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Evaluating the efficacy of handwashing demonstration on hand hygiene among school students – An interventional study

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Abstract:

BACKGROUND: Washing of hands and maintenance of appropriate hand hygiene plays a significant role in preventing the spread of many communicable diseases. However, literature demonstrating the efficacy of the World Health Organization (WHO) recommended handwashing procedure among schoolchildren in India is scanty.

AIM: The aim of this study was to assess hand hygiene efficacy through graphical assessment technique utilizing ultraviolet (UV)-sensitive fluorescent lotion before and after handwashing demonstration among students aged 12–18 years.

MATERIALS AND METHODS: This was an interventional study carried out over a period of 5 days among 21 schoolchildren aged 12–18 years in their respective school premises. Participants were requested to rub their hands with an UV-sensitive fluorescent lotion and then wash them. Hands were air-dried and examined under UV rays for blue light emission in a dark room. Emission of blue light highlighted parts of hand where lotion is still present and area not washed properly. Such areas were painted with nontoxic skin-friendly paints. Painted hands were imprinted over graph papers. Hand hygiene demonstration was provided to the participants as per the WHO guidelines by qualified public health dentists using audiovisual aids. Postintervention, the procedure followed at baseline was adopted to obtain imprints of uncovered (not covered during hand hygiene process) parts of hands. The mean percentage of uncovered parts of hand was assessed and compared between baseline and postintervention.

RESULTS: The overall mean percentage score of uncovered hand area significantly reduced from $73.90 \pm 19.81 \text{ mm}^2$ at baseline to $20.05 \pm 17.0 \text{ mm}^2$ after demonstration of proper hand hygiene guidelines ($P < 0.001$).

CONCLUSION: Hand hygiene demonstration by qualified public health dentists using audio-visual aids has significantly contributed to improving their hand hygiene practice.

Keywords:

Graphical assessment technique, hand hygiene, hand hygiene maintenance, hand rubbing, handwashing

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Introduction

Hand is the major source, to spread communicable diseases from person to person.^[1] A simple act of handwashing can prevent at least one out of ten episodes of diarrhea and one out of six episodes of

respiratory diseases such as pneumonia.^[2] According to the United Nations Children's Education Fund, handwashing procedure with soap and water is not a widespread practice in India.^[3] Numerous guidelines were published by the World Health Organization (WHO) and Center for Disease Control (CDC) to control infections, namely

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“A Guide to the Application of the WHO Multimodal Hand Hygiene Improvement Strategy” and the “My Five Moments for Hand Hygiene” Approach for health-care workers.^[4,5] These guidelines cover hand hygiene, including step-by-step demonstration of proper handwashing and hand rubbing.^[6,7] The WHO has published a “SAVE LIVES: Clean Your Hands WHO’s Global Annual Campaign Advocacy Toolkit.” Around 180 countries and 20,000 health facilities have joined the campaign as of May 2016.^[8] Around 688 hospitals from India have registered under this campaign.^[9]

Despite much attention focused on hand hygiene, literature indicate insufficient knowledge among health-care workers to maintain proper hand hygiene compliance and handwashing technique. This inadequate knowledge is probably attributed to lack of facilities, training, information, time, and high patient care load.^[1,10-14]

There is a paucity in the current literature on direct objective assessment of hand hygiene. Hand hygiene needs to be assessed according to the WHO guidelines preferably using graphical assessment technique (GAT). The technique does not assess microbial load or efficacy of handwashes/sanitizers, but it is a direct macroscopic objective assessment of efficiency with which an individual washes hand.^[4]

School-going children constitute a significant proportion of the population in any country. In India, children <15 years constitute about one-third of the total population. Literature evaluating the effectiveness of hand hygiene procedures/techniques adopted by Indian school-going children is scanty. In this background, this study was undertaken to assess hand hygiene efficacy using GAT which uses UV-sensitive fluorescent lotion. The evaluation of hand hygiene was done before and after giving demonstration of handwashing procedures among students aged 12–18 years.

Materials and Methods

This was an interventional study conducted over a period of 5 days among school students aged 12–18 years in their premises. The study protocol was approved by the institutional ethics committee (IEC). Permission was obtained from school authorities to conduct the study. A written informed assent/consent was obtained from all students participating in the study and their respective guardian after informing them about the research protocol. The consent and assent was obtained in local language (Kannada).

Sample size

The sample size was estimated using nMaster software. The sample size was estimated for hypothesis testing

between two means with an effect size of 0.8, at 95% confidence interval, and 90% power. It was computed to be 18. However, the sample size was rounded off to 20 to compensate around 10% dropout.

Selection of study participants

The list of all students in selected high school in Mysuru was obtained from school authorities. Research protocol was presented by a principal investigator to all prospective participants including the teachers, parents, and guardians. Among the students who volunteered to participate in the study, 20 students who fulfilled the following eligibility criteria were selected using lottery method of simple random sampling.

Inclusion criteria: Participants

- Aged 12–18 years
- With normal anatomic and physiological upper extremities
- Willing to offer informed consent
- Free from systemic diseases
- Free from physical and mental disabilities.

Exclusion criteria: Participants with

- History of drug allergy
- History of dermatologic complications
- Formal training on hand hygiene guidelines
- Any trauma or cut on hands.

Materials used for objective assessment of hand hygiene using graphical assessment technique

- GloGerm™—It is an antiseptic ultraviolet (UV)-sensitive fluorescent lotion
- Source of UV light
- Nontoxic, skin-friendly paints (watermark color)
- Fine-tipped brushes
- Graph booklet
- Cloth to wipe the hands after washing painted hands
- 0.5 mm pointed marker.

Glo Germ™ lotion, when placed on hand in either powder or liquid-based form, looked like blue colored area under UV light. Part of the hand from where the blue light emitted following exposure to UV light indicated the presence of lotion on hand.

Preintervention assessment

Eligible students were requested to remove hand jewelry, artificial nail, nail polish, and cut down extended nails if any before initiating baseline assessment. A definite quantity of antiseptic UV-sensitive fluorescent lotion was placed on their hands. Children were requested to rub and wash their hands according to their routine practice. Washed hands were air-dried and thoroughly examined under UV light in a dark room by a principal investigator. Parts of hands not washed properly

emitted blue color under UV light due to the presence of lotion. Nontoxic, skin-friendly paints and fine-tipped brush were used to paint the areas emitting blue light from hands. These areas of hand indicated that the lotion applied before washing was not completely removed. Subsequently, participants were guided to place their hands in a steady manner over a graph sheet with fingers wide apart. The portion of hand in contact with graph paper was outlined by a 0.5 mm pointed marker. Afterward, participants were instructed to wash and dry their hands. The total and colored area on the graph paper was measured in millimeters. The percentage of colored area on graph sheet was computed by dividing the colored area by total area of hand. The mean percentage score in mm² for all the participants was computed. The principal investigator was asked to repeat measurements on graphical sheet for 10% of the participants to check consistency in scoring. The consistency was found to be satisfactory with agreement of more than 80% between the mean percentage scores in two consecutive measurements. Participants' demographic information such as age, gender, and class was also noted in the datasheet by the investigator.

Intervention

Interactive sessions were conducted to demonstrate "eleven steps" of washing hands according to the guidelines published by the WHO and CDC.^[6,7] The participants were given a demonstration of hand rubbing apart from handwashing according to the guidelines published by the WHO and CDC by the principal investigator. Audiovisual aids were used along with practical demonstration.

Postintervention

Five days after demonstration of this procedure, UV-sensitive fluorescent lotion was again applied to hands of each participant. The participants were asked to follow 11 steps of handwashing as demonstrated during intervention. Washed hands were studied under UV light using the procedure described earlier. The percentage of colored area on graph sheet was computed for each participant, and the mean percentage area in mm² for the group was determined. Lesser mean percentage of area covered with UV fluorescent lotion after handwash under UV light indicated a better handwash procedure.

Statistical analysis

The statistical analysis was done using the Statistical Package for the Social Sciences (SPSS) software version 22, IBM, Chicago, USA. A paired *t*-test was used to compare the difference in area not covered by hand hygiene using graphical method before and after intervention. Statistical significance was fixed at 0.05.

Results

A total of 21 participants were recruited for the study. Among them, 6 were males and 15 were females. Thirteen participants were <13 years of age and eight were more than 13 years of age.

The overall mean score of hand area not covered during hand hygiene procedure before hand hygiene demonstration was 73.9 mm², with a standard deviation of 19.8. The overall mean score of uncovered hand area during postintervention period significantly reduced to 20.05 mm², with a standard deviation on 17.0 [$P < 0.001$, Table 1]. The reduction in score during postintervention compared to baseline scores was statistically significant even when a separate comparison was undertaken among males [$P < 0.001$, Table 1] and females [$P < 0.001$, Table 1]. There was no statistically significant difference in the hand hygiene efficacy between males and females at baseline [$P = 0.42$, Table 1] as well as after demonstration of hand hygiene procedure [$P = 0.26$, Table 1].

The study also found a reduction in mean percentage score during postintervention period to be statistically significant in comparison with baseline scores even when a separate comparison was undertaken among children aged <13 years [$P < 0.001$, Table 2] and those aged 14 years or more [$P = 0.002$, Table 2]. However, the difference in the mean scores between children in these two age groups was not statistically significant at baseline [$P = 0.68$, Table 2] and postintervention [$P = 0.11$, Table 2]. These results clearly indicated that children of all ages and gender groups will get equally benefited by such hand hygiene demonstration programs.

Discussion

Evaluating efficacy of hand hygiene procedures will be more valid and reliable if efficacy is assessed using an objective assessment technique. Studies in the past have assessed hand hygiene either using a questionnaire as a tool or by evaluating the microbial load.^[1,11,15-17] Literature evaluating the effectiveness of handwashing demonstrations which are done according to the WHO hand hygiene technique using objective evaluation in Indian context was practically nonexistent.^[4] In this background, the present study was undertaken to assess hand hygiene efficacy through GAT using UV-sensitive fluorescent lotion among a group of schoolchildren aged 12–18 years.

The study found that there was no statistically significant difference in the mean percentage area of hand (expressed in mm²) not covered between the two genders both at baseline and postintervention ($P \geq 0.5$). This finding

Table 1: Effectiveness of hand hygiene demonstration (hand area not covered in mm²) among males and females before and after intervention

Gender	Mean±SD		Statistical inference* (t, df, P)
	Preintervention	Postintervention	
Males (n=6)	68.22±11.19	13.28±2.94	15.03, 5, 0.00
Females (n=15)	76.18±22.28	22.75±19.54	7.57, 14, 0.00
Total (n=21)	73.90±19.81	20.05±17.0	10.59, 20, 0.00
Statistical inference** (t, df, P)	0.82, 19, 0.42		1.16, 19, 0.26

*Paired t-test, **Independent sample t-test. SD=Standard deviation

Table 2: Effectiveness of hand hygiene demonstration (hand area not covered mm²) among different age groups before and after intervention

Age (years)	Mean±SD		Statistical inference* (t, df, P)
	Preintervention	Postintervention	
<13 (n=13)	72.47±19.89	15.36±4.02	10.72, 12, 0.00
>14 (n=8)	76.24±20.81	27.65±26.28	4.66, 7, 0.002
Total (n=21)	73.90±19.81	20.05±17.0	10.59, 20, 0.00
Statistical inference** (t, df, P)	0.41, 19, 0.68		1.68, 19, 0.11

*Paired t-test, **Independent sample t-test. SD=Standard deviation

was similar to the finding in a study done by Kumar *et al.*, who found no significant difference between males and females in hand hygiene performance levels when the study was conducted among 197 students selected from a government-aided college.^[17] The lack of gender difference both at baseline and postintervention indicates that children are capable of adopting hand hygiene demonstrations with no gender differences.

The present study demonstrated a statistically significant reduction in mean percentage scores at postintervention period compared to baseline scores. This suggests that the children adopted better hand hygiene procedures following demonstration of handwashing procedure according to the WHO guidelines. Adoption of better hand hygiene procedures was noted among all children with no significant difference with regard to gender and age. Kumar *et al.* conducted a study among 40 students in New Delhi, India, from two different schools to evaluate the efficacy of handwashing demonstrations. They found the mean scores at baseline in these schools to be 10.08 ± 1.91 mm² and 11.96 ± 2.10 mm², respectively. One month after hand hygiene intervention, the scores among participants in these two institutions were 6.87 ± 1.69 mm² and 10.59 ± 2.07 mm², respectively.^[4] There was a significant reduction in the scores demonstrating improvement in hand hygiene. The results of our study were similar to the findings of this study.^[4]

The overall reduction in the mean score of hand area not covered during hand hygiene procedure indicated that the children might have adopted the WHO hand hygiene guidelines. Hence, a reduction was presumed to have occurred. Widmer *et al.* reported an increase in compliance to 70% following demonstration of the WHO guidelines for hand hygiene.^[18] Another study by

Lehotsky *et al.* also reported that the rate of inadequate hand rubbing reduced from 50% to 15% following demonstration of the WHO hand hygiene guidelines using UV-ray hand hygiene assessment.^[19] The results of all these studies clearly indicate the efficacy of demonstrating simple hand hygiene procedures similar to our findings. The necessity to maintain and follow proper hand hygiene technique is utmost important in developing countries such as India where the communicable diseases are still widely prevalent. The objective assessment of hand hygiene using GAT was feasible and could be easily applied in school settings. The technique could also be applied in other population groups to promote hand hygiene practices.

School-going children constitute a major section of the population in any country. If the procedure of hand hygiene can be incorporated in the regular school curriculum, it will help in improving the hand hygiene practices and play a vital role in reducing the burden of many communicable diseases which spread through improper hand hygiene. Hand hygiene demonstrations could be undertaken by trained teachers using the WHO manual and guideline.

Novelty

- The study used GAT for evaluating the efficacy of hand hygiene. This was an objective assessment of hand hygiene. The result of our study adds evidence to the existing body of limited literature that have used objective assessment for evaluating hand hygiene
- The objective assessment is expected to enhance self-motivation and provides a psychological reinforcement to improve hand hygiene especially among students

- The graphical technique facilitates a comparative analysis and monitoring among participants which is easy to apply.

Limitation

- The study assessed the hand hygiene efficacy on a short-term basis. The evaluation after 3 or 6 months following intervention would have given clarity on how many the students were able to remember and adopt on long-term basis. The time constraints compelled us to undertake postintervention assessment 5 days following intervention. Moreover, we presume that the behavior of participants might be influenced by an observer's presence during postintervention period
- Inter-digital regions and back of hand were not assessed in GAT.

Social relevance and public health significance

The study demonstrated the feasibility and effectiveness of demonstrating simple hand hygiene procedures among schoolchildren. The adoption of such meticulous hand hygiene procedures should become part of lifestyle of every human being, and this should be inculcated right from early childhood. The study clearly demonstrates public health significance and social relevance of preventing the transmission of communicable diseases by adoption of simple hand hygiene procedures. The results of the study indicate the importance and need for demonstrating hand hygiene procedures to the entire population in the context of ongoing COVID-19 outbreak.

Conclusion

- The mean percentage of hand area not covered during hand hygiene procedure decreased from 73.90 mm² to 20.05 mm² 5 days following demonstration of hand hygiene procedures. Postintervention scores were significantly lower compared to baseline scores which indicated a significant improvement in hand hygiene practice following demonstration of hand hygiene using the WHO guidelines among schoolchildren
- Hand hygiene demonstration by a qualified public health dentist using audio-visual aids has significantly contributed to enhancing hand hygiene practices among schoolchildren.

Way forward and strategic recommendations

- Long-term studies demonstrating the effectiveness of hand hygiene procedures could be undertaken among all government and private schools
- The teachers could be trained in hand hygiene procedures according to the WHO guidelines who, in turn, can demonstrate the procedures for all children. The trained children could become trainers for their family members

- The social media and television could play a significant role in enhancing the hand hygiene among general population.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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