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HAND HYGIENE AND HEALTH: AN EPIDEMIOLOGICAL STUDY OF STUDENTS IN AMRAVATI

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Abstract

Hands may be the most important means by which enteric pathogens are transmitted. Skin hygiene particularly of the hands, has been accepted as a primary mechanism to control the spread of infectious agents. Therefore the present study was undertaken to evaluate the number and type of enteric bacterial pathogens associated with hands. A total of 160 hands swab samples of 80 students of KG, PS, SS, UG, and PG were analyzed. Pathogens were isolated from hands includes *Escherichia coli* (22%), *Pseudomonas aeruginosa* (12%), *Staphylococcus aureus* (15%), *Proteus mirabilis* (11%), *Citrobacter freundii* (10%), *Enterobacter aerogenes* (8%), *Streptococcus* sp. (7%), *Klebsiella* sp. (6%), *Micrococcus* sp. (5%) and *Salmonella typhi* (4%). The prevalence of the bacterial pathogens was high in students of K.G. and primary than those in secondary schools and colleges. The data indicated that the hands of the female were more contaminated than male and the left hand was more contaminated than the right hand. Thus, the potential risk factors for transmission of enteric pathogens through hands should be investigated in order to improve the general health of the students.

Key words: - Hand hygiene, microbial load, Students, infectious diseases, personal hygiene)

Introduction

Clean hands are the single most important factor in preventing the spread of pathogens and reduce the incidence of infections. CDC estimates that each year nearly 2 million people in the United States get an infection due to dirty hands, and about 90,000 of these die as a result of their infection. The good hand hygiene practices promote health safety and prevent infections (CDC, 2002). Every day, diarrhoeal diseases from easily preventable causes claim the lives of approximately 5000 young children throughout the world. Personal hygiene and basic sanitation can cut this toll dramatically. A significant number of illnesses and deaths are reported annually as a result of unsanitary conditions. Diarrhoea-related illnesses alone are estimated to cause two to three million deaths per year; a majority of the mortality occurs in children (Bern et al*.,* 1992). Infants and young children are the innocent victims of the worldwide failure to make basic sanitation services available to impoverished people.

Hygiene or health education helps the people to understand the causes of their ill health and their possible preventive measures. Infectious diseases commonly spread through faecal-oral route, which includes several gastrointestinal disorders, infectious diarrhea etc. 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 die annually due to diarrhea (Water-Aid, 2006) Poor domestic and personal hygiene, low health and lack of formal education predispose to these diseases (Tambekar and Banginwar, 2004). The unhygienic habits of most of the people lead to the various infections via hands and fingernails. Children younger than 5 years are at much higher risk

of death from diarrhea than older children and adults. The dirty hands carry the infectious microorganisms and cause most of the serious infections. The home and school environments are of particular concern for the transmission of infections among young children or aged persons, who are at the greatest risk (Roberts et al*.,* 2000). If hygiene promotion is to succeed, it needs to identify and target only those few unhygienic practices, which are the major source of risk in any setting. It aims to reduce diarrhea disease linked to poor hand hygiene and to improve children's general health and well being by providing guidance on the importance of hand washing and other hygiene practices.

Materials and Methods

A total of 160 hand swabs of 80 students were collected from various KG, primary, secondary schools, UG and PG students in Amravati city (Maharashtra state, India) from July to December 2007. Out of 80 students 20 each from KG, primary, secondary respectively and 7 students from UG and 13 students from PG were selected for this study.

The left and right hand of each student were swabbed with the help of sterile cotton buds, soaked in 0.85% saline solution from define (fixed) area on the hands. These swabs were directly 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 37^0C 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.

Tentative identification of isolates were made by gram staining, motility, oxidase test and cultural characteristics by subculturing on CLED such as yellow colored colonies of lactose fermenting *E.coli,* greenish colour colonies of *Proteus* spp. greenish blue or blue colonies of *Ps. aeruginosa*, mucoid yellow to whitish blue colonies of *Klebsiella* spp. and deep yellow opaque colonies of *S. aureus* (Hi-Media Manual, 2003. Confirmation of various bacterial pathogens were made by subculturing on Xylose Lysine Deoxycholate agar (XLD agar; M1108, Himedia, Mumbai), Salmonella-Shigella agar (S-S agar M108, Himedia, Mumbai) for *Salmonella* spp, Mannitol salt agar for *Staphylococcus aureus*, Cetrimide Agar for *Pseudomonas* spp. MacConkey agar for other enteric pathogens and various special biochemical tests. For confirmation of the pathogens, typical colonies were inoculated into Rapid Microbial Limit Test kits, which are a combination media in liquid and solid phase in a single bottle for simultaneous enrichment, isolation, and confirmation of pathogens. These MLT kits are recommended in diagnostic microbiology for accurate identification of pathogen and are supplied by Himedia Laboratories Limited, Mumbai, India. Biochemical tests were performed using conventional methods to confirm pathogen identification whenever necessary (Collee et al., 1996).

Along with hand swab samples, information, or data on name, age, socio-economic back ground of family, sex, domestic and personal hygienic practices, nail hygiene, places of eating tiffin, sources of water etc collected and data correlated with bacterial contamination in hand swab. All data were analysed with the Statistical Package for Social Sciences 15 for Windows (SPSS Inc.; Chicago, IL, USA) software.

Results and Discussion

A total of 160 hand swabs from 38 males and 42 female students were collected. All hand swab samples were found to harbor enteric pathogens. There were a variety of bacterial species found on the hands of the students. Bacterial pathogens isolated include *Escherichia coli* (22%), *Pseudomonas aeruginosa* (12%), *Staphylococcus aureus* (15%), *Proteus mirabilis* (11%), *Citrobacter freundii* (10%), *Enterobacter aerogenes* (8%), *Streptococcus* sp. (7%), *Klebsiella* sp. (6%), *Micrococcus* sp. (5%), and 4% *Salmonella typhi* (Table 1). Doring (1996) and Aiello et al. (2004), observed the incidence of *S.aureus, B.subtilis, E.coli, Lactobacillus, Enterobacter* sp., *K.pneumoniae,* and *Pseudomonas* sp. on human palms. Tambekar et al*.* (2007) reported the presence of *E.coli*, *Pseudomonas* sp*., Proteus* sp., *Citrobacter* sp., *Klebsiella* sp., *Salmonella* sp., *Enterobacter* sp., and *S.aureus* from hand swabs of students. The study showed that bacterial load on the hands of the female students was more than on male students (Figure 1). Tambekar et al*.,* (2007) reported that the hands of female (52%). were more contaminated than male (45%), which may be due to long nails and carrying handkerchief in hands by female students. Personal and domestic hygienic practices indirectly depend on the education and educated students were more conscious of their health and hygiene. It was observed that the bacterial load on the hands of PS (primary school students) was

highest followed by SS (secondary school students), KG students and lowest among PG and UG students (Figure1). Oniya et al. (2006) also recorded high bacterial contamination in KG and primary students as compared to PG student's hand.

Table 1: Bacterial Pathogens Isolated from Right hand (RH) and Left hand (LH)

Type	No. of Pathogen isolated		Total Pathogens Isolated
	LH	RH	
Ps. aeruginosa	10	14	24 (12%)
E.coli	27	17	44 (22%)
C.freundii	9	10	19 (10%)
E.aerogenes	4	11	15 (8%)
Klebsiella sp	7	4	11 (6%)
S. aureus	18	12	30 (15%)
Pr. mirabilis	13	10	23 (11%)
Streptococcus sp	5	8	13 (7%)
S. typhi	6	2	8 (4%)
Micrococcus sp	7	2	9 (5%)
Total	**106**	**90**	**196**

Age of the student also determines the degree of contamination and, it decreased with the age of the students. Bacterial load on the hands of the students of the age group 5-9yrs and 3-4yrs was more as compared to 10-14yrs and 20-24yrs students (Figure1). It may be due to the carelessness and playing habits of the children. Tambekar et al (2007) also reported similar findings. Long nails harbor more pathogens than visibly clean short nails (Figure1).

Figure 1a: Various parameters and hand hygiene

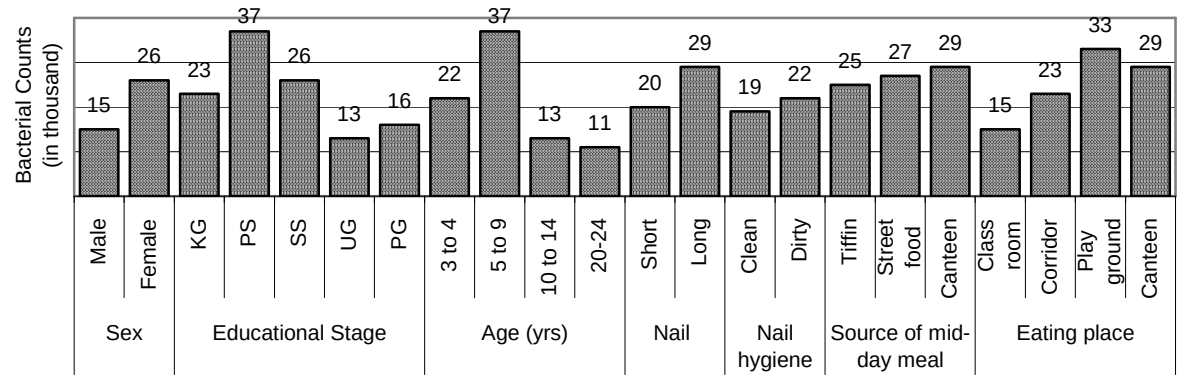
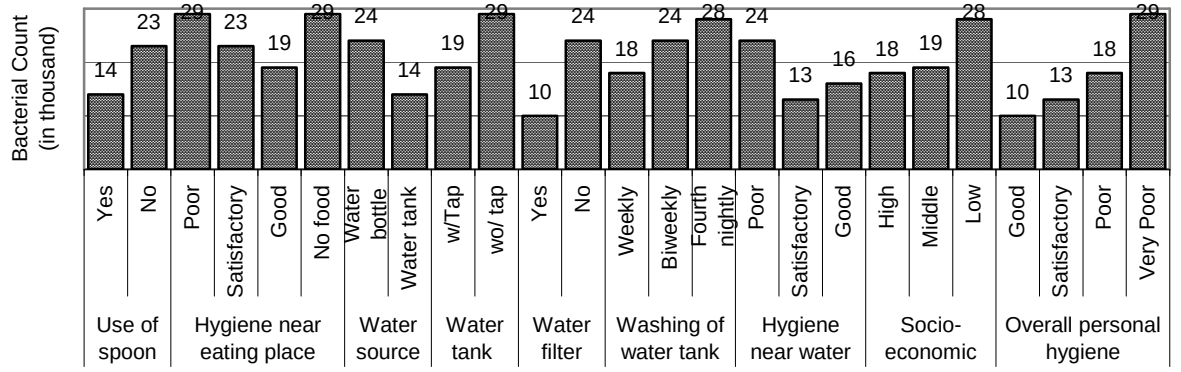


Figure 1b: Various parameters and hand hygiene



Students taking mid-day meal of canteen carry more bacteria on their hands as compared to street food and Tiffin user. High bacterial count was reported from the student's hands that take their mid-day meal on play ground rather than canteen, corridor and classroom (Figure1). In schools, college students are more likely to take meal and water without washing hands and they may be at risk of infection (Tambekar et al., 2007). Use of spoon for taking mid-day meal was necessary as the

candidates who were not using spoon found to harbor more pathogenic load (Figure 1). Inadequate hand hygiene also contributes to food-related illnesses, such as infectious diarrhea. School environment is of particular concern for the transmission of infection among young children, who are at the greatest risk. Poor hygienic conditions near eating-place made more bacterial flora on the hands of student's than students with good hygienic condition (Figure 1). Poor hygienic condition near water tank leads to the more bacterial load on the hands of students. Water bottle user was found to harbor more bacterial flora on their hands than water tank users. The students using water from tank with filter facility had low density on their hands than without filter (Figure 1). Washing of water tank from health point of view is important as bacterial count on the hands of the students with weekly washing practices of tank was less than biweekly and fourth nightly. Socioeconomic status of the students is one of the parameters that can help to determine hygiene status of the student. Students with low socioeconomic status were found to harbor more bacteria on their hand than students of middle and high socioeconomic status (Figure 1). Generally, the higher socioeconomic people enjoy better living practices as live in modern houses in which good health conditions could be attained. But in poor community, it is observed that the people are not conscious about their health. But it is very important to educate them for good hygienic behavior so that there is reduction in the cause of disease.

The bacterial contamination of hands was higher in students with poor than good personal hygiene (Figure1). Similarly, Strina et al*.* (2002) also reported more prevalence of diarrhea among children with unhygienic behavior than children in hygienic group. Right hands of the female students were more contaminated than left hand while left hands of male were more contaminated (Figure 2). Hoque et al*.* (1995) reported that the count of left hand was 1995 and right hand was 1318 faecal coliform units/hand of 90 women from semi-rural area of Bangladesh. Education also plays an important role in the hygienic condition of the students. Right hand of the SS and KG while left hand of PG students were highly contaminated. From the result it was interpreted that age groups of 5-9yrs students had higher bacterial load on left hand than on the right hand, while 3-4yrs and 10-14 yrs students carry higher on right hand than on the left hand (Figure 2).

Figure 2a: Effect of various parameters on right and left hands of students

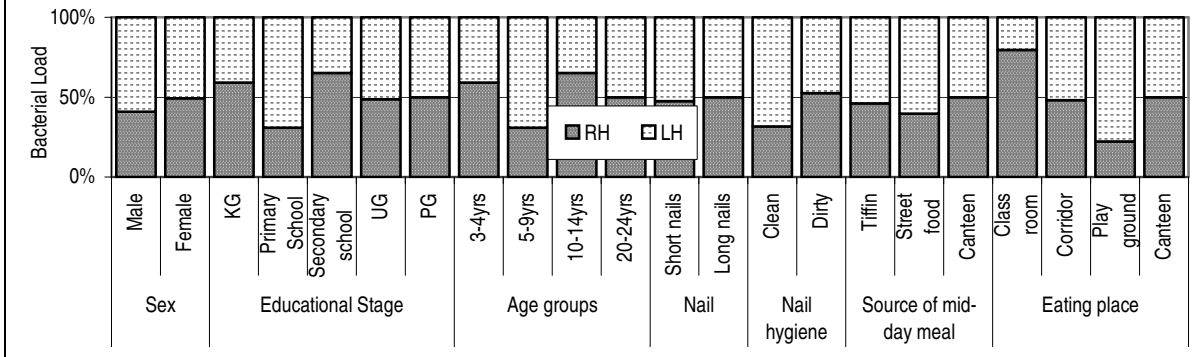
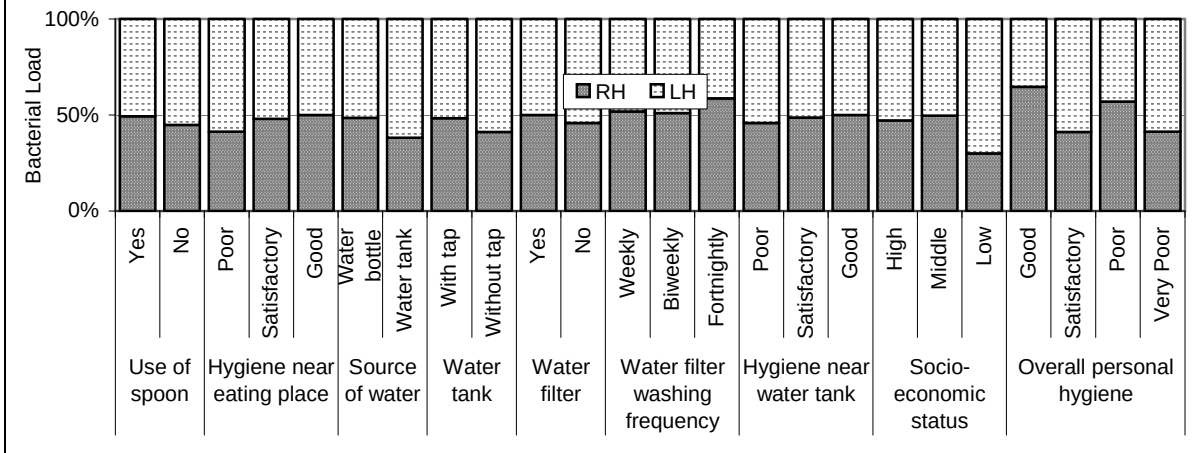


Fig ure.2b: Effect of various parameters on right and left hands of students



Left and right hand of the students with long and short nails are equally contaminated. Bacterial pathogens isolated from the hands of students that cut no nails were higher than the properly cut nails. Long nails tend to harbor more microorganisms than short nails. Left hand of the students who used the Tiffin and street vended food was more contaminated than right hand. Students not using spoon showed more bacterial count on left hand. Water tank and water bottle user were with more contamination on left hand. Similar situation was found with the students with and without tap (Figure 2). Tambekar et al*.,* (2007) also reported that the left hand was more contaminated (52%) than the right hands (48%).

Proper sanitation is important not only from the general health point of view but it has a vital role to play in our individual and social life too. Students with dirty hands harbor more pathogens on right hand. Highly contaminated right and left hands were observed for the students eating mid-day meal in classroom and those eating on the playground respectively (Figure 2). Students with poor hygiene near eating place showed more contamination on left hand while right hand were more contaminated in case of satisfactory hygiene of eating-place. The high bacterial load occurs as a result of multiple factors linked to hygiene practices and circumstances. Therefore, there is need to shift the focus and integrate hygiene awareness and education programmes to influence behavior change.

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