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# Bacteriological profile and perception on hand hygiene in school-going Children

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## Abstract:

**BACKGROUND:** Handwashing is the most important daily activity to keep microbial infections at a distance. Schoolchildren tend to acquire most of the infections by not following the protocol of frequent handwashing which leads to frequent illnesses and absenteeism from school on a regular basis.

**MATERIALS AND METHODS:** A cross-sectional study was conducted by means of collecting hand swabs from 133 schoolchildren to estimate the extent of germs present. Furthermore, student's perception on hand hygiene was assessed by means of questionnaire.

**RESULTS:** Among the schoolchildren, majority (68.4%) of them felt washing hands is important. Almost 56.4% of students washed their hands before eating lunch, but only 64.7% of them used soaps for cleaning their hands. Furthermore, hand swabs of 133 schoolchildren showed the growth of potential pathogens such as *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* spp., and *Enterococcus faecalis*.

**CONCLUSIONS:** Hands of schoolchildren were found to be contaminated and measures to inculcate the habit of frequent handwashing with soap are essential.

## Key words:

Bacteriological profile, hand hygiene, student's perception, use of soap

## Introduction

Hand hygiene plays a pivotal role in the containment of infectious diseases commonly circulating in home as well as in community.<sup>[1]</sup> With greater advancements in medical knowledge and technology, human beings have come a long way, but still, there is a wide gap in the application of such vast knowledge in our day-to-day life. Contaminated hands act as a good source in spreading the commonly acquired respiratory and gastrointestinal diseases.<sup>[2]</sup> Dr. Ignaz Semmelweis, in 1847 stated the importance of handwashing in reducing the transmission of puerperal fever.<sup>[3]</sup>

Handwashing practice is comparatively poor in rural areas when compared with the urban population. Studies from various states in India report that large percentage of people in rural sectors do not wash their hands after cleaning child's bottom. Furthermore, among the rural population, the practice of washing hands with mud or ash instead of using soap is quite prevalent which, in turn, leads to many diseases.<sup>[4]</sup>

Studies showing the bacteriological profile among children are reported in many parts of the world as well as from India.<sup>[5,6]</sup> These studies have reported fecal streptococci as the main contaminant. Also, *Staphylococcus aureus* and enteric pathogens are also commonly isolated pathogens from school going children. The spread of infectious agents as well as the spread of multiresistant pathogens is considered to be

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the main contributors to disease outbreaks due to hand contamination.<sup>[7]</sup>

Many initiatives have been taken by the WHO, the United Nations, to address the issue of improved hand hygiene practices by declaring 2008 as the International Year of Sanitation and October 15 as the Global Handwashing Day.<sup>[8-10]</sup> In spite of many policies and protocols, studies report poor hand hygiene practices among students and health-care workers such as doctors, nurses, and medical students, across the world.<sup>[11]</sup> Lack of facilities such as availability of soap all the time, alcohol-based hand rub dispensers, and liquid soap dispensers is also the key issue which varies from place to place to inculcate handwashing practices more efficiently.

As we wanted to report the prevalence of hand contamination among schoolchildren from this geographic region, the following objective was framed for the study: to understand the prevalence of bacteriological profile and the perception of school-going children about the importance of hand hygiene.

## Materials and Methods

For the study, we chose a school located 10 km from our Institute (Sri Venkateshwara Medical college and Research Centre, Ariyur, Puducherry, India) at Kandamangalam, Tamilnadu, and 133 schoolchildren, aged approximately 9–12, i.e., in grades 6<sup>th</sup> to 8<sup>th</sup>, were included in the study. The study was initiated after obtaining institutional ethical clearance and prior consent from the school administration.

For the sample collection, a station was established to collect the swabs aseptically. The dominant hand of the child was swabbed using the sterile moistened swab. Swabs were taken on a random basis and it was done by beginning from the wrist, followed by the palm area and finally leading up to all the five fingers which included the creases and the nail beds and ending in the dorsal aspects of the hand.

Perception about hand hygiene among school-going children was assessed by questionnaire devised in accordance with the WHO's guidelines in assessing the hand hygiene practices. The pro forma consisted of 25 questions mainly including multiple choices or "yes" or "no" questions. Washing hands before meal, washing hands with soap after using toilet, is failure to wash hand transmits infectious diseases, presence of handwashing station at school, presence of soap and water for handwashing at school and at home, etc., were the main questions asked to the school students.

The swabs were collected in Amies' Transport Media swabs (Himedia) and were transported to the laboratory

within 1–2 h. In the laboratory, the swabs were inoculated on blood agar and MacConkey's agar and were examined for bacterial growth after 24–48 h of incubation. Pathogens were identified based on the colony morphology, gram staining, catalase test, coagulase test, mannitol fermentation, and biochemical reactions. All the isolates were screened for antimicrobial susceptibility testing by modified Kirby–Bauer disc-diffusion method as per the Clinical Laboratory Standards Institute Guidelines. *S. aureus* ATCC 25923 and *Escherichia coli* ATCC 25922 were used as the quality control.

## Data entry and analysis

- Data were entered and analyzed by Epidata software version 2.2.2.186 (Epidata Association, Denmark, Europe) and by STATA analysis software version 11 (STATA Corp LLC, Texas, USA).

## Results

A total of 133 schoolchildren were included in the study. Hand swabs were collected and details regarding hand hygiene were entered in structured questionnaire. Hand swabs were taken from all the included students which showed the growth of potential pathogens.

The following pathogens were identified following the culture and biochemical testing in the microbiology laboratory:

- Coliforms such as *E. coli*, *Klebsiella*, and *Enterobacter* spp. mainly responsible for diarrheal diseases – detection by biochemical tests
- S. aureus* causing skin, respiratory, and also diarrheal diseases – detected by Gram-stain, coagulase, and catalase test
- Salmonella* and *Shigella* causing enteric and diarrheal diseases – detection by biochemical tests
- Nonpathogenic commensals such as coagulase-negative staphylococci, diphtheroids, and *Candida* spp. – detected by colony morphology, Gram-stain, and coagulase test
- Nonpathogenic environmental flora such as Micrococci and *Bacillus* spp. was detected by Gram-stain.

The most common pathogen isolated was *S. aureus* (19%) which was many associated with skin and respiratory infections. Among the coliforms, *E. coli* (20%) was the foremost pathogen followed by *Klebsiella* spp. (14%) and *Enterococcus faecalis* (11%). Few cultures showed the growth of commensal flora and some cultures showed no bacterial growth following 48 h of aerobic incubation [Tables 1 and 2].

The study included 133 school-going children who belonged to the age group of 9–12 years. Among the total

participants, 83 (62.4%) of children were male, whereas 50 (37.6%) were female. Among all the study participants, 75 (56.4%) were from urban areas, whereas 58 (43.6%) belonged to the rural areas.

**Table 1: Distribution of isolated organisms from the 133 hand swabs**

Pathogens identified	Total (%)
<i>Staphylococcus aureus</i>	25 (19)
<i>Escherichia coli</i>	27 (20)
<i>Klebsiella</i> spp.	18 (14)
<i>Enterococcus faecalis</i>	14 (11)
Commensal flora	42 (31.5)
Sterile culture	7 (6)

When the data were analyzed by multivariate logistic regression analysis using STATA software, family occupation and parent's educational status were statistically significant. From the sociodemographic profiles of the schoolchildren, children whose parents belonged to farmer category showed significant association with proper handwashing (adjusted odds ratio [AOR]: 7.07, 95% confidence interval [CI]: [1.72, 29.11]). Similarly, schoolchildren whose parents were educated performed proper handwashing practice when compared with the uneducated category (AOR: 42.73, 95% CI: [1.96, 929.37]) [Table 3].

**Table 2: Factors affecting hand washing practice among schoolchildren (n=133)**

Variables	Hand washing practice			COR (95% CI)	AOR (95% CI)
	Total	Proper, n (%)	Improper, n (%)		
Residency					
Urban	75	60 (80)	15 (20)	3.48 (1.62-7.49)	2.75 (0.89-8.50)
Rural	58	31 (53.45)	27 (46.55)	1	1
Family occupation					
Civil servant	42	32 (76.19)	10 (23.81)	5.12 (1.77-14.81)	0.82 (0.16-4.13)
Farmer	27	16 (59.26)	11 (40.74)	2.33 (0.77-7.00)	7.07 (1.72-29.11)
Shop owner	38	33 (86.84)	5 (13.16)	10.56 (3.09-36.07)	2.89 (0.58-14.32)
Daily laborer	26	10 (38.46)	16 (61.54)	1	1
Parent's educational status					
Educated	86	70 (81.40)	16 (18.60)	5.42 (2.45-11.95)	42.73 (1.96-929.37)
Uneducated	47	21 (44.68)	26 (55.32)	1	1
Washing hands with soap after using toilet					
Yes	86	70 (81.40)	16 (18.60)	5.42 (2.45-11.95)	1
No	47	21 (44.68)	26 (55.32)	1	-
Washing hands before meal					
Yes	75	60 (80)	15 (20)	3.48 (1.62-7.49)	0.64 (0.05-8.38)
No	58	31 (53.45)	27 (46.55)	1	1
Can germs be acquired when desks, door, books, and animals are touched?					
Yes	92	68 (73.91)	24 (26.09)	2.22 (1.02-4.80)	0.79 (0.16-3.87)
No	41	23 (56.10)	18 (43.90)	1	1
Do poor handwashing cause diseases?					
Yes	76	58 (76.32)	18 (23.68)	2.34 (1.11-4.94)	0.16 (0.01-3.79)
No	57	33 (57.89)	24 (42.11)	1	1
Knowledge					
Insufficient	53	27 (60)	23 (43.40)	1	1
Sufficient	80	64 (72.73)	19 (23.19)	2.46 (1.16-5.20)	1.18 (0.05-29.99)
You only need to wash your hands with soap if they look dirty or smell bad?					
Yes	97	84 (70.59)	26 (26.80)	2.18 (0.98-4.84)	2.22 (0.45-11.03)
No	36	7 (50)	16 (44.44)	1	1
Presence of soap for handwashing					
Yes	72	49 (68.06)	23 (31.94)	0.96 (0.46-2.00)	0.67 (0.26-1.76)
No	61	42 (68.85)	19 (31.15)	1	1
Presence of soap and water for handwashing at home					
Yes	94	65 (69.15)	29 (30.85)	1.12 (0.50-2.48)	0.83 (0.29-2.41)
No	39	26 (66.67)	13 (33.33)	1	1

CI=Confidence interval, COR=Crude odds ratio, AOR=Adjusted odds ratio

**Table 3: Antibiotic resistance pattern of *Staphylococcus aureus* (n=25) for other antibiotics**

Antibiotic	Resistant strains, n (%)
Penicillin (10 units)	25 (100)
Amikacin (30 µg)	12 (48)
Ciprofloxacin (5 µg)	10 (40)
Co-trimoxazole (1.25/23.75 µg)	11 (44)
Doxycycline (30 µg)	13 (52)
Erythromycin (15 µg)	9 (36)
Clindamycin (2 µg)	8 (32)
Vancomycin E-strip	0
Linezolid (30 µg)	0
Cefoxitin (30 µg)	13 (52)

## Discussion

Our study showed the presence of 64% of pathogenic bacteria on the hands of the schoolchildren. Isolation of these pathogens was similar from the existing Indian data where the commonly isolated pathogens were *Staphylococcus* spp., *E. coli*, *Klebsiella* spp., *Proteus* spp., *Citrobacter* spp., *Streptococcus* spp., *Enterococcus* spp., *Pseudomonas* spp., and *Salmonella* spp.<sup>[2,6]</sup>

Our study showed a good proportion (68.4%) of schoolchildren followed proper handwashing practice. The present findings of our study were found to be similar by a study done in Ethiopia, wherein more number of students (99.0%) reported to follow handwashing before meals.<sup>[12]</sup> Using soap for washing hands was found to be suboptimal in our study which was also in accordance with other studies done in various parts of the world.<sup>[13]</sup>

Accessibility of water and soap at school and at home all the time is a crucial factor. In our study, the unavailability of resources such as soap or handwash at school is a preventive factor for the students to inculcate proper handwashing practice. This finding was in line with other studies done from different parts of the world.<sup>[14,15]</sup>

As the isolated potential pathogens are the primary source of infections such as diarrhea, dysentery, and pneumonia, effective handwashing practices with clean water and with soap are very much essential. Such findings were supported by studies done in Kolkata, India, and in Karachi, Pakistan, which proved that washing hands with soap reduces the incidences of bacterial infections among school-going children.<sup>[16,17]</sup>

## Conclusions

Hand contamination was observed among the schoolchildren, especially before taking their meals and after using toilets. Although frequent handwashing was observed by the schoolchildren, they hardly used soap for washing hands. Nonavailability of soap at the

washing station and in the toilets was the reason for the contaminated hands among the schoolchildren.

Healthy habits should be inculcated from a young age which will motivate schoolchildren to continue hand hygiene practice into their adulthood also. However, due to the nonavailability of water and soap at the washing stations, inculcating such hygiene practices would not be possible.

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## Conflicts of interest

There are no conflicts of interest.

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