Determinants of hand-hygiene practices in India: reflections from the 76th round National Sample Survey, 2018

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Abstract

This paper studies the differences and determinants of handwashing practices in India and identifies sections of the population with poor handwashing practices who are relatively more vulnerable during the COVID-19 pandemic. We have used the data from the recent National Sample Survey (NSS, 76th round) for India (2018). Bivariate and logistic regression analyses have been performed to predict the determinants of handwashing practices across states and socio-economic groups. Levels of education of the household head, Usual Monthly Per Capita Expenditure (UMPCE) of the household, access to water (other than drinking water) resources and sanitation facilities, and the availability of water with soap in and around latrines are major socio-economic and demographic factors that impact handwashing practices. Higher access to principal sources of water for drinking and other purposes, access to bathrooms and latrines with soap, and the availability of water in or around latrines increase the likelihood of handwashing among the people. Universal handwashing across different sections of the population will be effective to prevent further infection. The available data help us to identify the vulnerable sections of the population which are towards the lower end of the handwashing compliance spectrum. The policymakers can outline specific planning and strategy implementation for them.

Key words: COVID-19, handwashing, hygiene practices, preventive care, sanitation

Highlights

- The National Sample Survey is a recent assessment of sanitation and hand-hygiene practices in India.
- It gives a regional- as well as community-level picture of handwashing practices.
- It provides a detailed account of the determinants of hand-hygiene practices.
- This survey is relevant in the current situation of the COVID-19 pandemic.
- It fulfils the gaps in the research of access to water resources and related hand-hygiene practices.

Introduction

Hands play a major role in the spread of infections (Teare 1999; Aiello & Larson 2002; Curtis & Cairncross 2003). Handwashing is a simple personal hygiene measure that has historically proved to be effective in reducing the transmission of infections (Larson 1988; Coignard et al. 1998). It is also a cost-effective strategy to reduce the pressure on the health system across the country and reduce the global burden of diseases (Hirai et al. 2016). Handwashing with soap at critical moments, such as prior to meals and post defaecation, can effectively prevent infectious diseases by interrupting the transmission of infectious agents (Hirai et al. 2016). An integrated approach, including improvements in personal hygiene with a simultaneous development of public health infrastructure, can effectively control infections (Esrey & Habicht 1986; Esrey et al. 1991; Curtis Cairncross & Yonli 2000; Aiello & Larson 2002).

Inadequate handwashing post defaecation and anal cleaning practices are common in the Indian subcontinent and are a major source of faeco-oral transmission of enteric diseases (Hoque et al. 1995; Hoque 2003). Improvement in water and sanitation facilities has proved to have reduced infections (Esrey & Habicht 1986; Esrey et al. 1991). The World Health Organization (WHO) has advised frequent handwashing with water and soap (among several others) as an effective...
preventive measure against COVID-19. However, like other hygiene practices, handwashing is highly influenced by individual behaviour and usually has biological and social origins (Deodhar 2003). Even during crucial moments such as post defaecation and before meals, handwashing behaviour varies widely across different social and economic groups of the population. Therefore, if handwashing compliance is to be ensured to prevent infections, it is important to delve into the complex set of factors that influence it – the most important being accessibility to basic facilities required for handwashing compliance. Hand-sanitizing gels and alcohol-based hand rubs are effective alternatives to handwashing with water and soap except when hands are visibly soiled (Widmer 2000) but are not accessible universally. In this paper, an attempt has been made to study the differential handwashing behaviour across social and economic groups of the population in two instances – prior to meals and post defaecation. Since these two instances are crucial ones, it can give a picture of the general anticipated handwashing behaviour and help to identify the vulnerable sections of the population.

Objectives
This paper attempts to study the differential handwashing practices and their determinants in India and identify the sections of the population that are less compliant with handwashing practices. This will be helpful to outline some public health planning and strategies that can be implemented to facilitate handwashing practices among these sections of the population to prevent the spread of infections.

MATERIALS AND METHODS

Data source
Data from the 76th round of National Sample Survey (NSS) (Schedule 1.2) in India have been used, which include information on the issues of drinking water, sanitation, hygiene and housing conditions. It is a nationally representative multistage stratified sample survey of households, wherein the total number of households surveyed was 106,838 (63,736 in rural areas and 43,102 in urban areas).

Outcome variables
Two questions related to handwashing practices were asked during the survey: ‘(i) whether household members regularly wash their hands before meals?’ and ‘(ii) whether household members regularly wash their hands after defaecation?’ A set of four options were available to choose from: if household members wash their hands ‘with water and soap/detergent – 1; with water and ash/mud/sand, etc. – 2; with water only – 3; no – 4’. All these responses have been recoded into a binary variable, i.e. ‘with water and soap/detergent – 1 and all others – 0’, as only handwashing with water and soap/detergent is effective against COVID-19 among the four categories of responses.

Explanatory variables
Various regional, demographic and socio-economic determinants of handwashing have been considered. In addition, access to water resources, the availability of sanitation facilities and institutional factors have also been considered. The place of residence and Empowered Action Group (EAG)\(^1\) status of the states have been considered to examine the regional effects. Main demographic and socio-economic variables are the size of the family, highest education level of household head, Usual Monthly Per Capita Expenditure (UMPCE) of the household, caste and religion. Variables of access to water resources and sanitation include the availability of water in or around latrines used, access to the principal sources of drinking water and other water and access to bathroom and latrine at the household or community level. Benefits obtained from the government scheme on drinking water and sanitation are considered as an institutional factor. The detailed categories of independent variables and sample characteristics are given in Table 1.

Statistical analysis
Chi-square test and bivariate and multivariate statistical tools have been applied in this study using the STATA-14 statistical software. The relationship between the dependent variables (hand washing before meals and after defaecation) and

\(^1\) In connection with this low achievement of some states in controlling population growth, health and educational progress, the Government of India had constituted EAG states in 2001 constituting eight states to provide them with better support for faster growth and sustainable development through self-empowered action. The states under the EAG Group include Bihar, Jharkhand, Uttar Pradesh, Uttaranchal, Rajasthan, Orissa, Madhya Pradesh and Chhattisgarh.
### Table 1 | Sample characteristics

| Background variables | Categories                          | N    | Percent |
|----------------------|-------------------------------------|------|---------|
| Place of residence   | Rural                               | 63,736 | 59.66   |
|                      | Urban                               | 43,101 | 40.34   |
| EAG status           | EAG states                          | 39,909 | 37.36   |
|                      | Non-EAG states                      | 66,928 | 62.64   |
| Family size          | Small (up to three)                 | 35,514 | 33.24   |
|                      | Medium (four to six)                | 58,021 | 54.31   |
|                      | Large (more than six)               | 13,302 | 12.45   |
| Levels of education of the household head (HH) | Illiterate                          | 26,512 | 24.82   |
|                      | Literate without formal schooling   | 998   | 0.93    |
|                      | Below primary and primary           | 22,769 | 21.31   |
|                      | Upper primary                       | 17,272 | 16.17   |
|                      | Secondary                           | 16,223 | 15.18   |
|                      | Higher secondary and above          | 23,063 | 21.59   |
| Social group         | Scheduled tribe (ST)                | 14,767 | 13.82   |
|                      | Scheduled caste (SC)                | 18,157 | 17.00   |
|                      | Other backward class (OBC)          | 43,694 | 40.85   |
|                      | Others                              | 30,273 | 28.34   |
| Religious group      | Muslim                              | 13,789 | 12.91   |
|                      | Hindu                               | 81,825 | 76.59   |
|                      | Christians                          | 6,338  | 5.93    |
|                      | Others                              | 4,885  | 4.57    |
| Usual monthly per capita expenditure | Poorest                            | 15,803 | 14.79   |
|                      | Poor                                | 17,549 | 16.43   |
|                      | Middle                              | 20,528 | 19.21   |
|                      | Rich                                | 23,868 | 22.34   |
|                      | Richest                             | 29,089 | 27.23   |
| Access to the principal source of drinking water | Community                          | 24,762 | 23.18   |
|                      | Neighbours source                   | 3,508  | 3.28    |
|                      | Common use of HHs in building       | 11,823 | 11.07   |
|                      | HHs exclusive                       | 58,001 | 54.29   |
|                      | Others                              | 8,743  | 8.18    |
| Principal source of drinking water for all household activities | Bottle/piped in HH | 32,298 | 30.23   |
|                      | Piped in plot/neighbour            | 14,772 | 13.83   |
|                      | Public tap/stand pipe              | 9,593  | 8.98    |
|                      | Hand pump/tube well                 | 39,361 | 37.03   |
|                      | Well                                | 7,002  | 6.55    |
|                      | Others                              | 3,811  | 3.57    |
| Principal source of water for all household activities excluding drinking | Bottle/piped in HH | 30,659 | 28.7    |
|                      | Piped in plot/neighbour            | 12,774 | 11.96   |
|                      | Public tap/pipe                    | 7,717  | 7.22    |
|                      | Hand pump/tube well                 | 39,565 | 37.03   |
|                      | Well                                | 7,471  | 6.99    |
|                      | Others                              | 8,651  | 8.1     |
| Access of the household to bathroom | No bathroom                         | 30,324 | 28.38   |
|                      | Own                                 | 66,354 | 62.11   |
|                      | Common                              | 9,707  | 9.09    |
|                      | Public/community with or without payment | 452 | 0.42     |
| Access of the household to latrine | No latrine                         | 17,771 | 16.63   |
|                      | Own                                 | 77,159 | 72.22   |
|                      | Common                              | 10,108 | 9.46    |
|                      | Others                              | 1,799  | 1.68    |

(Continued.)
RESULTS

Regional variation in handwashing practices

Handwashing practices in two critical moments – before meals and after defaecation – are shown in Table 2 across rural and urban areas in each state. It is observed that on an average, about 35% of people wash their hands with soap/detergent and water before meals. While only 25% of people in rural areas wash hands with soap/detergent and water before meals, the same figure in urban areas is 56%. Union territories record the highest (70%), followed by non-EAG states (43%) and north eastern states (42%), and the lowest is recorded in the EAG states (23%). Variation in handwashing practices before meals across states is shown in Figure 1.

On the other hand, it is seen that about 74% of people wash their hands with soap/detergent and water post defaecation. While only 67% of people in rural areas wash hands with soap/detergent and water post defaecation, the same figure in urban areas is 88%. The highest percentage is observed in union territories (96%), followed by EAG states (74%) and non-EAG states (73%), and the lowest is recorded in north eastern states (62%). Rural areas in Chandigarh and urban areas in Goa record 100% of people washing hands post defaecation. Variation in handwashing practices after defecation across states is shown in Figure 2.

Relation between handwashing and socio-economic and demographic characteristics

Table 3 reveals the association of handwashing practices with socio-economic and demographic characteristics of the households. People who wash hands prior to meals are comparatively high in the urban areas (55.28%, $P<0.001$) compared to rural areas (24.96%, $P<0.001$). Handwashing prior to meals is highest in small families (38.70%, $P<0.001$), and post defaecation is highest in large families (76.25%, $P<0.001$). People who wash hands prior to meals and post defaecation are comparatively high among those with education at higher secondary and above (55.90 and 89.36%, respectively, $P<0.001$). The rate of handwashing prior to meals and post defaecation is satisfactorily high (49.04 and 86.71%, respectively, $P<0.001$) among the non-scheduled and backward social group. Handwashing before meals is lowest among Muslims (32.35%, $P<0.001$) and after defaecation among Christians (67%, $P<0.001$). There is a significantly progressive association observed between both outcome variables and the increasing wealth status of the household ($P<0.001$). Non-EAG states have a higher percentage of population washing hands prior to meals (44.11%, $P<0.001$). The highest tendency of handwashing in both cases is observed among households who used bottled/piped water as principal sources of household activities excluding drinking (57.55 and 88.64%, respectively, $P<0.001$). A similar pattern was observed in the case of principal source of water for all household activities (56.65 and 87.02%, respectively, $P<0.001$). It must be noted that bottled water is packaged drinking water that meets certain safety standards and is therefore considered safe for drinking; piped water is provided by corporation, municipality, panchayat or other local authorities and can also be considered safe (Government of India 2018). The highest percentage of handwashing before meals is observed among households that possess their own bathrooms (45.67,
The percentage of handwashing in both cases is higher where water is available in or around the latrine used (48.91 and 94.04%, respectively, \( P < 0.001 \)). Households that received benefits from government schemes for drinking water have a higher percentage of people washing hands in both situations (36.12 and 77.57%, respectively, \( P < 0.001 \)). On the other hand, households that do not receive benefits from government schemes for sanitation have a higher percentage of people washing hands before meals (27.29%, \( P < 0.001 \)), while the percentage of people washing hands

### Table 2 | Regional variation in handwashing across India, 2018

| State/UTs                    | Whether household members regularly wash their hands with water and soap/detergent before meal? | Whether household members regularly wash their hands with water and soap/detergent after defaecation? | No. of sample households |
|-----------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------|
|                             | Rural | Urban | Total   | Rural | Urban | Total   |                                  |
| Non-EAG others              |       |       |         |       |       |         |                                  |
| Jammu and Kashmir           | 46.21 | 60.06 | 49.63   | 72.58 | 90.74 | 77.06   | 1,714                                |
| Himachal Pradesh            | 87.6  | 77.56 | 86.24   | 97.61 | 99.23 | 98.38   | 947                                  |
| Punjab                      | 74.36 | 81.85 | 77.53   | 96.33 | 99.36 | 97.61   | 2,361                                |
| Haryana                     | 56.07 | 76.77 | 64.02   | 87.22 | 95.82 | 90.53   | 2,145                                |
| Assam                       | 28.2  | 44.72 | 30.7    | 69.41 | 94.3  | 73.18   | 3,600                                |
| West Bengal                 | 18.57 | 47.72 | 28.3    | 70.28 | 93.24 | 77.95   | 7,789                                |
| Gujarat                     | 32.62 | 60.71 | 46.35   | 73.42 | 89.51 | 81.28   | 4,840                                |
| Maharastra                  | 42.92 | 73.2  | 56.51   | 75.59 | 96.59 | 85.02   | 9,298                                |
| Andhra Pradesh              | 25.84 | 51.79 | 34.61   | 44.31 | 72.95 | 53.99   | 3,863                                |
| Karnataka                   | 35.11 | 67.28 | 49.53   | 57.4  | 83.82 | 69.25   | 6,108                                |
| Goa                         | 30.69 | 69.88 | 55.09   | 98.06 | 99.27 | 99.84   | 9,928                                |
| Kerala                      | 51.57 | 56.04 | 53.76   | 82.76 | 93.11 | 88.33   | 7,383                                |
| Telangana                   | 13.19 | 41.27 | 27.35   | 30.74 | 61.51 | 46.26   | 6,108                                |
| Telangana                   | 28.9  | 52.47 | 39.89   | 61.31 | 86.77 | 73.18   | 2,949                                |
| Total                       | 33.04 | 58.34 | 43.46   | 65.09 | 85.54 | 73.51   | 54,131                               |
| EAG                         |       |       |         |       |       |         |                                  |
| Uttarakhand                 | 32.91 | 71.4  | 44.01   | 89.03 | 99.26 | 91.98   | 984                                  |
| Rajasthan                   | 19.66 | 53.37 | 28.67   | 64.92 | 93.27 | 72.49   | 3,240                                |
| Uttarakhand                 | 16.87 | 44.73 | 23.79   | 72.76 | 95.15 | 81.67   | 12,423                               |
| Bihar                       | 12.22 | 30.81 | 14.29   | 66.65 | 90.99 | 80.36   | 6,993                                |
| Jharkhand                   | 3.28  | 32.84 | 10.56   | 50.56 | 85.53 | 59.41   | 1,265                                |
| Odisha                      | 9.22  | 42.16 | 15.11   | 46.34 | 83.42 | 59.72   | 1,265                                |
| Chhattisgarh                | 33.27 | 56.87 | 48.14   | 84.07 | 98.23 | 89.90   | 1,256                                |
| Madhya Pradesh              | 26.64 | 57.41 | 35.24   | 74.95 | 95.81 | 80.78   | 5,908                                |
| Total                       | 17.04 | 47.14 | 23.73   | 68.8  | 93.79 | 74.05   | 39,909                               |
| Non-EAG North Eastern States|       |       |         |       |       |         |                                  |
| Sikkim                      | 85.38 | 90.56 | 87.05   | 100   | 98.53 | 99.53   | 816                                  |
| Arunachal Pradesh           | 50.38 | 69.05 | 54.82   | 75.2  | 92.7  | 86.38   | 1,143                                |
| Nagaland                    | 32.17 | 55.08 | 39.25   | 45.28 | 68.85 | 52.56   | 912                                  |
| Manipur                     | 40.69 | 54.72 | 45.29   | 44.86 | 61.37 | 50.28   | 2,242                                |
| Mizoram                     | 36.22 | 59.48 | 47.53   | 43    | 75.36 | 58.74   | 1,200                                |
| Tripura                     | 28.06 | 44.04 | 31.78   | 62.18 | 82.09 | 66.82   | 2,256                                |
| Meghalaya                   | 31.94 | 60.74 | 37.53   | 48.57 | 75.01 | 53.71   | 1,292                                |
| Tripura                     | 36.72 | 56.82 | 42.23   | 56.38 | 75.75 | 61.69   | 9,861                                |
| Total                       |       |       |         |       |       |         |                                  |
| Union Territories           |       |       |         |       |       |         |                                  |
| Chandigarh                  | 100   | 79.96 | 80.97   | 100   | 97.27 | 97.41   | 192                                  |
| Delhi                       | 55.97 | 73.92 | 67.35   | 99.67 | 97.51 | 97.56   | 1,616                                |
| Daman and Diu               | 23.39 | 5.85  | 7.97    | 95.44 | 97.24 | 97.03   | 192                                  |
| Dadra and Nagar Haveli      | 12.98 | 36.22 | 27.98   | 69.51 | 90.62 | 83.14   | 192                                  |
| Ladakh                      | 7.39  | 34.24 | 18.42   | 95.16 | 97.03 | 96.84   | 144                                  |
| Puducherry                  | 59.61 | 78.58 | 70.28   | 59.61 | 87.06 | 75.78   | 360                                  |
| Andaman and Nicobar Islands | 14.55 | 82.17 | 53.1    | 95.96 | 99.04 | 97.72   | 240                                  |
| Total                       | 47.24 | 72.32 | 70.72   | 80.37 | 97.02 | 95.95   | 2,936                                |
| India Total                 | 25.31 | 56.05 | 35.82   | 66.81 | 88.26 | 74.15   | 1,06,837                             |

Estimated by the author from NSSO 76th Round.
Figure 1 | Percentage of population who wash hands prior to meals in India, 2018 (data source: NSS 76th round, Schedule 1.2).
Figure 2 | Percentage of population who wash hands after defaecation in India, 2018 (data source: NSS 76th round, Schedule 1.2).
Table 3 | Bivariate statistics for the association between handwashing before meals and after defaecation with different background variables

| Background variables                          | Categories                          | Before meal | P-value | After defaecation | P-value |
|-----------------------------------------------|-------------------------------------|-------------|---------|--------------------|---------|
| Place of residence                            | Rural                               | 24.96       | 0.001   | 68.35              | 0.001   |
|                                               | Urban                               | 55.28       |         | 89.19              |         |
| Empowered Action Group                        | EAG states                          | 22.75       | 0.001   | 74.66              | 0.001   |
|                                               | Non-EAG states                      | 44.11       |         | 74.82              |         |
| Family size                                   | Small (up to three)                 | 38.70       | 0.001   | 73.25              | 0.001   |
|                                               | Medium (four to six)                | 34.69       |         | 74.6               |         |
|                                               | Large (more than six)               | 29.77       |         | 76.25              |         |
| Levels of education of HH                     | Illiterate                          | 22.20       | 0.001   | 64.87              | 0.001   |
|                                               | Literate without formal schooling   | 29.70       |         | 73.29              |         |
|                                               | Below primary and primary           | 29.27       |         | 71.02              |         |
|                                               | Upper primary                       | 31.82       |         | 76.15              |         |
|                                               | Secondary                           | 43.11       |         | 81.47              |         |
|                                               | Higher secondary and above          | 55.90       |         | 89.36              |         |
| Social group                                  | Scheduled tribe (ST)                | 22.8        | 0.001   | 57.8               | 0.001   |
|                                               | Scheduled caste (SC)                | 26.18       |         | 67.12              |         |
|                                               | Other backward class (OBC)          | 31.42       |         | 74.55              |         |
|                                               | Others                              | 49.04       |         | 86.71              |         |
| Religious group                               | Muslim                              | 32.35       |         | 80.71              | 0.001   |
|                                               | Hindu                               | 33.49       |         | 73.4               |         |
|                                               | Christians                          | 40.00       |         | 67                 |         |
|                                               | Others                              | 56.41       |         | 86.66              |         |
| Usual Monthly Per Capita Expenditure          | Poorest                             | 22.08       | 0.001   | 63.56              | 0.001   |
|                                               | Poor                                | 25.71       |         | 68.19              |         |
|                                               | Middle                              | 30.12       |         | 72.49              |         |
|                                               | Rich                                | 38.48       |         | 79.46              |         |
|                                               | Richest                             | 55.37       |         | 90.41              |         |
| Access to the principal source of drinking water | Community                      | 18.65       | 0.001   | 59.19              | 0.001   |
|                                               | Neighbours source                   | 21.52       |         | 63.26              |         |
|                                               | Common use of HHs in building       | 34.19       |         | 77.95              |         |
|                                               | HH exclusive                        | 40.85       |         | 82.05              |         |
|                                               | Others                              | 44.35       |         | 73.63              |         |
| Principal source of drinking water for all households | Bottle/piped in HH                         | 56.65       | 0.001   | 87.02              | 0.001   |
|                                               | Piped in plot/neighbour             | 38.59       |         | 74.11              |         |
|                                               | Public tap/stand pipe               | 23.49       |         | 56.51              |         |
|                                               | Hand pump/tube well                 | 21.91       |         | 71.94              |         |
|                                               | Well                                | 33.69       |         | 70.76              |         |
|                                               | Other sources                       | 29.67       |         | 65.37              |         |
| Principal source of drinking water for all household activities excluding drinking | Bottle/piped in HH                         | 57.55       | 0.001   | 88.64              | 0.001   |
|                                               | Piped in plot/neighbour             | 35.09       |         | 72.75              |         |
|                                               | Public tap/stand pipe               | 24.07       |         | 53.08              |         |
|                                               | Hand pump/tube well                 | 24.81       |         | 73.75              |         |
|                                               | Well                                | 34.09       |         | 71.85              |         |
|                                               | Other sources                       | 18.2        |         | 56.47              |         |
| Access of the household to bathroom           | No bathroom                         | 12.45       | 0.001   | 58.65              | 0.001   |
|                                               | Own                                 | 45.67       |         | 82.74              |         |
|                                               | Common                              | 39.74       |         | 82.76              |         |
|                                               | Public/community with or without payment | 23.12       |         | 66.14              |         |

(Continued.)
Factors associated with handwashing with soap/detergent and water prior to meals

Table 4 presents the regression models predicting handwashing with soap/detergent and water prior to meals. Several factors determine whether a person uses soap/detergent and water for washing his or her hands before having meals. Significant predictors include the place of residence, levels of education of a household head, state-/region-specific characteristics, social group, religion, monthly per capita expenditure, family size, benefits received by the household from the government on schemes for drinking water, access to the principal source of drinking water, the principal source of water for all household activities excluding drinking water, access of the household to bathroom, the availability of water in or around the latrine used and whether the household has benefited from government schemes related to drinking water.

People residing in the urban areas are 1.40 (adjusted odds ratio or AOR = 1.40, 95% confidence interval or CI: 1.35–1.45) times more likely to wash hands before meals than those in rural areas. The non-EAG states are 2.04 (AOR = 2.04, 95% CI: 1.97–2.11) times more likely to wash hands than EAG states. It is observed that medium (four to six members) and small (up to three members) families are 0.93 (AOR = 0.93, 95% CI: 0.89–0.97) and 0.86 (AOR = 0.86, 95% CI: 0.81–0.90) times less likely to wash hands than large families (above six members). The odds of washing hands with soap/detergent and water prior to meals increase with an increase in levels of education of a household head and those with higher secondary and above education are 1.70 (AOR = 1.70, 95% CI: 1.62–1.78) times more likely than those who are illiterate. The odds of washing hands with soap/detergent and water prior to meals were 1.16 (AOR = 1.16, 95% CI: 1.09–1.23), 1.07 (AOR = 1.07, 95% CI: 1.02–1.12) and 1.51 (AOR = 1.51, 95% CI: 1.25–1.37) times more likely among people belonging to scheduled tribes, other backward classes and others, respectively, than those who belong to scheduled castes. Hindus, Christians and people belonging to other religious groups are 1.28 (AOR = 1.28, 95% CI: 1.22–1.34), 1.39 (AOR = 1.39, 95% CI: 1.28–1.50) and 2.17 (AOR = 2.17, 95% CI: 2.01–2.35) times, respectively, more likely to wash hands than Muslims. People belonging to poor, middle, rich and richest quintiles are 1.07 (AOR = 1.07, 95% CI: 1.01–1.13), 1.15 (AOR = 1.15, 95% CI: 1.09–1.20), 1.18 (AOR = 1.18, 95% CI: 1.12–1.25) and 1.4 (AOR = 1.4, 95% CI: 1.32–1.48) times more likely, respectively, to wash hands than the poorest quintile. Households that have received benefits from government schemes for drinking water are 1.57 (AOR = 1.57, 95% CI: 1.34–1.83) times more likely to wash hands with soap/detergent and water prior to meals.

Households for which the access to the principal source of drinking water is from the common use of households in building, exclusively for the households, are 1.14 (AOR = 1.14, 95% CI: 1.06–1.18) and 1.13 (AOR = 1.13, 95% CI: 1.07–1.19) times more likely, and other sources are 0.90 (AOR = 0.90, 95% CI: 0.84–0.97) times less likely to wash hands with soap/detergent and water, respectively, than those using water from community sources. Households that depend on bottled and piped water

after defaecation is the same for those who have received (73.21%, P < 0.001) benefits from government schemes and those who have not (73.86%, P < 0.001).

Table 3 | Continued

| Background variables | Categories | Washing hands with water and soap/detergent | Before meal | After defaecation |
|----------------------|------------|-------------------------------------------|------------|------------------|
| Access of the household to latrine | No latrine | Percentage | P-value | Percentage | P-value |
| Own                  | 41.2       | 11.18 | 0.001 | 47.02 | 0.001 |
| Common               | 33.19      | 82.21 |       |       |       |
| Others               | 39.85      | 81.06 |       |       |       |
| Availability of water in or around the latrine used | Not available | 19.78 | 0.001 | 72.12 | 0.001 |
| Water/water with mud, etc. | 12.85 | 40.22 |       |       |       |
| Water with soap/detergent | 48.91 | 94.04 |       |       |       |
| Benefits received by the household from government schemes for sanitation | Not received | 27.29 | 0.001 | 73.86 | 0.001 |
| Received            | 20.45      | 73.21 |       |       |       |
| Benefits received by the household from government schemes for drinking water | Not received | 31.68 | 0.001 | 74.66 | 0.001 |
| Received            | 36.12      | 77.57 |       |       |       |

Estimated by the author from NSSO 76th Round, Schedule 1.20.
Note: P-values at a 95% confidence interval, P-values < –0.05 is considered as the significance level.
Table 4 | Factors associated with handwashing with soap/detergent and water prior to meals

| Background characteristics | Categories | Handwashing before meal |
|----------------------------|------------|-------------------------|
|                            |            | Unadjusted odds ratio (UOR) Odds ratio (95% CI) P-values AOR Odds ratio (95% CI) P-values |
| Place of residence         | Rural      | Reference               |
|                            | Urban      | 3.14 (3.06–3.22) 0.001 | 1.40 (1.35–1.45) 0.001 |
| Empowered Action Group     | EAG states | Reference               |
|                            | Non-EAG states | 2.54 (2.47–2.61) 0.001 | 2.04 (1.97–2.11) 0.001 |
| Family size                | Large (above six) | Reference               |
|                            | Small (up to three) | 1.36 (1.3–1.42) 0.001 | 0.86 (0.81–0.9) 0.001 |
|                            | Medium (four to six) | 1.22 (1.17–1.27) 0.001 | 0.93 (0.89–0.97) 0.002 |
| Levels of education of the HH | Illiterate | Reference               |
|                            | Literate without formal schooling | 1.47 (1.28–1.69) 0.001 | 1.09 (0.94–1.27) 0.268 |
|                            | Below primary and primary | 1.46 (1.4–1.52) 0.001 | 1.10 (1.05–1.15) 0.001 |
|                            | Upper primary | 1.76 (1.68–1.83) 0.001 | 1.20 (1.14–1.26) 0.001 |
|                            | Secondary | 2.74 (2.63–2.86) 0.001 | 1.38 (1.32–1.45) 0.001 |
|                            | Higher secondary and above | 4.45 (4.28–4.62) 0.001 | 1.70 (1.62–1.78) 0.001 |
| Social group               | Scheduled caste (SC) | Reference               |
|                            | Scheduled tribe (ST) | 1.21 (1.15–1.27) 0.001 | 1.16 (1.09–1.23) 0.001 |
|                            | Other backward class (OBC) | 1.31 (1.26–1.36) 0.001 | 1.07 (1.02–1.12) 0.003 |
|                            | Others | 2.55 (2.45–2.65) 0.001 | 1.31 (1.25–1.37) 0.001 |
| Religious group            | Muslim | Reference               |
|                            | Hindu | 1.14 (1.1–1.18) 0.001 | 1.28 (1.22–1.34) 0.001 |
|                            | Christians | 1.49 (1.4–1.58) 0.001 | 1.39 (1.28–1.5) 0.001 |
|                            | Others | 2.68 (2.51–2.87) 0.001 | 2.17 (2.01–2.35) 0.001 |
| Usual Monthly Per Capita Expenditure | Poorest | Reference               |
|                            | Poor | 1.22 (1.17–1.28) 0.001 | 1.07 (1.01–1.13) 0.013 |
|                            | Middle | 1.46 (1.39–1.53) 0.001 | 1.13 (1.08–1.12) 0.001 |
|                            | Rich | 2.01 (1.92–2.1) 0.001 | 1.18 (1.12–1.25) 0.001 |
|                            | Richest | 3.57 (3.42–3.72) 0.001 | 1.4 (1.32–1.48) 0.001 |
| Access to the principal source of drinking water | Community | Reference               |
|                            | Neighbours source | 1.2 (1.1–1.3) 0.001 | 1.07 (0.97–1.18) 0.169 |
|                            | Common use of HHs in building | 2.32 (2.21–2.44) 0.001 | 1.14 (1.06–1.22) 0.001 |
|                            | Exclusive use of HH | 3.25 (3.14–3.36) 0.001 | 1.13 (1.07–1.19) 0.001 |
|                            | Others | 3.21 (3.04–3.38) 0.001 | 0.90 (0.84–0.97) 0.008 |
| Principal source of drinking water for household | Public tap/stand pipe | Reference               |
|                            | Bottle and piped water into dwelling | 4.44 (4.22–4.68) 0.001 | 1.50 (1.36–1.65) 0.001 |
|                            | Piped water in plot and from neighbour | 2.18 (2.06–2.31) 0.001 | 1.30 (1.17–1.44) 0.001 |
|                            | Tube well/hand pump | 1.01 (0.95–1.06) 0.842 | 1.10 (1.01–1.2) 0.028 |
|                            | Well: protected and unprotected | 1.85 (1.73–1.98) 0.001 | 1.40 (1.24–1.59) 0.001 |
|                            | Other sources | 1.89 (1.75–2.05) 0.001 | 2.01 (1.78–2.28) 0.001 |
| Principal source of water for all household activities excluding drinking | Public tap/stand pipe | Reference               |
|                            | Bottle and piped water into dwelling | 4.42 (4.18–4.68) 0.001 | 1.54 (1.23–1.47) 0.001 |
|                            | Piped water in plot and from neighbour | 1.93 (1.82–2.06) 0.001 | 1.02 (0.92–1.12) 0.736 |
|                            | Tube well/hand pump | 1.13 (1.07–1.19) 0.001 | 1.02 (0.94–1.12) 0.608 |
|                            | Well: protected and unprotected | 1.79 (1.67–1.91) 0.001 | 1.00 (0.89–1.12) 0.997 |
|                            | Other sources | 0.99 (0.92–1.06) 0.715 | 0.88 (0.8–0.97) 0.111 |
| Access of the household to bathroom | No bathroom | Reference               |
|                            | Exclusive use of HH | 5.74 (5.54–5.95) 0.001 | 1.83 (1.75–1.91) 0.001 |
|                            | Common use of HHs in building | 4.51 (4.28–4.75) 0.001 | 1.69 (1.59–1.8) 0.001 |
|                            | Public/community use with or without payment and others | 2.34 (1.9–2.88) 0.001 | 1.48 (1.18–1.86) 0.001 |
into dwelling, piped water in plot and from neighbour, protected and unprotected wells and other sources for the principal source of drinking water for household are 1.50 (AOR=1.50, 95% CI: 1.36–1.65), 1.30 (AOR=1.30, 95% CI: 1.17–1.44), 1.40 (AOR=1.40, 95% CI: 1.24–1.59) and 2.01 (AOR=2.01, 95% CI: 1.78–2.28) times, respectively, more likely to wash hands than who use water from public tap/stand pipe. Households that depend on bottled and piped water into dwellings for the principal source of water for all household activities excluding drinking are 1.34 (AOR=1.34, 95% CI: 1.23–1.47) times, respectively, more likely to wash hands before meals than those who use water from public taps/stand pipes.

Households that have their own bathrooms, use common bathrooms for all households in the building and use public or community bathrooms are 1.83 (AOR=1.83, 95% CI: 1.75–1.91), 1.69 (AOR=1.69, 95% CI: 1.59–1.80) and 1.48 (AOR=1.48, 95% CI: 1.18–1.86) times, respectively, more likely to wash their hands before meals than those with no bathrooms. Households that have water available along with mud/sand around the latrines are 0.49 (AOR=0.49, 95% CI: 0.44–0.54) times less likely and those households that have soap/detergent available with water around latrines are 2.41 (AOR=2.41, 95% CI: 2.18–2.65) times more likely to wash hands after defaecation than those who do not have water available around latrines.

Factors associated with handwashing with soap/detergent and water after defaecation

Table 5 presents the regression models predicting handwashing with soap/detergent and water post defaecation. Several factors influence whether a person uses soap/detergent and water for washing their hands after defaecation. Significant predictors include the place of residence, levels of education of a household head, EAG characteristics, social group, religion, monthly per capita expenditure, family size, access to the principal source of drinking water, the principal source of water for all household activities excluding drinking are 1.34 (AOR=1.34, 95% CI: 1.23–1.47) times, respectively, more likely to wash hands before meals than those who use water from public taps/stand pipes.

People residing in the urban areas are 1.50 (AOR=1.50, 95% CI: 1.42–1.57) times more likely to wash hands after defaecation than people in rural areas. The non-EAG states are 0.54 (AOR=0.54, 95% CI: 0.51–0.56) times less likely to wash hands than EAG states. Medium (four to six members) and small (upto three members) families are 0.85 (AOR=0.85, 95% CI: 0.80–0.90) and 0.75 (AOR=0.75, 95% CI: 0.69–0.78) times less likely to wash hands than larger families (more than six members). The odds of washing hands with soap/detergent and water after defaecation were 1.68 (AOR=1.68, 95% CI: 1.58–1.80) times more likely among households with the education level of household head as higher secondary and above than those who are illiterate. The odds of washing hands with soap/detergent and water and post defaecation were 0.95 (AOR=0.95, 95% CI: 0.89–1.01) times less and 1.02 (AOR=1.02, 95% CI: 0.97–1.07) and 1.68 (AOR=1.68, 95% CI: 1.58–1.80) times more likely among people belonging to scheduled tribes, other backward classes and others, respectively, than those who belong to scheduled castes. Hindus and Christians are 0.92 (AOR=0.92, 95% CI: 0.87–0.97) and 0.64 (AOR=0.64, 95% CI: 0.58–0.70) times less likely and people belonging to other religions are 1.29 (AOR=1.29, 95% CI: 1.15–1.44) times, respectively, more likely to wash hands than Muslims. People belonging to rich and richest quintiles are 1.10 (AOR=1.10, 95% CI: 1.03–1.16) and 1.35 (AOR=1.35, 95% CI: 1.26–1.45) times, respectively, more likely to wash hands than the poorest quintile. Households for

Table 4 | Continued

| Background characteristics | Categories | Handwashing before meal |
|----------------------------|------------|-------------------------|
|                            |            | Unadjusted odds ratio (UOR) | P-values | Odds ratio (95% CI) | P-values |
|                            |            | Odds ratio (95% CI) | P-values | Odds ratio (95% CI) | P-values |
| Availability of water in or around the latrine used | Not available | Reference | Reference | 0.75 (0.68–0.83) | 0.001 | 0.49 (0.44–0.54) | 0.001 |
|                            | Water/water with mud, etc. | 4.55 (4.16–4.98) | 0.001 | 2.41 (2.18–2.65) | 0.001 |
|                            | Water with soap/detergent | Reference | Reference | 1.46 (1.27–1.67) | 0.001 | 1.57 (1.34–1.83) | 0.001 |
| Whether received any benefits from government scheme during last 3 years (related to drinking water) | Not received | Reference | Reference | 0.95 (0.91–0.98) | 0.001 | 1.29 (1.25–1.33) | 0.001 |
|                            | Received | 1.67 (1.63–1.71) | 0.001 | 1.68 (1.64–1.72) | 0.001 |

Estimated by the author from NSSO 76th Round, Schedule 1.20.

Note: P-values are at a 95% confidence interval. P-values < – 0.05 is considered as the significance level.

*Other sources include – tanker-truck: public and private; spring: protected and unprotected; rainwater collection, surface water: tank/pond and other surface water (river, dam, stream, canal, lake, etc.) and others (cart with small tank or drum, etc.).
| Table 5 | Factors associated with handwashing with soap/detergent and water post defaecation |
|---------|-------------------------------------------------------------------|
| Place of residence | Rural | Reference | Reference |
| | Urban | 3.50 (3.38–3.62) | 0.001 | 1.5 (1.42–1.57) | 0.001 |
| Empowered Action Group | EAG states | Reference | Reference |
| | Non-EAG states | 0.92 (0.89–0.95) | 0.001 | 0.54 (0.51–0.56) | 0.001 |
| Family size | Large (above six) | Reference | Reference |
| | Small (up to three) | 0.93 (0.89–0.98) | 0.006 | 0.73 (0.69–0.78) | 0.001 |
| | Medium (four to six) | 0.96 (0.92–1.00) | 0.058 | 0.85 (0.8–0.9) | 0.001 |
| Levels of education of the HH head | Illiterate | Reference | Reference |
| | Literate without formal schooling | 1.45 (1.26–1.66) | 0.001 | 1.27 (1.07–1.52) | 0.008 |
| | Below primary and primary | 1.36 (1.31–1.42) | 0.001 | 1.1 (1.05–1.16) | 0.001 |
| | Upper primary | 1.81 (1.73–1.89) | 0.001 | 1.27 (1.21–1.34) | 0.001 |
| | Secondary | 2.55 (2.43–2.67) | 0.001 | 1.34 (1.26–1.42) | 0.001 |
| | Higher sec. and above | 4.88 (4.65–5.13) | 0.001 | 1.68 (1.58–1.8) | 0.001 |
| Social group | Scheduled caste (SC) | Reference | Reference |
| | Scheduled tribe (ST) | 0.73 (0.69–0.76) | 0.001 | 0.95 (0.89–1.01) | 0.001 |
| | Other backward class (OBC) | 1.39 (1.33–1.44) | 0.001 | 1.02 (0.97–1.07) | 0.003 |
| Religious group | Muslim | Reference | Reference |
| | Hindu | 0.75 (0.71–0.78) | 0.001 | 0.92 (0.87–0.97) | 0.001 |
| | Christians | 0.39 (0.37–0.42) | 0.001 | 0.64 (0.58–0.7) | 0.001 |
| Usual Monthly Per Capita Expenditure | Poorest | Reference | Reference |
| | Poor | 1.22 (1.16–1.27) | 0.001 | 1.04 (0.98–1.1) | 0.205 |
| | Middle | 1.50 (1.43–1.57) | 0.001 | 1.03 (0.98–1.09) | 0.257 |
| Access to the principal source of drinking water | Access of the household to bathroom | No bathroom | Reference | Reference |
| | Neighbours source | 1.16 (1.08–1.24) | 0.001 | 1.09 (0.99–1.2) | 0.075 |
| | Common use of HHs in building | 2.92 (2.78–3.08) | 0.001 | 1.21 (1.12–1.31) | 0.001 |
| | Exclusive use of HH | 3.40 (3.29–3.52) | 0.001 | 1.34 (1.27–1.42) | 0.001 |
| | Others | 1.82 (1.72–1.92) | 0.001 | 0.89 (0.81–0.98) | 0.021 |
| Principal source of drinking water for household | Public tap/stand pipe | Reference | Reference |
| | Bottle and piped water into dwelling | 5.63 (5.34–5.93) | 0.001 | 0.94 (0.84–1.05) | 0.282 |
| | Piped water in plot and from neighbour | 2.36 (2.24–2.50) | 0.001 | 0.82 (0.73–0.92) | 0.001 |
| | Tube well/hand pump | 2.08 (1.98–2.17) | 0.842 | 1.05 (0.95–1.15) | 0.337 |
| | Well: protected and unprotected | 1.87 (1.75–1.99) | 0.001 | 0.93 (0.81–1.06) | 0.250 |
| | Other sources | 1.15 (1.06–1.24) | 0.001 | 1.07 (0.94–1.23) | 0.313 |
| Principal source of water for all household activities excluding drinking | Public tap/stand pipe | Reference | Reference |
| | Bottle and piped water into dwelling | 7.62 (7.19–8.07) | 0.001 | 1.97 (1.76–2.2) | 0.001 |
| | Piped water in plot and from neighbour | 2.68 (2.53–2.85) | 0.001 | 1.76 (1.57–1.97) | 0.001 |
| | Tube well/hand pump | 2.71 (2.58–2.85) | 0.001 | 1.47 (1.33–1.61) | 0.001 |
| | Well: protected and unprotected | 2.37 (2.21–2.53) | 0.001 | 1.44 (1.26–1.64) | 0.001 |
| | Other sources | 1.16 (1.08–1.23) | 0.715 | 1.08 (0.98–1.19) | 0.133 |
| Access of the household to bathroom | No bathroom | Reference | Reference |
| | Exclusive use of HH | 3.41 (3.31–3.51) | 0.001 | 1.17 (1.12–1.23) | 0.001 |
| | Common use of HHs in building | 3.65 (3.44–3.87) | 0.001 | 1.12 (1.02–1.22) | 0.019 |

(Continued.)
Table 5 | Continued

| Table 5 | Continued |

| Handwashing after defaecation | Access of the household to latrine | Availability of water in or around the latrine used | Whether received any benefits from government scheme during last 3 years for sanitation |
|-------------------------------|-----------------------------------|-----------------------------------------------|-----------------------------------------------|
|                               | Public/community use with or without payment and others | No latrine                                    | Not available                                  |
|                               | 1.29 (1.07–1.57)                     | 5.26 (5.08–5.44)                             | 0.28 (0.26–0.30)                              |
|                               | 0.001                                | 0.001                                         | 0.001                                         |
|                               | Reference                            | Reference                                     | Reference                                     |
|                               |                                     |                                               |                                               |
|                               | Exclusive use of HH                  | Common use of HHs in building                 | Water/water with mud, etc.                    |
|                               | 6.88 (6.33–7.48)                     | 4.60 (4.09–5.18)                             | 6.22 (5.75–6.72)                             |
|                               | 0.001                                | 0.001                                         | 0.001                                         |
|                               | Reference                            | Reference                                     | Reference                                     |
|                               |                                     |                                               |                                               |
|                               | Public/community latrine with or without payment and others | Water with soap/detergent                    | Received                                      |
|                               | 1.27 (1.01–1.58)                     | 1.27 (1.02–1.58)                             | 1.27 (1.01–1.58)                             |
|                               | 0.001                                | 0.001                                         | 0.001                                         |
|                               | Reference                            | Reference                                     | Reference                                     |
|                               |                                     |                                               |                                               |

Note: P-values < 0.05 is considered as the significance level.

who the access to the principal source of drinking water is from common use of households in the building and is exclusively for the households are 1.21 (AOR=1.21, 95% CI: 1.12–1.31) and 1.34 (AOR=1.34, 95% CI: 1.27–1.42) times more likely to wash hands with soap/detergent and water, respectively, than those using water from community sources. Households that depend on bottled and piped water into dwelling, piped water in plot from neighbour, tube well/hand pump, protected and unprotected wells for the principal source of water for all household activities excluding drinking are 1.97 (AOR=1.97, 95% CI: 1.76–2.00), 1.76 (AOR=1.76, 95% CI: 1.57–1.97), 1.47 (AOR=1.47, 95% CI: 1.33–1.61) and 1.44 (AOR=1.44, 95% CI: 1.26–1.64) times more likely to wash hands than those who use water from public taps/stand pipes. Households that depend on piped water in plot and from neighbours for the principal source of drinking water are 0.82 (AOR=0.82, 95% CI: 0.73–0.92) times less likely to wash hands after defaecation than those who use water from public taps/stand pipes. Households that have their own bathrooms are 1.17 (AOR=1.17, 95% CI: 1.12–1.23) times more likely to wash their hands after defaecation than those with no bathrooms. Households that use public/community latrines with or without payment are 2.79 (AOR=2.79, 95% CI: 2.29–3.41) times more likely to wash hands after defaecation than those who have no access to latrines. Households that have water available along with mud/sand around the latrines and those households that have soap/detergent available with water around latrines are 0.24 (AOR=0.24, 95% CI: 0.22–0.27) and 4.95 (AOR=4.95, 95% CI: 4.52–5.42) times, respectively, more likely to wash hands after defaecation than those who do not have water available around latrines.

**DISCUSSION**

The WHO’s preventive advisory guidelines related to hand hygiene to contain COVID-19 are not easy to follow by all sections of the population. Although water and sanitation occupy a place in Millennium Development Goals and Sustainable Development Goals, hygiene promotion and monitoring has received limited attention (Hirai et al. 2016). The differential handwashing practices across caste, class, consumption expenditure groups, regions and various other background characteristics reveal that although handwashing is a vital hygiene practice, it is far from being universal. The lack of adequate handwashing practices makes the population vulnerable to infections. The differential access to essential services across caste, ethnicity and classes is evident, and inclusive policies can help in the reduction of disparities (Desai & Dubey 2011; Kumar 2015). The EAG states are mostly in the lower phase of epidemiological transition and face health threats due to unsafe water, sanitation and handwashing (India State-Level Disease Burden Initiative Collaborators 2017). Handwashing practices are also towards the lower end of the spectrum in these states.

While it is understood that the dataset captures the picture before the onset of the COVID-19 pandemic, it must be noted that this paper aims to identify the vulnerable sections of the society which are in the lower end of the spectrum of...
handwashing compliance. The dataset is large enough to provide a macro picture of the situation prior to the pandemic and gives a fair idea of the handwashing behaviour of the people captured through two crucial moments of the day. Information on handwashing during two daily crucial instances helps us to understand the behaviour of the people regarding handwashing practices. Although minor changes may have been implemented, large-scale changes in behaviour are unlikely to have occurred. If compliance is not available during these vital moments, how much compliance can be anticipated during the newly emerging disease, is a question. The awareness creation strategies by the government shall definitely have an impact on the handwashing behaviour. But the general characteristics might act as an impediment towards its implementation. Identifying these vulnerable sections will help policymakers decide which sections of the population might need more attention regarding planning and implementation of strategies to combat COVID-19.

CDC (Centers for Disease Control and Prevention) recommends handwashing with soap and water whenever possible, but alcohol-based hand sanitizers may also be used (Kumar 2020). In both cases, awareness among people is important which can be effectively done through mass media. People are often aware of several health measures through mass media campaigns but are unable to practice them due to the lack of availability of proper facilities. Besides creating the awareness, the government also has to provide the facilities of water and soap through various avenues since not all people have access. Our study provides an insight that the beneficiaries of government schemes (related to drinking water) are more likely to wash hands regularly than others in the same category. Due to the localized nature of problems with the availability and accessibility of water and soap, steps can be taken at the disaggregated level for the creation of awareness as well as the distribution of soaps and sanitizers. Local volunteers may be directed to encourage people to practice frequent handwashing and distribute soaps, liquid soap and hand-sanitizing gel. These may also be provided in the PDS (Public Distribution System) shops along with basic food items, as mentioned in the Revamped PDS (1992). Regular supply of water in the localities has to be ensured to encourage people to practice handwashing.

CONCLUSION

Handwashing as an important preventive measure against infectious diseases needs more attention and monitoring. Handwashing practices are not universal across all sections of the population, making them vulnerable to infectious diseases. During the COVID-19 pandemic, it is crucial that every person, irrespective of their background, has access to basic facilities required to practice handwashing and maintain other hygiene practices. This paper helps to identify the vulnerable sections of the population who would require more attention in planning and implementing strategies to combat COVID-19 infections. Hand hygiene forms a part of the comprehensive package, which should be followed to prevent COVID-19 infections including the use of masks, physical distancing and following respiratory etiquette.

DATA AVAILABILITY STATEMENT

All relevant data are available from http://mospi.nic.in/unit-level-data-report-nss-76th-round-schedule-12-july-december-2018-drinking-water-sanitation.

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