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Factors predicting proper handwashing practice amidst the COVID-19 pandemic in India: a field-based cross-sectional study

Shibaji Gupta [a], Debasis Das [b], Arup Chakraborty [b] and Rudradeep Banerjee [c,*]

[a] Department of Community Medicine, Midnapore Medical College, Medinipur, Paschim Medinipur, West Bengal, India
[b] Department of Community Medicine, Medical College, Kolkata, West Bengal, India
[c] Department of General Surgery, Institute of Post Graduate Medical Education and Research, Kolkata, West Bengal, India
*Corresponding author. E-mail: rudradeep1989@gmail.com

SG, 0000-0002-1594-9337; DD, 0000-0003-3323-2839; AC, 0000-0002-5349-9920; RB, 0000-0001-5028-0301

ABSTRACT

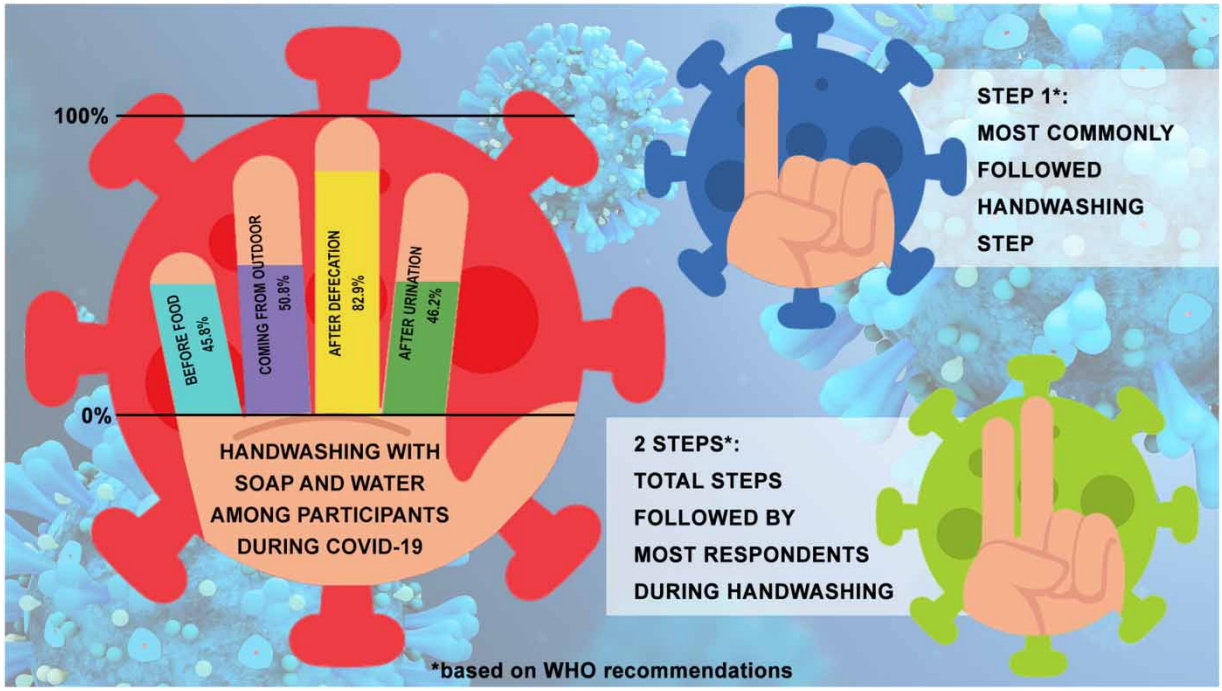
Proper handwashing is one of the effective ways to prevent many communicable diseases, including COVID-19. We explored the handwashing practices in a rural Indian population before the probable third wave of the COVID-19 pandemic. A data collection schedule was administered to eligible adult members of a rural community, selected by multi-stage sampling, to assess their pattern and practice of handwashing. All 176 respondents washed their hands after defecation, 82.4 and 80.7% washed hands after urination and before taking food, respectively, while 68.2% of respondents washed hands after coming back from outdoors. Among those who handwashed, 82.9% used soap water after defecation; 46.2, 45.8 and 50.8% washed hands with soap water after urination, before taking food and after visiting outdoors, respectively. Only a quarter (24.4%) of all the participants used soap water for handwashing consistently after defecation, after urination, before taking food and after coming home. The more educated, those coming from higher socioeconomic stratum and working from home, were more likely to report proper handwashing practice. Handwashing, as recommended by health agencies, for restraining COVID-19 infection, was not noticed in the majority of the participants. Better awareness of handwashing is recommended to help restrain COVID-19 in the Indian population.

Key words: community-based, hand hygiene, infection, SARS-CoV-2, West Bengal

HIGHLIGHTS

- Global health bodies stress upon proper handwashing as one of the effective ways to curb the COVID-19 pandemic, but this study reveals an unsatisfactory state of handwashing practice in rural India.
- Handwashing was not universal among the participants for all the indicators; the use of soap water during handwashing was not a commonly noted practice.
- None were found to follow all the recommended steps of handwashing.

GRAPHICAL ABSTRACT



INTRODUCTION

Handwashing has been of public health importance since the 19th century. In the middle of the 19th century, Hungarian physician Dr Ignetz Senemmelweis found that ensuring hand hygiene among health personnel could limit puerperal fever (Ray *et al.* 2011). Hand hygiene by handwashing since then has been demonstrated to be an excellent method of reducing the risk of developing communicable diseases, such as acute respiratory infections and diarrhea. Using soap and water for handwashing has been found to achieve better removal of micro-organisms than using water alone (Burton *et al.* 2011). It significantly reduces episodes of sickness and the associated use of antibiotics, which, in turn, reduce the likelihood of antibiotic resistance (CDC 2020b). 'Water, sanitation, and hygiene' now feature prominently on the global health agenda (Cairncross & Valdmanis 2006). Handwashing with soap is one of the most cost-effective ways of reducing the global infectious disease burden (The Global Handwashing Partnership 2017). Every year 15th October is celebrated as the Global Handwashing Day (Ray *et al.* 2009).

Hundreds of millions worldwide have been affected by the COVID-19 outbreak, India being one of the most affected countries (WHO 2021). Vaccines have been available since late 2020s and have played a vital role in the fight against the disease, with a proven protective role (Office for National Statistics 2021). However, new coronavirus strains have raised concerns about their effectiveness against the new strains (Rubin 2021). Global health authorities, such as the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO), insist on combining preventive measures to limit this epidemic, handwashing being one of them, in addition to face masks and social isolation (CDC 2020a; WHO 2020). A significant drop in the risk of COVID-19 infection among frequent handwashers has been reported (Beale *et al.* 2020). An American survey indicated a rise in handwashing frequency during the pandemic in similar lines with a survey from the UK (Beale *et al.* 2020; Safety and Health Magazine 2020). Africa, however, faces shortfalls in handwashing practice (Mohammed & Khameis 2020). In India, research works regarding handwashing behavior during the pandemic were hardly found, especially in rural areas. Inadequacy in COVID-19-specific handwashing behavior, including washing hands after coming home from outdoors, was seen as a result of inadequate knowledge and scarce water supply (Krishnan 2020; WaterAid 2020).

Little information is available about handwashing practices of the Indian people during the pandemic. In order to bridge this gap in existing evidence, the current study aimed to discover if handwashing was being practised by the participants after

defecation, after urination before taking food and after coming home from outdoors, and if so, whether or not there was a statistical relationship between sociodemographic variables and the handwashing practices. This study might be among the very few that have been conducted in India till now on this issue.

METHODS

Study design and participants

A descriptive, community-based epidemiological study of the cross-sectional design was undertaken among residents of the rural field practice area of a Kolkata-based Medical College of West Bengal. The area is in the Barasat-II block of the North 24 Parganas district. The study was conducted over 2 months (July–August 2021). A map of the study location is given in Figure 1.

Data collection schedule

A pre-tested data collection form was designed to gather sociodemographic information on participants and their handwashing practices. The form also comprised a checklist of WHO-recommended handwashing steps, which checked the participants' handwashing practices (C Diff Foundation 2016).

Sample size calculation

The formula $n_0 = z^2pq/e^2$ was used to calculate the sample size. Here, n_0 was the sample size before correction, $z = 1.96$ (at 95% confidence interval), p is the prevalence of proper handwashing practice, taken as 50.0%, $q = 100 - p$, e is the relative error on prevalence, taken as 10% of p. Sample size n_0 was further corrected due to finite population, using the formula $n = n_0/[1 + \{(n_0 - 1)/N\}]$, where N is the number of line listed families (227) and n is the final sample size after correction. The estimated sample size was 143, to which 30% was added to count for probable non-response. The sample size finally calculated was 186.

Data collection, and inclusion and exclusion criteria

From the list of 227 families, 186 families were randomly selected and approached, of whom 176 families were available for data collection. The rest were either unwilling toward participation or were not available on three successive days of data collection. People aged 18 years and above living in these families, who were present at the time of data collection and were willing to participate, were included in the study. People who were seriously ill were excluded. One eligible member from each family was selected randomly.

Data management and statistical analysis

Statistical Packages for Social Science (SPSS)® (SPSS Inc., Chicago, IL, USA) version 16.0 was used for data entry and analysis. Results were obtained based on pre-defined objectives. The calculation of frequency and percentages of the variables were done; simple proportions were used for descriptive statistics. Univariate regression analysis was carried out to find out the sociodemographic variables, which significantly predicted proper handwashing practice. The variables that showed significant statistical predictability ($p < 0.1$) were further subjected to multivariate logistic regression analysis. Proper handwashing practice was the outcome variable. For the purpose of the study, proper handwashing practice was defined as the practice of using soap and water to wash one's hands after defecation, after urination, before eating and after returning home from an outing.

Ethical committee approval

Free and informed consent of the participants was obtained, and the study protocol was approved by the appropriate Committee for the Protection of Human Participants – The Institutional Ethical Committee, Medical College, Kolkata (Ref. No.: MC/KOL/IEC/NON-SPON/363/04-2019, dt. 27.4.2019). The anonymity of all participants was maintained.

RESULTS

Out of the 176 respondents, 44.9% (79/176) were aged between 38 and 47 years, also there were females (68.8%, 121/176), illiterates (47.7%, 84/176) and presently married (83.4%, 151/176). The majority (58.5%, 103/176) were Muslims, while the rest were Hindus (73/176; 41.5%). Of the participants, 54.5% (96/176) stayed or worked from home, while the rest (45.5%; 80/176) had to walk out for earning. Most (44.9%, 79/176) belonged to Class IV socioeconomic class, as per the Modified

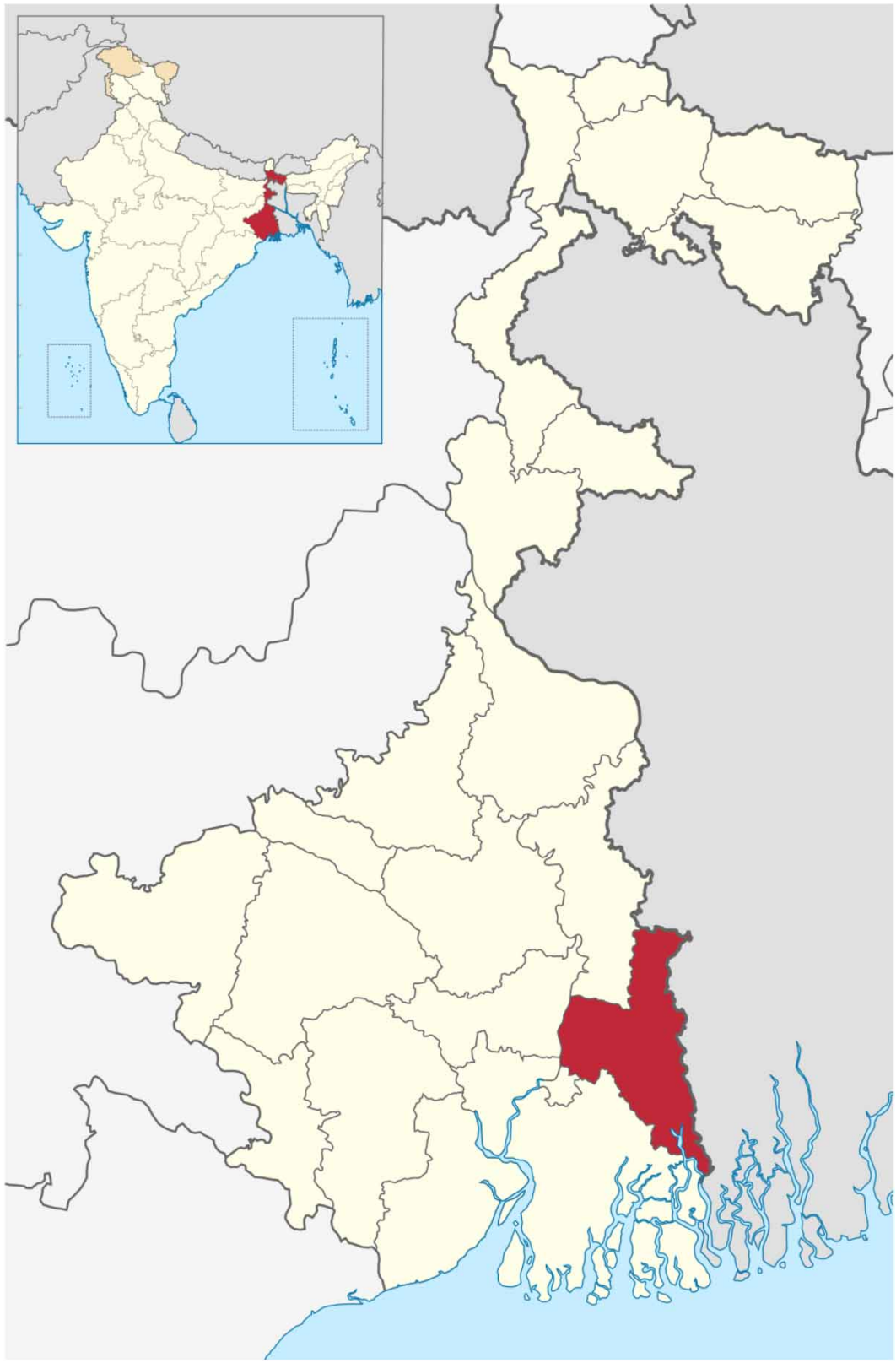


Figure 1 | A map of India with the state of West Bengal and the district of North 24 Parganas highlighted (Work based on User:NordNordWest 2021).

B.G. Prasad Scale, July 2020. This scale classifies families into five classes based on their per-capita monthly income – Class I being the highest and Class V being the lowest (Prasad Social Classification Scale Update 2020). Of the respondents, 77.9% (141/176) were aware of at least one disease that can be avoided by washing hands (Table 1).

All respondents washed their hands after defecation, though 82.9% (146/176) used soap water. The majority, i.e., 82.4% (145/176) and 80.7% (142/176), washed hands after urination and before taking food, respectively. Of all, 68.2% (120/176) always washed hands first after coming from outside. Among those who washed hands after urination and before eating, 46.2% (67/145) and 45.8% (65/142), respectively, used soap water. Of those washing hands coming from outdoors, 50.8% (61/120) used soap and water. A quarter (24.4%; 43/176) consistently used soap and water for handwashing after defecation, after urination, before taking food and after coming home (Figure 2).

Handwashing as recommended by international health agencies amidst the COVID-19 outbreak was hence not practised (CDC 2020c; UNICEF 2020a). Dedicated space for handwashing was found in 76.7% (135/176) of the households. Only

Table 1 | Sociodemographic characteristics of the study participants ($n = 176$)

Sociodemographic characteristics	Category/group	Frequency [*N* (%)]
Age (in completed years) (mean = 37.7; SD: 10.4)	18–27	27 (15.3)
	28–37	51 (29.0)
	38–47	79 (44.9)
	48–57	16 (9.1)
	>57	3 (1.7)
Educational qualification	Illiterate	84 (47.7)
	Primary	43 (24.4)
	Middle	13 (7.4)
	Secondary or above	39 (22.2)
Marital status	Presently married	146 (83.0)
	Unmarried	14 (8.0)
	Widowed	12 (6.8)
	Separated	4 (2.3)
Socioeconomic class[a]	Class I	3 (1.7)
	Class II	13 (7.4)
	Class III	25 (14.2)
	Class IV	79 (44.9)
	Class V	56 (31.8)

[a]As per the Modified BG Prasad Scale July 2020 (Prasad Social Classification Scale Update 2020).

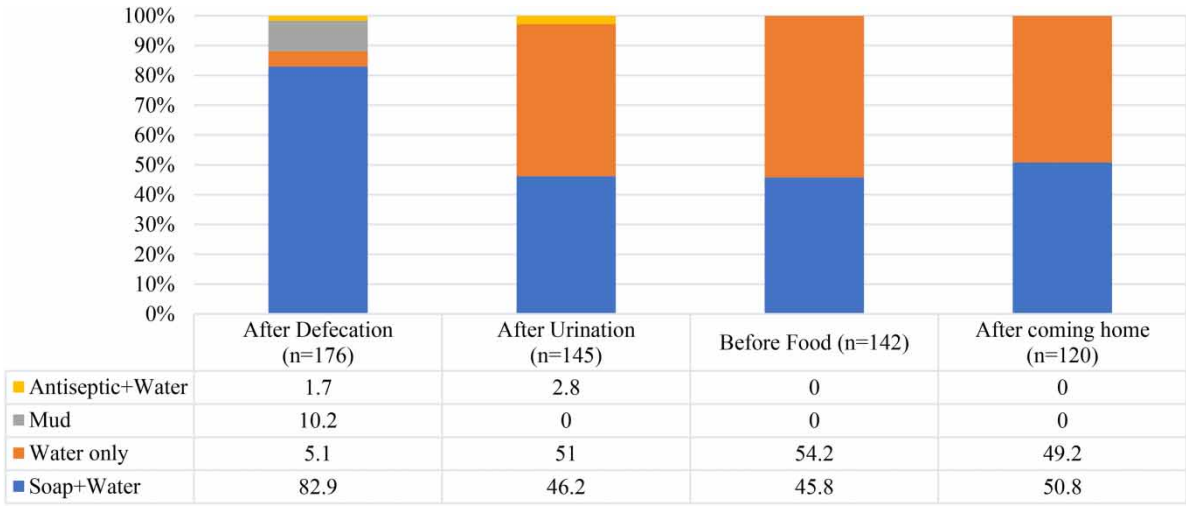


Figure 2 | A component bar diagram showing the distribution of the study population according to the handwashing medium used.

14.8% (26/176) washed hands for a duration of 20 seconds or more, though none were found to follow all the recommended steps of handwashing (C Diff Foundation 2016). The majority of participants (105/176; 59.6%) were found to follow only 2 out of the 11 WHO-recommended steps of handwashing, with palm-to-palm washing performed by everyone (Figures 3 and 4).

Education, occupation and socioeconomic status significantly predicted proper handwashing on univariate regression analysis ($p < 0.1$) – these variables were subjected to multivariate regression analysis. On the basis of the results of multivariate logistic regression analysis, higher education [adjusted odds ratio i.e., AOR = 5.595 (2.087–14.994); $p = 0.001$], staying or working from home [AOR = 3.093 (1.288–7.427); $p = 0.012$] and a higher socioeconomic class [AOR = 2.985 (1.220–7.301); $p = 0.017$] were significantly predicting proper handwashing practice. Nagelkerke's R^2 value of this regression model was 0.290 (Table 2).

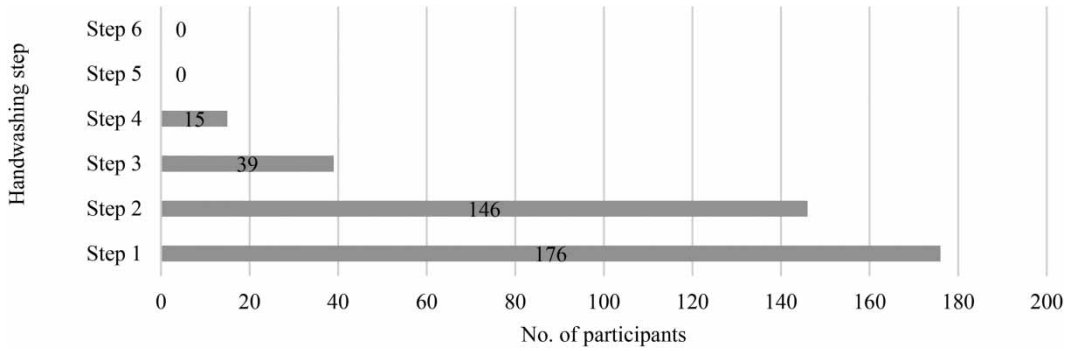


Figure 3 | Steps of handwashing (WHO-recommended) followed by the respondents.* ($n = 176$). *observed; multiple options.

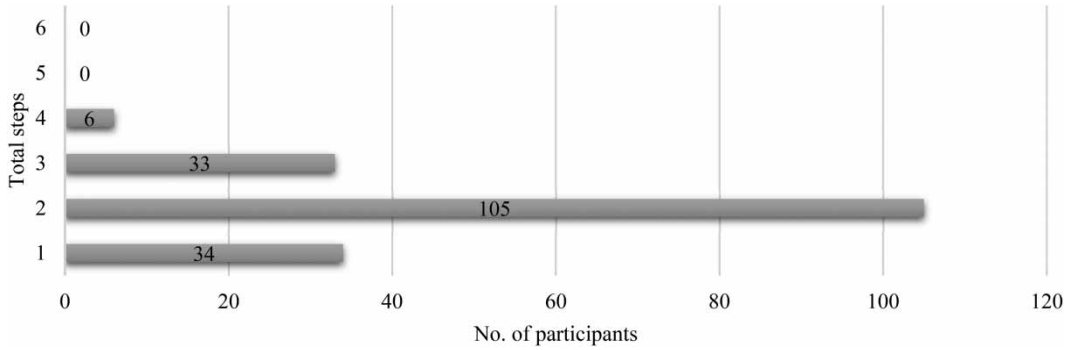


Figure 4 | The distribution of study participants according to total steps of handwashing followed.* ($n = 181$). *observed.

Table 2 | Multivariate logistic regression predicting proper handwashing practice ($n = 176$)

Independent variable		Handwashing practice		Total	AOR (95% CI)[a]	p
		Proper	Not proper			
Socioeconomic class	Class IV–V	22	113	135	Ref.	0.024
	Class I–III	20	21	41	2.845 (1.151–7.030)	
Education	Middle school or less	24	116	140	Ref.	0.002
	Secondary or more	17	19	36	4.956 (1.780–13.802)	
Occupational status	Working outdoor	12	68	80	Ref.	0.002
	Work from home	31	65	96	4.273 (1.716–10.641)	

[a]Adjusted odds ratio (95% confidence interval).

DISCUSSION

In order to investigate the behavioral tendencies of rural Indians toward handwashing during the COVID-19 pandemic and to investigate its sociodemographic predictors, the present study was conducted in mid-2021.

India has been severely affected by the COVID-19 pandemic (WHO 2021). India's 'Swachh Bharat Mission' was introduced in 2014 to improve the country's sanitation coverage, with a goal to build 100 million toilets in rural areas. Despite the country's concerted effort, approximately 50 million Indians are still without handwashing facilities, contributing to 40% of the world's population and consequently increasing their risk of COVID-19 infection (Ministry of Drinking Water and Sanitation Government of India 2020; Times of India 2020; UNICEF 2020b).

Hand hygiene can potentially minimize the burden caused due to preventable and communicable diseases, especially in developing countries like India. If practised properly, handwashing along with vaccinations, face mask usage and social distancing can potentially limit the spread of the COVID-19 pandemic, along with other communicable diseases (WHO 2020).

All 176 participants washed their hands after defecation (100.0%); however, not all were found to wash hands after urination and before taking food. The majority washed their hands after coming home from outdoors. A study conducted in West Bengal found that 51% of participants practised handwashing after urination; all participants washed hands after defecation (Ray *et al.* 2009). A Pune-based study found all participants to be washing hands after defecation; 95.03% did so before and after taking food (Pandve *et al.* 2017).

Most participants of the present study (82.9%) used soap water for handwashing after defecation. Among those who washed hands, less than 50% used soap water after urination and before taking food; half of the participants who washed hands after coming home used soap-water. However, 24.4% used soap and water for handwashing every time in all such instances. Data regarding handwashing practice during COVID-19 in India were difficult to obtain.

Against the Indian handwashing research, which was rarely found in the rural areas, there were few reports which indicated that scarce water supply acted as a retardant against handwashing practices. Inadequate awareness about COVID-19-specific handwashing practices, such as washing hands after coming home from the outdoors, has also been hurting the chances of better mass adoption of appropriate handwashing behavior in India (Krishnan 2020; WaterAid 2020). A study from an African low-income nation indicated similar shortfalls in practice (Mohammed & Khameis 2020). A survey in the USA during the COVID-19 pandemic suggested a rise in handwashing frequency in the country (Safety and Health Magazine 2020). Around 90% of survey participants washed hands for a longer duration, and more frequently, with a 37% rise in respondents who washed hands at least six times a day compared to pre-COVID times. A similar study found that 59% of participants used soap and water after defecation (Ray *et al.* 2009). Another study from an urban slum found that 98 and 36% of its participants used soap water for washing hands after defecation and before a meal, respectively; in the rural area, however, 71 and 13% of participants, respectively, used soap water after defecation and before a meal (Ray *et al.* 2006). A study from the UK reported that a significant proportion of its participants washed their hands at least six times a day. Adults and health workers tended to wash hands more frequently (Beale *et al.* 2020).

Lack of access to dedicated handwashing space with running water supply has been shown as a hindrance toward the adoption of adequate handwashing behavior during the COVID-19 pandemic (WaterAid 2020). A majority (76.7%) of respondents in this study had a dedicated space for handwashing at their home. All participants (100.0%) followed Step 1 of handwashing (palm to palm) followed by Step 2 (palm to dorsum) – 82.9%. None followed all the recommended steps of handwashing. Only 14.8% of participants washed hands for 20 seconds or more. Another study found that 16.1% of its respondents washed hands for the recommended 15–30 seconds. Palm-to-palm washing was followed by most participants, with none following other steps (Ray *et al.* 2009). Some international studies have also found a relatively lower number of participants following the ideal way of handwashing, thus indicating a common shortfall in knowledge and practice (Al-Wutayd *et al.* 2021). A Sudanese study found that 31.2% of its participants washed hands for the said duration during the COVID-19 pandemic (Mohammed & Khameis 2020). The study from Pune reported that two study participants were able to demonstrate an ideal way of handwashing (Pandve *et al.* 2017).

RECOMMENDATIONS AND CONCLUSION

In discussing the results of the current study, it can be mentioned that individuals who were less educated, poor and had to leave home for work or study tended to have poorer hand hygiene practices. Handwashing adherence may be low due to a

lack of knowledge or a lack of education. Therefore, a dedicated handwashing awareness program is necessary to improve this situation. Of late, COVID-19 disease prevention efforts have been widespread, and significant efforts to raise handwashing awareness have been seen. The mass media channels have been used to deliver information about the importance of handwashing to prevent COVID-19 illness. People have now started talking about the need for handwashing (Alzyood *et al.* 2020). Nation-wide construction of more public toilets and handwashing facilities should be prioritized and accelerated along with the encouragement to use them well.

Regular campaigns through social mobilization should be continued to reach every corner of Indian society. Taking advantage of the importance and power of social media and mass media, intensified campaigns may be run. Teaching and encouraging the underprivileged and the economically poorer regarding all the indicators for handwashing, all the techniques of handwashing, the right time duration of handwashing, use of soap and water for handwashing, alternative use of sanitizer in places of water scarcity, using face masks properly and maintaining social distance can be viewed as an urgent matter that needs to be dealt with all haste. Increasing the acceptance of anti-COVID vaccines through awareness efforts is also necessary. Folk media, role play and puppet show-like traditional communication channels may be very much effective to instill the message in local people. Educating the students on basic hygienic practices may be seen as a method to instill healthy habits in them.

The findings of this community-based study can be generalized to similar communities in India, thus making this its strength. It also adds vital evidence to the rarely visited domain of examining public handwashing practices during the ongoing pandemic. The present study predominantly relied on the version provided by participants to gauge handwashing behavior, which may have been influenced by a social desirability bias. The Hawthorne effect might have altered or enhanced their handwashing behavior, as they knew that they were being studied.

This research provides vital data on handwashing practices from the field among rural Indians during the pandemic. It indicates that there is a serious need for improvement. The investigation found that the public is unaware of the correct hand hygiene procedures and COVID-appropriate behavior. Those who were less educated, came from a lower socioeconomic class and had to leave home to work or study had inferior handwashing behavior. In order to improve the situation, a focused approach to educate them about the handwashing process is required. This study provides a baseline for public health research on assessing field-based handwashing practices in rural India, as well as the opportunity to follow up and assess the impact of health information and interventions.

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DATA AVAILABILITY STATEMENT

Data cannot be made publicly available; readers should contact the corresponding author for details.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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