

Role of hand washing and factors for reducing transmission of enteric infections among students of Amravati district

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ABSTRACT

Hands are the principle vehicles for transfer of infectious agents. Transmission of bacterial infections via hands has important consequences on students, as they are more likely to take meal and water without washing hands therefore they are posed to risk of infection. Hand washing can potentially result in the reduction of the spread of infection. Present study was designed to evaluate the number and type of enteric bacteria associated with hands of students and influence of hand washing on percent reduction in bacterial type and count after hand washing. Thus, 1200 hand swabs from left and right hands were collected as before and after hand wash from 300 students of Amravati district which included 181 female and 119 male students. All students (100%) found to harbour bacteria on their hands before washing hands. Varieties of bacteria were found on the hands of the students before taking mid-day meal at school viz *Escherichia* species (27%), *Staphylococcus* species (17%), *Pseudomonas* species (11%), *Proteus* species (9%), *Klebsiella* species (8%), *Enterobacter* species (8%), *Micrococcus* species (7%), *Streptococcus* species (5%), *Citrobacter* species (5%), *Enterococcus* species (2%) and *Salmonella* species (1%). There was complete removal of bacteria from the hands of 64 (21%) of the students after washing hands with soap and water. There was about 56% overall reduction in bacterial count after washing hands with soap and water. Bacterial load on the hands of the female students was more (59%) than on the hands of male students (41%) before washing hands. Highest bacterial contamination (70%) was observed on the hands of the KG students than primary, secondary and post graduate students. Highest bacterial contamination (69%) was reported from the hands of the students who frequently experienced the gastrointestinal problems. Hence hand washing is a key component of good hygiene and can produce significant benefits in terms of reducing the transmission/ incidence of (gastrointestinal infection) enteric bacterial infections.

KEY WORDS: Hand washing, bacterial infections, transmission, students

INTRODUCTION

The unhygienic habits of most of the people lead to the various infections via hands and fingernails. Contaminated hands play a major role in fecal-oral transmission of diseases (Ray *et al*, 2011). In developing countries, 80% of the diseases are associated with the poor domestic and personal hygiene and about 2.2 million people; mostly children and school students died annually due to diarrhoea (WHO, 2006). The home and School environment are particularly concerned for the transmission of infection among young children who are at the greatest risk (Larson and Aiello, 2001). The casual link between contaminated hands and infectious disease transmission is one of the best-documented phenomena in clinical science (hospitals) but there is great need to focus on school community. India has one of the largest

school going children. In such highly contaminated environments, faecal contamination of hands is one of the important route by which children are exposed to pathogenic organisms (Langford, 2009). Schools are an ideal environment for the spread of infection and infectious diseases. Transmission of bacterial enteric infections via hands has important consequences on students, as they are more likely to take meal and water without washing hands therefore they are posed to risk of infection. Illness-related absences of students have been shown to lead to negative educational and economic outcomes (Lau *et al*, 2012). The simple act of washing hands with soap can cut the risk of diarrhoea by almost half and respiratory tract infection by a third (Coombes and Devine, 2010) and risk of diarrhea by 42-47% (Langford, 2009).

Thus one of the ways for healthy living is hand hygiene (Patel *et al*, 2010). In the present study emphasis was given on the influence of hand washing on reduction and minimization of bacterial enteric infections among students of Amravati district. Therefore our research was designed to evaluate the number and type of enteric bacteria associated with hands of students before hand washing and percent reduction in bacterial type and count after hand washing.

MATERIALS AND METHODS

Total 1200 hand swab samples were collected for the bacteriological studies from the hands of 300 students. The students were randomly selected from different schools (12), college (1) and university post graduate department (1) of Amravati district (Maharashtra state, India). Out of 300 students, 70 from Kinder Garten (KG), 115 from primary school (Ist), 30 each from secondary school (IInd) and under graduate (UG), 55 students from post graduate (PG) were selected for study.

The visit was paid to the selected schools an hour preceding the mid-day meal time. The left and right hand of each students were swabbed with the help of sterile cotton buds, soaked in 0.85% saline solution from define (fixed) area on the palm as before and after hand washing. Hands were washed thoroughly with water and soap in their usual (regular) manner. Hand swab samples were transported to the laboratory within 2-3 h for bacteriological analysis. These swabs were added into saline solutions of various dilutions under aseptic conditions and 0.2mL from each dilution was inoculated on sterilized MacConkey agar plate and uniformly spread and incubated at 37°C for 24h. After incubation, numbers of CFU were counted and different types of colonies were isolated. The distinct colonies were screened and selected on the basis of morphology, cultural characteristics and identified on the basis of standard test.

Morphological, cultural and biochemical test results of isolated organisms were matched with standard results hence confirming the isolated organisms by using Bergey's manual of determinative bacteriology and Hi-Media manual (Holt *et al*, 1994; Hi-media manual, 2003).

Along with hand swab samples, the detail information were collected based on name, age,

sex, socio-economic back ground of family, domestic and personal hygienic practices, nail hygiene and places of eating mid-day meal at school etc which were interrelated with bacterial contamination in hand swab.

The data were collected on the respondent's personal and domestic hygiene practices, socio-economical status, bacterial count (contamination on hands) both before and after hand washing. The data collected were statistically analyzed by using SPSS software (SPSS version 15.0 for window).

RESULTS AND DISCUSSION

School environment is one of the important routes for transmission of enteric infections among children. Thus total 300 students were selected from schools (12), college (1) and University post graduate department (1) of Amravati district, Maharashtra for the study.

Microbial contamination of the hands has become a global health problem. Thus total of 1200 hand swabs from left and right hands of 300 students were collected as before and after hand washing. Students from Kinder Garten (70), primary school (115), secondary school (30), under graduate (30) and post graduate (55) were selected which included 181 female and 119 male students.

All students (100%) found to harbour bacteria on their hands before washing hands. Ray *et al*, (2011) also found that hand swab samples of 61% children harbours potential pathogens before taking food. In the present study varieties of bacterial species were found on the hands of the students before taking mid-day meal at school.

Bacterial pathogens isolated from the hands of students include *Escherichia* species (27%), *Staphylococcus* species (17%), *Pseudomonas* species (11%), *Proteus* species (9%), *Klebsiella* species (8%), *Enterobacter* species (8%), *Micrococcus* species (7%), *Streptococcus* species (5%), *Citrobacter* species (5%), *Enterococcus* species (2%) and *Salmonella* species (1%) before hand washing (Fig. 1) as the number and types of enteric bacteria associated with the hands are of greater concern for health.

Ray *et al*, (2011) also reported presence of pathogenic microbes on the hands of the students which included *S. aureus*, *E. coli*, *Enterococcus faecalis*, *Klebsiella* spp., commensals flora from the hands of school students of Bangalore and Kolkata.

Fig. 1: Different types of bacteria isolated before hand washing from the hands of the students

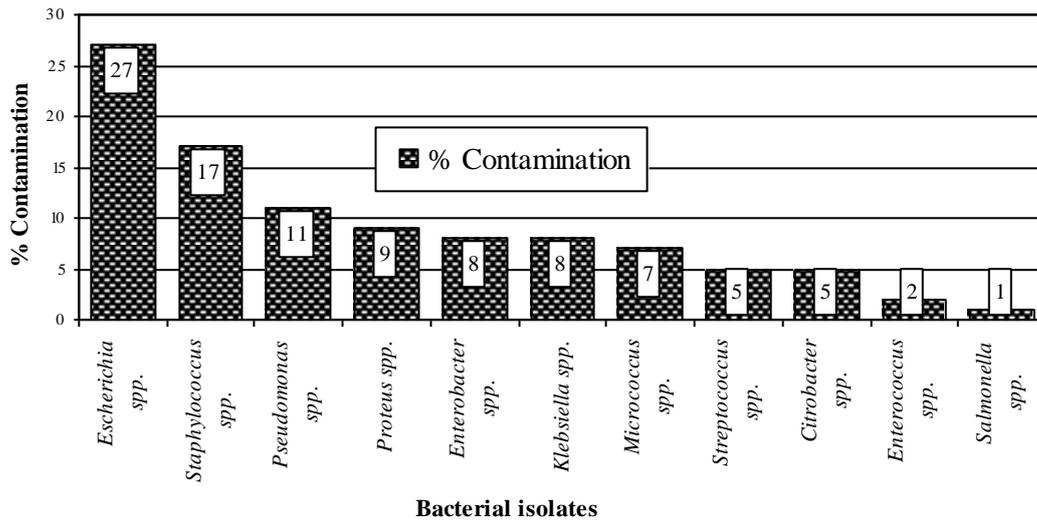


Fig. 2: After hand washing percent reduction in bacterial type isolated from hands of the students

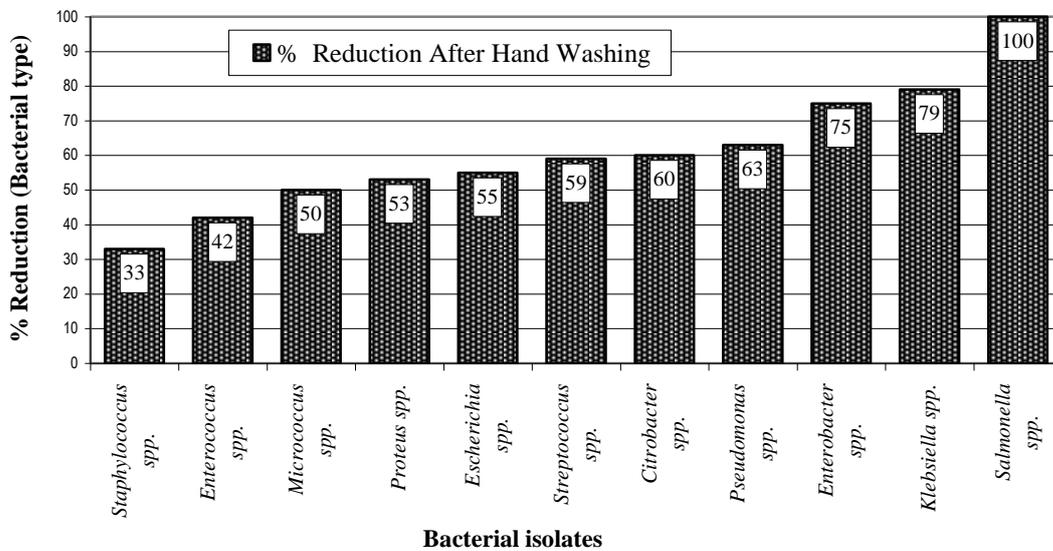
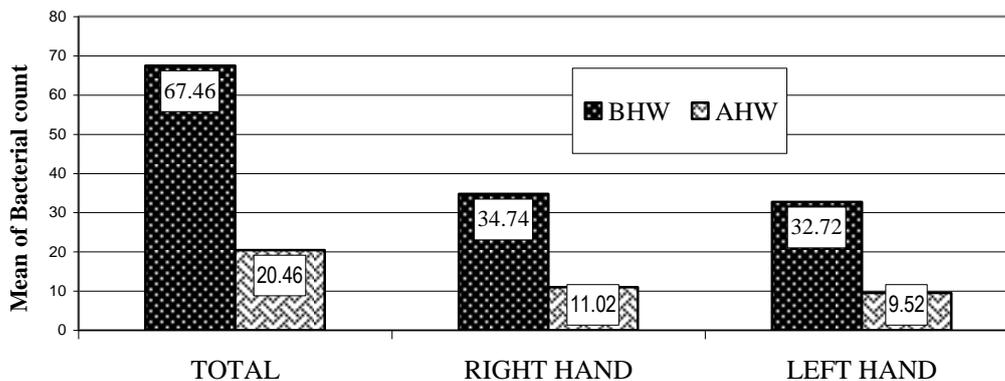


Fig. 3: Mean of bacterial count for right hand, left hand and total (Both left and Right hand) before and after hand washing



Note: BHW=Before Hand Washing; AHW= After Hand Washing

Tambekar and Shirsat, (2012) reported the presence of *E. coli*, *Pseudomonas* spp., *Proteus* spp., *Citrobacter* spp., *Klebsiella* spp., *Salmonella* spp., *Enterobacter* spp. and *S. aureus* from the hand swabs of students. Chinakwe *et al*, (2012) also isolated *E. coli*, *S. aureus*, *Enterobacter* spp., *Klebsiella* spp., *Enterococcus* spp., *Pseudomonas* spp., *Shigella* spp. and *Corynebacterium* spp. from the hand-wash water samples. They stated that these microorganisms are causative agents of diseases and infections which are easily contracted through hand to hand contact, as well as several cases of gastrointestinal disorders.

So the practice of proper hand hygiene is advocated owing to its public health significance. Therefore we allowed/recommended the students to wash their hands with soap and water before they took their mid-day meal at school. Then observed for reduction in bacterial count and bacterial type after hand washing which was reported earlier in before hand washing hand swab samples of the individual students.

Percent reduction of *Staphylococcus* species was (33%), *Enterococcus* species (42%), *Micrococcus* species (50%), *Proteus* species (53%), *Escherichia* species (55%), *Streptococcus* species (59%), *Citrobacter* species (60%), *Pseudomonas* species (63%), *Enterobacter* species (75%) followed by *Klebsiella* species (79%) and *Salmonella* species was completely (100%) removed after hand washing from hands of the students (Fig. 2). there was complete removal of bacteria from the hands of 64 (21%) of the students after washing hands with soap and water. In present study *Staphylococcus* spp. was the least removed organism even after hand washing. Resident flora not readily removed through the mechanical friction associated with hand washing (Vessey *et al*, 2007) which includes *Staphylococcus* spp. and *Micrococcus* spp. etc. Similarly the reduction in the number of pathogens after hand washing was also reported by Tambekar *et al*, (2009).

The bacterial isolates found before hand washing were more (67.46%) than after (20%) hand washing samples (Fig. 3). There was about 56% overall reduction in bacterial count after washing hands with soap and water. Tambekar *et al*, (2007) also reported 43% reduction in bacterial contamination after hand washing. Griffith *et al*, (2003) documented the ability of the various stages of hand washing to decrease skin-surface microbial counts. Hand washing reduce the load of bacteria

up to a level that does not harmful to the health. Right hand of students harbors more microbes (34.7%) than left hand (32.7%) (Fig. 3).

Ray *et al*, (2009) observed a decrease in colony count following hand washing with soap in 60% of the samples in a study conducted in areas around Kolkata. The evidence suggested that hand washing with soap reduced the bacterial count in majority of the respondents.

From a practical standpoint, hand-washing compliance among school children in Amravati may be enhanced by focusing on higher risk contamination events. Therefore, in order to understand about the variables affecting hand hygiene, we had to consider about the associations of the variables rather than every single aspect.

The study showed that bacterial load on the hands of the female students was more (59%) than on the hands of male students (41%) before washing hands (Fig. 4). It may be due to the poor hand washing and nail trimming practices of the girls. Tambekar *et al*, (2009) also observed similar results.

Highest bacterial contamination (70%) was observed on the hands of the KG students followed by 67% on hands of primary students, 66% on secondary students, 64% on PG students and least (57%) on the hands of under graduate students (Fig. 4). Oniya *et al*, (2006) isolated microorganisms transmissible through hand-shake and also reported prevalence of microorganisms was higher in primary and secondary school students than in the under graduate students. It indicates that education of the students is also one of the factors that affect level of contamination on hands as educated people are more conscious about their cleanliness and health.

Students with short finger nails (properly cut) had 64% bacterial contamination (bacterial count) and students with long finger nails showed more (67%) contamination of bacterial count on their hands (Fig. 5). Additionally Rayan and Flourny (1987) had reported heavy bacterial growth under fingernails that were more than 1mm in length. Lin *et al*, (2002) reported that long fingernail tends to harbors more microorganisms than short nails. Visibly clean nails were observed merely by appearance of finger nails of students, showed presence of 62% bacterial contamination on their hands. Visibly dirty (soiled) nails of students had more 66% bacterial contamination (bacterial count) on their hands (Fig. 5).

Fig. 4: Percent contamination on the hands of the students before washing hands on the basis of their education and sex

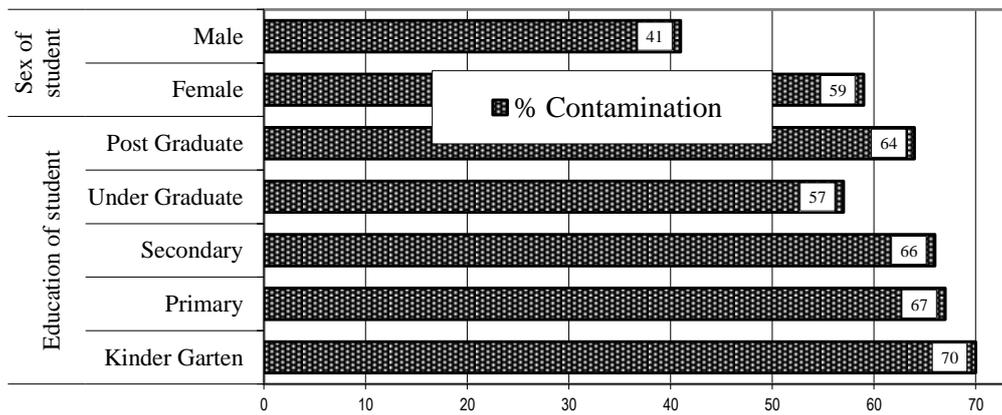


Fig. 5: Percent contamination on the hands of the students before washing hands on the basis of nail hygiene, nail type and habit of nail biting and daily bathing

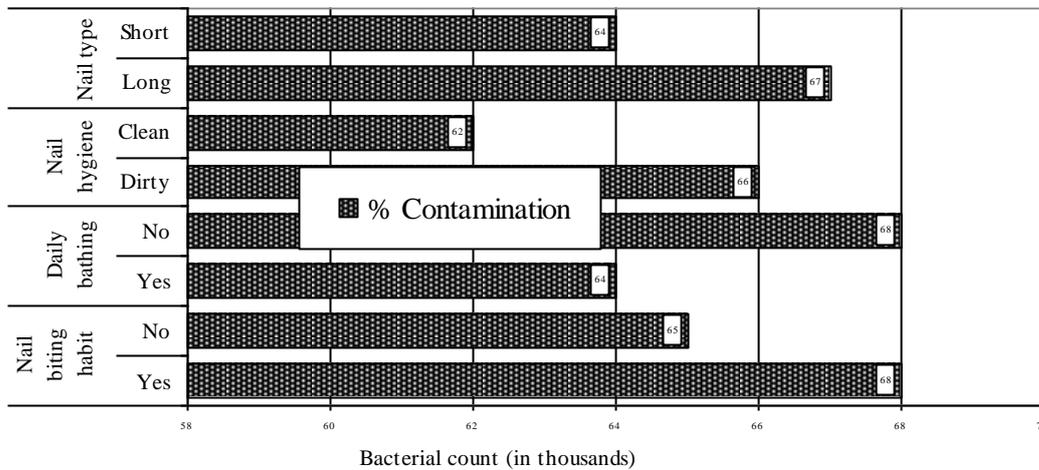
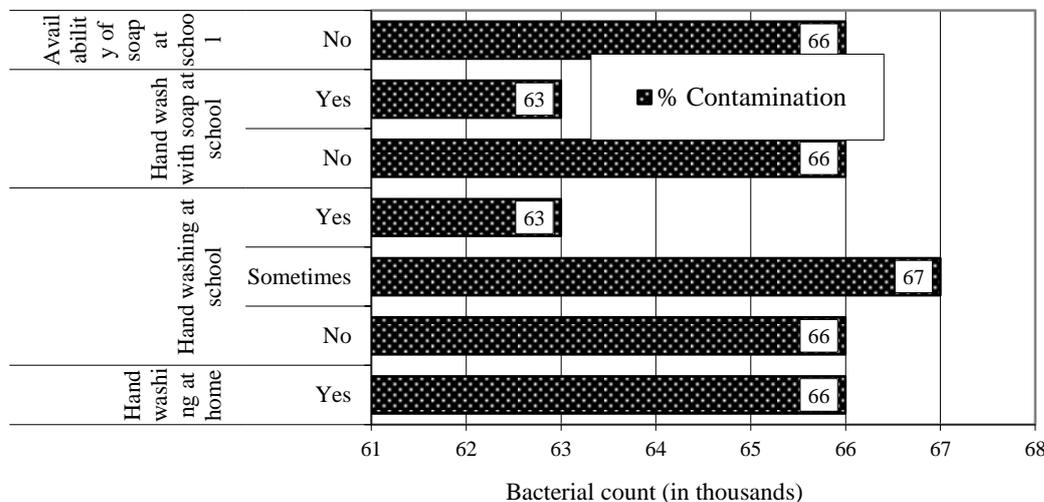


Fig. 6: Percent contamination on the hands of the students before washing hands on the basis of their hand washing practices at school and home, hand washing frequency and availability of soap at school



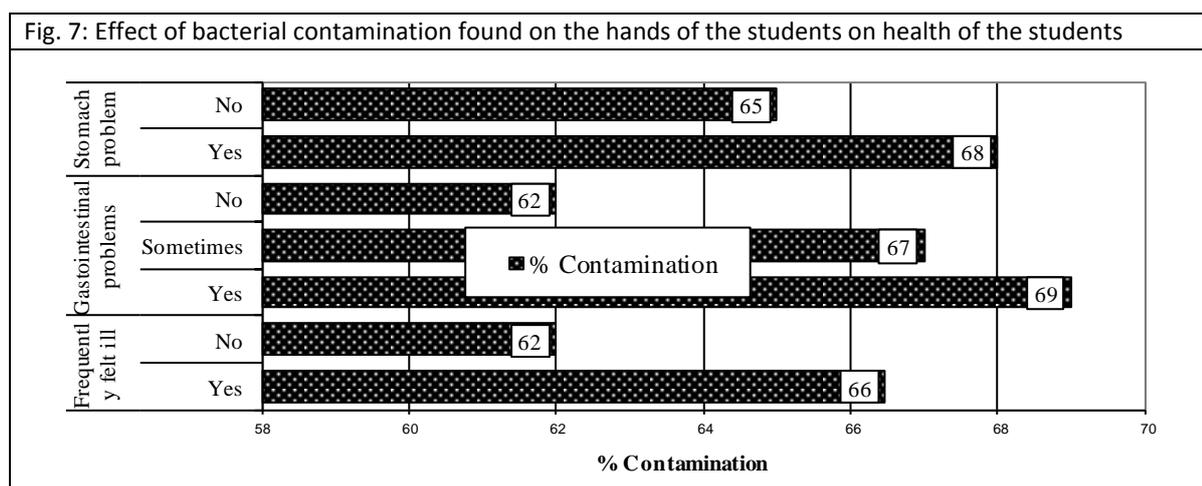
It indicates the immediate need to wash dirty hands as well as visibly clean nails to prevent entry of microbes via food or water through contaminated hands.

Students with daily bathing (regular bath) habit had 64% bacterial count on their hands before hand washing but the students who negelected practice of regular bathing had 68% bacterial contamination on their hands (Fig. 5). Because hands also acquire microbial flora from skin surfaces, and daily bathing helps to remove microbial flora from body.

Students with nail biting habit had more (68%) bacterial count on their hands than on the hands of the students who avoid nail biting (65%) (Fig. 5). The results was alarming because students with nail biting habit directly put their contaminated fingernails in their mouth, as they were unaware about the extent and type of bacterial contamination present on their hands and the risk involved. None of the school under the study reported regular availability of soap for students. These findings concur with those of the School Sanitation and Hygiene Education study in which schools in several developing countries consistently reported lack of soap for hand washing (Bolt *et al*, 2006). Availability of hand washing resources (mainly soap) at school is an important factor to encourage practices of hand washing. Students without availability of soap at school had 66% bacterial contamination on their hands (Fig. 6) which exhibits immediate need of promotion of hand washing and provision of hand washing resources at school. Lopez-Quintero *et al*, (2009) reported that only 7% of the students reported that their school had clean water and soap available and accessible on a regular basis.

Few students who use soap (brought from home) for hand washing at school premises showed 63% bacterial contamination whereas it was 66% on the hands of the students who did not use soap for hand washing (Fig. 6) as no school under the study found to provide hand wash resources like soap.

Students suffered from stomach problems had 68% bacterial contamination on their hands while it was 65% among the students who did not complaint about stomach problems (Fig. 7). It showed that students with more bacterial count on their hands had suffered from stomach problems which may be due to the isolated enteric bacteria which can act as opportunistic pathogens. Zeller, (2007) stated that germs are transmitted from unclean hands to food and then passed to those who eat the food and could spread, grow and cause gastrointestinal diseases. Highest bacterial contamination (69%) was reported from the hands of the students who frequently experienced the gastrointestinal problems and 67% for the students with occational gastrointestinal illness (Fig. 7). However, the students without the complaints of gastrointestinal problems exhibits lower (62%) proportion of bacterial contamination on their hands. It indicates that the occurance of the gastrointestinal infections was caused by higher bacterial contamination on their hands. It also points towards the risk of disease transmission through contaminated hands. Bacterial contamination (66%) was observed on the hands of the students who were frequently ill while it was less (62%) on the hands of the students who did not complaint frequent illness (Fig. 7). It clearly revealed that the occurance of more bacterial contamination on the hands of the students was the main reason behind their ill health.



CONCLUSION

All the students (100%) were found to harbor the bacterial flora on their hands before taking mid-day meal. The rate of contamination on the hands of students varies. The present study showed clear evidence of drastic decreased in microbial flora after hand washing. The bacterial contamination on the hands of the students before washing the hands was higher (67%) than the bacterial load reported after hand washing. Significant decrease in bacterial count (56%) was

observed after hand washing. Hands of female students were found to harbour more bacterial load. Decontamination of hands can be carried out either by hand washing with soap to reduce contamination of hands. Thus it helps to reduce the risk of entry of enteric pathogens in body. Hand washing is a key component of good hygiene in the school community and can produce significant benefits in terms of reducing the transmission/incidence of (gastrointestinal infection) enteric bacterial infections.

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