing, traumatic injury to hand or forearm and children not assenting to participate were excluded.

After Institutional Review Board approval, principals of private sector primary schools in vicinity of The Indus Hospital were contacted for their interest in participating in the study. Research purpose along with methodology was shared with them accordingly. Parent's permission was sought through letters attached in homework diaries of the children. Subsequently, study team visited school on a proposed date. Children having parental consent were enrolled in the study. Verbal assent was also taken from the children. Pre-intervention questionnaire was filled by the Principal Investigator (PI) after interaction with each student. This was followed by taking each student to the sink, observing the steps of hand washing technique according to WHO and marking them accordingly on pre-defined questionnaire. After this activity, a session of approximately 15-20 minutes was conducted for the students by the PI, where importance and seven-steps of hand washing according to World Health Organization (WHO) standards were demonstrated to all participants through verbal and visual means. A video was prepared by PI in local language, which demonstrated the seven-steps of hand washing for better understanding of the students. The participants were then divided into two groups randomly with the help of SNOSE envelopes which were created by research center. Group A (No glow gel group) participants were asked to wash their hands as demonstrated by the PI. No glow gel was used for this group. In Group B (Glow gel group), glow gel was applied on participant's hand and germs were shown under ultraviolet light. Participants were then asked to wash their hands as demonstrated by PI. The study team observed the steps followed by each participant of both the groups and marked accordingly on first post intervention questionnaire.

After two weeks, the school was revisited and participants from both the groups were applied glow gel and asked to wash their hands according to the seven steps previously taught. Study team assessed hand washing technique and cleanliness standards by observing the hands under ultra-violet light and marking on second post intervention questionnaire which also include

assessment of cleanliness grade according to scoring system<sup>[17]</sup> Score zero was given if no germs seen and score one was given if germs seen. For scoring, the right hand was divided into following seven areas: finger tips, palms, front of wrist, back of wrist, nails, knuckles, and between fingers. Grading was assigned as follows grade 7 if germs seen in all area (very dirty), grade 4-6 if germs seen in 4-6 area (dirty), grade 1-2 if germs seen in 1-2 areas (clean), and grade 0 if no germs seen in any area (very clean).

### Statistical analysis

Data were entered and analyzed using SPSS version 21.0. Mean  $\pm$  SD or Median (IQR) was computed for age, knowledge, and hand washing score. Frequency and percentage were computed for gender and ethnicity. Independent sample T-test/Mann-Whitney U test was applied as appropriate to assess significant difference in age, knowledge, and change in hand washing score between the two groups. Paired t-test/Wilcoxon Signed Rank test was applied as appropriate to assess significant difference in pre and post hand washing scores for the two groups separately. *P* value  $<0.05$  was considered statistically significant.

### Result

A total of 93 children (46.2% boys and 53.8% girls) of grade 2 were included in the study. The mean age ( $\pm$ SD) of the children was 7.58 ( $\pm$ 0.816) years with a range 6 to 10 years [Table 1].

Almost all the children were right-hand dominant. When asked about when you washed your hands from yesterday until now, regardless of gender, majority (90-92%) of the children replied after using the toilet and before eating the food, followed by after reaching from school 65.6%, after eating food 59.1% and after playing 49.5% (*P* = 0.451, Table 2).

After the sneezing activity, higher proportion of boys didn't cover their nose/mouth as compared to girls (60.5% vs 30.0% *P* < 0.05, Table 2), on the contrary higher proportion of girls sneezed into bare as compared to boys (*P*-value <0.05, Table 2). On asking importance of hand hygiene, higher proportion of boys answered to stop germs from spreading as compared to girls (86% vs 68%, *P* value < 0.05, Table 2), followed by to prevent illness (30.2% vs 22%, *P* value >0.05, Table 2), and to remove dirt (11.6% vs 16%, *P* value >0.05, Table 2). Three-fourth of the children had trimmed nails at the time of survey (baseline) and at 2-weeks follow-up (*P* = 0.419), however, the cleanliness of nails improved after educating children at 2-weeks follow-up as compared to baseline (52.7% vs 37.6%, *P* = 0.015).

All the children were randomly divided in two groups. One group were demonstrated the hand washing protocol only (Group A) and the other group were demonstrated the hand washing protocol through glow-gel hand washing technique (Group B). Hand washing scores were calculated pre and post intervention and at 2-weeks follow-up. No significant differences were found in median hand washing scores (# of steps followed) at baseline between both the

**Table 1: Characteristics of study population**

| Features                  | n (%)           |
|---------------------------|-----------------|
| Age in years              | 7.58 $\pm$ 0.81 |
| Gender                    |                 |
| Male                      | 43 (46.2)       |
| Female                    | 50 (53.8)       |
| Nails length at baseline  |                 |
| Trimmed nails             | 70 (75.3)       |
| Grown nails               | 21 (22.6)       |
| Missing                   | 2 (2.2)         |
| Nails Status at baseline  |                 |
| Clean                     | 35 (37.6)       |
| somewhat dirty            | 39 (41.9)       |
| Very Dirty                | 18 (19.4)       |
| Missing                   | 1 (1.1)         |
| Nails length at follow up |                 |
| Trimmed nails             | 72 (77.4)       |
| Grown nails               | 16 (17.2)       |
| Missing                   | 5 (5.4)         |
| Nails Status at follow up |                 |
| Clean                     | 49 (52.7)       |
| somewhat dirty            | 20 (21.5)       |
| Very Dirty                | 19 (20.4)       |
| Missing                   | 5 (5.4)         |
| Hands used to write       |                 |
| Right                     | 88 (94.6)       |
| Left                      | 3 (3.2)         |
| Missing                   | 2 (2.2)         |
| Hands used to eat         |                 |
| Right                     | 90 (96.8)       |
| Left                      | 1 (1.1)         |
| Missing                   | 2 (2.2)         |

groups (Group A vs B: 4 vs 5, *P* value = 0.659, [Table 3]). While significant improvement in median hand washing scores was seen post intervention in group B as compared to group A (7 vs 6, *P* value = 0.011, S[Table 3]. However, no significant differences were seen in median hand washing scores at 2-weeks follow-up between both the groups (Group A vs B: 9 vs 8.5, *P* value = 0.715) but significant improvement was observed in both the groups in the hands washing practices from baseline (*P*-value = 0.000). On the contrary, no significant differences were found in median cleanliness grade between both the groups at 2-weeks follow-up (Median for both the groups was 5, *P* value = 0.695, Table 3). Showing that though the children were following all the steps, but their hands were still filthy as they were not performing the steps properly.

### Discussion

The main cause of diarrheal and respiratory diseases among children across the globe is improper and insufficient hand washing practices which contributes to half of all child deaths per year.<sup>[18]</sup> In our study there were no significant differences found in median hand washing scores (# of steps followed) at baseline between both the groups (Group A vs B: 4 vs 5, *P* value = 0.659), However, no significant differences were seen

**Table 2: Comparison of Characteristics of Hand Hygiene**

|   | Gender                 |                        | Total      | P       |
|---|------------------------|------------------------|------------|---------|
|   | Male n (%)             | Female n (%)           |            |         |
| Washed hands yesterday                    |                        |                        |            |         |
| After Reaching from School                | 28 (65.1)              | 33 (66.0)              | 61 (65.59) | 0.451   |
| Before Eating Food                        | 40 (93.0)              | 44 (88.0)              | 84 (90.32) |         |
| After Eating Food                         | 26 (60.5)              | 29 (58.0)              | 55 (59.14) |         |
| After Using Toilet                        | 39 (90.7)              | 47 (94.0)              | 86 (92.47) |         |
| After Playing                             | 25 (58.1)              | 21 (42.0)              | 46 (49.46) |         |
| After Waking Up in The Morning            | 27 (62.8)              | 22 (44.0)              | 49 (51.96) |         |
| Other                                     | 4 (9.3)                | 5 (10.0)               | 9 (9.53)   |         |
| Sneezing activity                         |                        |                        |            |         |
| Child sneezes without covering nose/mouth | 26 (60.5) <sup>b</sup> | 15 (30.0)              | 41 (44.09) | 0.000** |
| Child sneezes into bare hands             | 13 (30.2)              | 34 (68.0) <sup>a</sup> | 47 (50.54) |         |
| Child sneezes into tissue paper           | 1 (2.3)                | 0 (0.0)                | 1 (1.08)   |         |
| Child sneezes into elbow                  | 0 (0.0)                | 0 (0.0)                | 0 (0.00)   |         |
| Child unable to perform activity          | 5 (11.6)               | 3 (6.0)                | 8 (8.06)   |         |
| Other                                     | 2 (4.7)                | 1 (2.0)                | 3 (3.23)   |         |
| Importance of hand washing                |                        |                        |            |         |
| Prevent illness                           | 13 (30.2)              | 11 (22.0)              | 24 (25.81) | 0.156   |
| To remove germs                           | 37 (86.0) <sup>b</sup> | 34 (68.0)              | 71 (76.34) |         |
| To remove dirt                            | 5 (11.6)               | 8 (16.0)               | 13 (13.98) |         |
| Other                                     | 2 (4.7)                | 0 (0.0)                | 2 (2.15)   |         |
| Don't know                                | 3 (7.0)                | 5 (10.0)               | 8 (8.60)   |         |
| Nail length at baseline                   |                        |                        |            |         |
| Trimmed nails                             | 31 (75.6)              | 39 (78.0)              | 70 (76.9)  | 0.788   |
| Grown nails                               | 10 (24.4)              | 11 (22.0)              | 21 (23.1)  |         |
| Total                                     | 41 (100)               | 50 (100)               | 91 (100)   |         |
| Nail Status at baseline                   |                        |                        |            |         |
| Clean                                     | 19 (45.2)              | 16 (32.0)              | 35 (38.0)  | 0.261   |
| Somewhat dirty                            | 14 (33.3)              | 25 (50.0)              | 39 (42.4)  |         |
| very dirty                                | 9 (21.4)               | 9 (18.0)               | 18 (19.6)  |         |
| Total                                     | 42 (100)               | 50 (100)               | 92 (100)   |         |
| Nails length at follow up                 |                        |                        |            |         |
| Trimmed nails                             | 30 (76.9)              | 42 (85.7)              | 72 (81.8)  | 0.288   |
| Grown nails                               | 9 (23.1)               | 7 (14.3)               | 16 (18.2)  |         |
| Total                                     | 39 (100)               | 49 (100)               | 88 (100)   |         |
| Nails status at follow up                 |                        |                        |            |         |
| Clean                                     | 19 (48.7)              | 30 (61.2)              | 49 (55.7)  | 0.174   |
| Somewhat dirty                            | 8 (20.5)               | 12 (24.5)              | 20 (22.7)  |         |
| very dirty                                | 12 (30.8)              | 7 (14.3)               | 19 (21.6)  |         |
| Total                                     | 39 (100)               | 49 (100)               | 88 (100)   |         |

\*P<0.05, \*\*P<0.0001, Chi-square test. For each significant pair, the key of the category (a=male, b=female) with the smaller column proportion appears under the category with the larger column proportion. Results are based on two-sided Z-test for column proportions with significance level 0.05

**Table 3: Comparison between Education and Glow Gel**

|  | Intervention groups |                        | Overall    | P                   |
|--|---------------------|------------------------|------------|---------------------|
|  | Education only      | Education and glow gel |            |                     |
| Hand washing demonstration time (in seconds) |                     |                        |            |                     |
| Before education; median (IQR)               | 27 (20-37.8)        | 24.5 (20-36.8)         | 25 (20-37) | 0.361 <sup>†</sup>  |
| After education; mean±SD                     | 40.6±15.1           | 48.4±19.2              | 44.7±17.7  | 0.040* <sup>‡</sup> |
| Hand washing score (# of steps followed)     |                     |                        |            |                     |
| Before education; median (IQR)               | 4 (4-5)             | 5 (4-5.8)              | 5 (4-5)    | 0.659 <sup>†</sup>  |
| After education; median (IQR)                | 6 (4-7)             | 7 (6-8)                | 7 (5-7)    | 0.011* <sup>‡</sup> |
| 2-weeks followup; median (IQR)               | 9 (7-10)            | 8.5 (6-10)             | 9 (7-10)   | 0.715 <sup>†</sup>  |
| Cleanliness grade                            | 5 (4-6)             | 5 (3-6)                | 5 (3-6)    | 0.695 <sup>†</sup>  |

\*P<0.05, <sup>†</sup>Independent sample t-test, <sup>‡</sup>Mann-Whitney U test

in median hand washing scores at 2-weeks follow-up between both the groups (Group A vs B: 9 vs 8.5,  $P$  value=0.715, [Table 3] and significant improvement was observed in both the groups in the hands washing practices from baseline ( $p$ -value = 0.000). These findings are consistent with the study conducted by Ashutosh Shrestha which indicate that the mean knowledge score of personal hygiene was 53.86 which increased to 77.54 after health education intervention, which was statistically  $P < 0.001$  and the mean practice score of personal hygiene was 41.43 which increased to 60.87 after health education intervention.<sup>[19]</sup> Another study conducted by Bieri *et al.* reported that the mean KAP score regarding hand washing and preventing worm infection at baseline were 26.3 (25.5 to 27) and 30.7 (29.8 to 31.5) for control group and intervention group respectively. Post intervention the mean KAP score increases to 33.4 (32.5-34.4) and 63.3 (62.3-64.4) in control and intervention group respectively.<sup>[20]</sup>

We use glow gel in one of our study group as it allows patients to directly visualize the dirt on their hands and scrubbing longer and harder is an obvious way to improve hand washing. To our knowledge there is only one study conducted by Anna B. Fishbein *et al.* Comparing the glow gel intervention with and without hand hygiene education and reported that the mean hand washing score of all children significantly improved the pre-intervention hand washing result was 16.3 (SD,  $\pm 3.66$ ) and the post intervention hand washing score was 17.9 (SD,  $\pm 3.91$ ) at the 2-4 weeks follow-up visit. The total mean improvement score was 1.60 (SD,  $\pm 4.7$ ;  $P = 0.02$ ). The mean score of children in glow gel without hand washing education ( $n = 24$ ) improved by 1.4 (SD,  $\pm 4.72$ ) and the mean score of children in glow gel with education ( $n = 22$ ) improved by 1.60 (SD,  $\pm 4.7$ ;  $P = 0.02$ ). The difference between the 2 randomized groups was not significant ( $P = .82$ )<sup>[17]</sup> These findings are in agreement with the result of our study.

UNICEF insists that hand washing before eating and after toilet use are the two most critical occasions of hand washing.<sup>[21]</sup> In the present study 90.3% children confirmed that they wash their hands before eating food and 92.4% children answered that they wash their hand after visiting toilet. This is in accordance with the studies done within various countries of the South Asian region and African region<sup>[22-25]</sup> In contrast to these findings, a study conducted by Gawai PP *et al.* reported that only 18.1% of participants consider washing hands after using the toilet.<sup>[21]</sup>

In the present study 19.6% of the participants have clean nails and 38.0% of the participants have very dirty nails. After intervention the percentage of clean nails increased to 21.6 and the percentage of dirty nails also increased to 55.7. Although the hand washing score increased after intervention in both the study groups the overall cleanliness grade remained the same and the proportion of dirty nails increased from baseline to follow up. The result of the study conducted by Alyssa Vivas *et al.* supported these findings and reported that 72.5% of the participants with adequate knowledge of hygiene have dirty fingernails.<sup>[23]</sup> In

contrast to the result of the present study Dongre AR, *et al.* reported that after hygiene education the proportion of clean and cut nails also improved from 67.8% to 80%.<sup>[26]</sup> A.R Dongre also reported that the prevalence of clean and cut nails was 29.7% and it increased to 48.2% after health education.<sup>[27]</sup>

When asked about the importance of hand washing 25.81% of participants answered that it prevents illness, 76.34% answered that it removes germs and 13.98% stated that it removes dirt. This is contradictory to the result of the study conducted at Ghana where 37.67% of participants answered that hand washing is important to prevent illness, 21.3% of participants stated that it removes germs and the same proportion of participants (21.3%) stated that it removes dirt.<sup>[25]</sup>

Hand washing is the primary prevention for all types of communicable diseases. If we practice proper hand hygiene it will avoid many consequences with these diseases. In this regard, the key role of primary care physicians is critical as people visit them often even without illness or for their regular/annual check-ups, child vaccinations and counselling for various matters. Impact of their frequent counselling plays a vital role in preventing these diseases.

The strength of our study is, as this is the first study of its kind being conducted in the school of Karachi targeting children aged 6 to 8 years through direct guidance and using visual aid. Children of this age can be easily encouraged and motivated to develop healthy hygiene habits by frequent hand washing especially before eating food and after visiting toilet.

During the conduct of this study, limitations were also faced. Although it was a randomized control trial we used some self-reported questions such as the importance of hand washing. This self-reporting may have resulted in over-reporting of proper hygiene practices. The second limitation was that this study was conducted in one school at a low social economic area so the results cannot be generalized.

## Conclusion

The knowledge and practice of hand hygiene increased after health education intervention in both the groups. Children are more adaptive to learning and can easily develop healthy behaviors at a younger age. They can also be the ambassador of change by spreading what they have learned in school to their family and community members. Curriculum should be revised and the Sindh education board should also consider hand washing education in the school through liaison with health services and NGOs. This will not only help promote health education but also help control multiple communicable diseases.

## Ethical Statement

Interactive Research Development- Institute Review Board (IRD-IRB) reviewed the protocol for human subjects and issued approval to the study ID # IRD\_IRB\_2017\_03\_011.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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