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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
	Other backward class (OBC)	43,640	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	36.84
	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.*)

Table 1 | Continued

Background variables	Categories	*N*	Percent
Availability of water in or around the latrine used	Not available	3,073	2.88
	Water/water with mud, etc.	18,221	17.05
	Water with soap/detergent	67,030	62.74
Benefits received by the household from government schemes for drinking water during last 3 years	Received	1,759	1.65
	Not received	1,556	1.46
	Don't know	1,03,522	96.90
Benefits received by the household from government schemes for sanitation during last 3 years	Received	12,436	11.64
	Not received	2,161	2.02
	Don't know	92,240	86.34

Estimated from NSS 76th Round, Schedule 1.2.

independent socio-economic and demographic variables has been examined using the Chi-square test. Two separate logistic regression models are executed to examine the impacts of various determinants of handwashing before meals and after defaecation.

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,

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	97.83	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
	Maharashtra	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	4,895
	Goa	30.69	69.88	55.09	98.06	100	99.27	239
	Kerala	51.57	56.04	53.76	82.76	93.11	87.83	3,383
	Tamil Nadu	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	5,240
	Uttar Pradesh	16.87	44.78	23.79	75.6	96.15	80.69	12,423
	Bihar	12.22	30.81	14.29	66.65	90.99	69.36	6,993
	Jharkhand	3.28	32.84	10.56	50.56	86.53	59.41	2,565
	Odisha	9.22	42.16	15.11	46.34	83.42	52.96	3,671
	Chhattisgarh	33.27	56.87	38.14	84.07	98.23	86.99	2,125
	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	74.35	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	79.37	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
	Total	36.72	56.82	42.23	56.38	75.75	61.69	9,861
Union Territories	Chandigarh	100	79.96	80.97	100	97.27	97.41	192
	Delhi	55.97	73.92	73.5	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	73.9	34.24	38.42	95.16	97.03	96.84	144
	Puducherry	59.61	78.58	70.78	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.

$P<0.001$) and latrines (41.2, $P<0.001$). 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

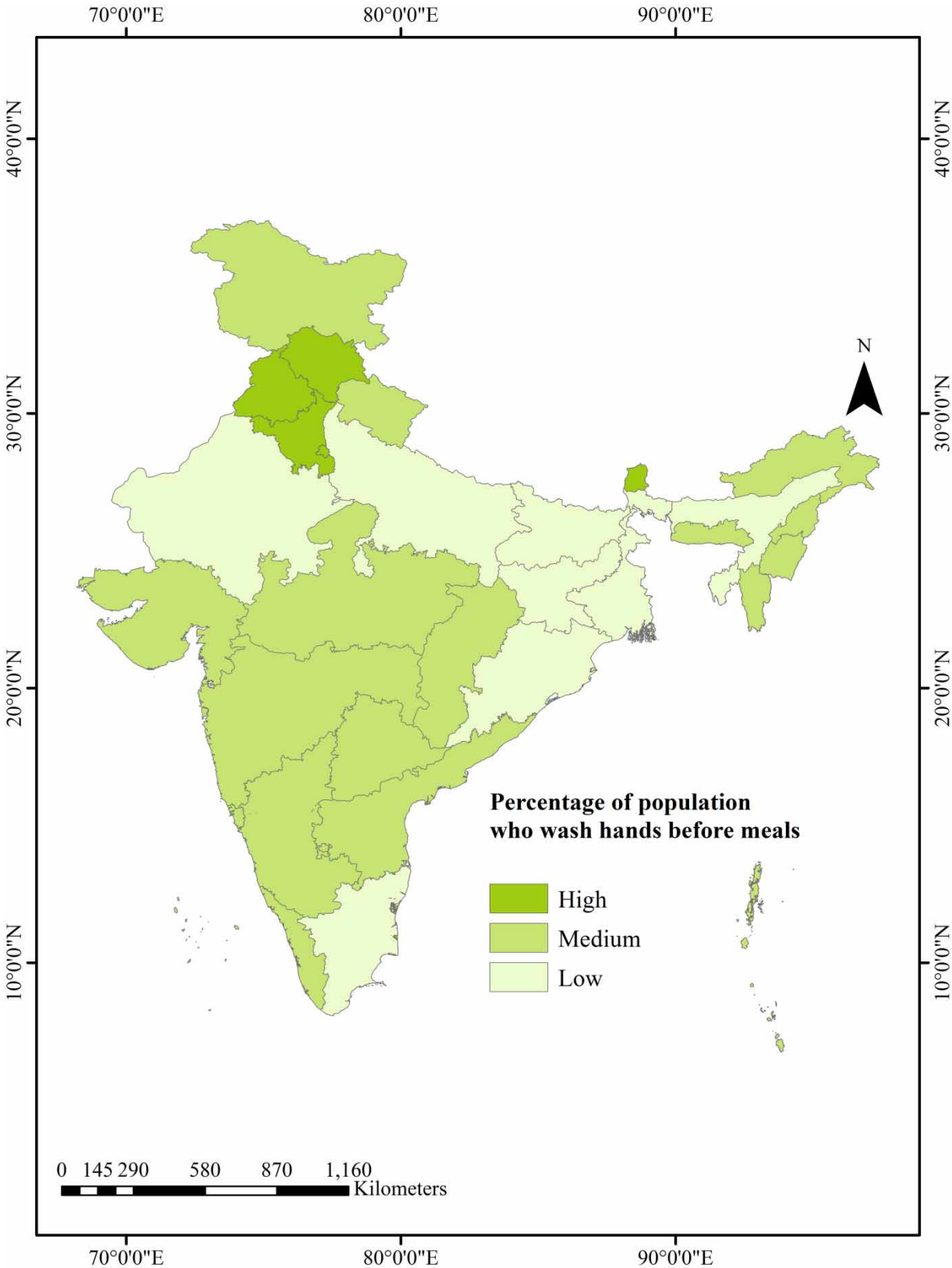

Figure 1 | Percentage of population who wash hands prior to meals in India, 2018 (data source: NSS 76th round, Schedule 1.2).

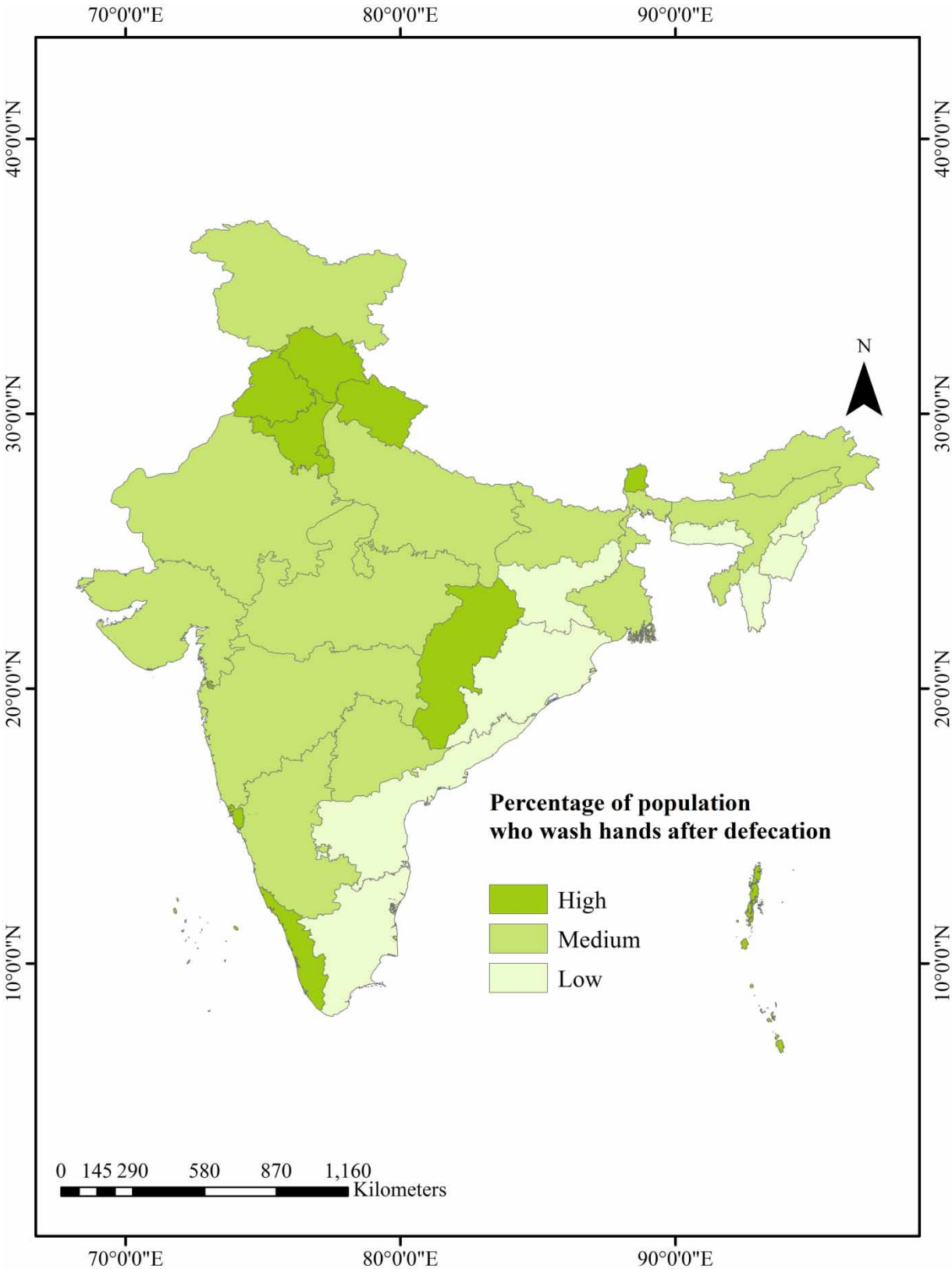

Figure 2 | Percentage of population who wash hands post defaecation in India, 2018 (data source: NSS 76th round, Schedule 1.2).

Table 3 | Bivariate statistics for the association between handwashing before meals and after defaecation with different background variables

		Washing hands with water and soap/detergent			
		Before meal		After defaecation	
Background variables	**Categories**	**Percentage**	***P*-value**	**Percentage**	***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.*)

Table 3 | Continued

Background variables	Categories	Washing hands with water and soap/detergent			
		Before meal		After defaecation	
		Percentage	*P*-value	Percentage	*P*-value
Access of the household to latrine	No latrine	11.18	0.001	47.02	0.001
	Own	41.2		82.21	
	Common	33.19		82.1	
	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.

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%, $P<0.001$).

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 benefitted 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 1.31 (AOR=1.31, 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), 1.13 (AOR=1.13, 95% 1.08–1.20), 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

Table 4 | Factors associated with handwashing with soap/detergent and water prior to meals

		Handwashing before meal			
Background characteristics	**Categories**	**Unadjusted odds ratio (UOR) Odds ratio (95% CI)**	***P*-values *P*>*z***	**AOR Odds ratio (95% CI)**	***P*-values *P*>*z***
Place of residence	Rural	Reference		Reference	
	Urban	3.14 (3.06–3.22)	0.001	1.40 (1.35–1.45)	0.001
Empowered Action Group	EAG states	Reference		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		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 head	Illiterate	Reference		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		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		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		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 (1.08–1.2)	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		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		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[a]	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		Reference	
	Bottle and piped water into dwelling	4.42 (4.18–4.68)	0.001	1.34 (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[a]	0.99 (0.92–1.06)	0.715	0.88 (0.8–0.97)	0.011
Access of the household to bathroom	No bathroom	Reference		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

(*Continued.*)

Table 4 | Continued

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

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.

[a]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.).

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 before meals 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, the principal source of drinking water for the household, access of the household to bathroom, the availability of latrine facilities and the availability of water in or around the latrine used and whether the household has benefitted from government schemes related to sanitation.

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 0.73 (AOR=0.73, 95% CI: 0.69–0.78) times less likely to wash hands than large 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 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% 1.26–1.45) times, respectively, more likely to wash hands than the poorest quintile. Households for

Table 5 | Factors associated with handwashing with soap/detergent and water post defaecation

		Handwashing after defaecation			
		UOR Odds ratio (95% CI)	*P*-values *P*>*z*	AOR Odds ratio (95% CI)	*P*-values *P*>*z*
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
	Others	3.22 (2.10–2.24)	0.001	1.68 (1.58–1.78)	0.001
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
	Others	1.27 (1.16–1.38)	0.001	1.29 (1.15–1.44)	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
	Rich	2.10 (2.01–2.20)	0.001	1.1 (1.03–1.16)	0.002
	Richest	5.14 (4.89–5.40)	0.001	1.35 (1.26–1.45)	0.001
Access to the principal source of drinking water	Community	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

		Handwashing after defaecation			
		UOR Odds ratio (95% CI)	*P*-values *P*>*z*	AOR Odds ratio (95% CI)	*P*-values *P*>*z*
	Public/community use with or without payment and others	1.29 (1.07–1.57)	0.001	0.99 (0.78–1.27)	0.952
Access of the household to latrine	No latrine	Reference		Reference	
	Exclusive use of HH	5.26 (5.08–5.44)	0.001	0.80 (0.68–0.95)	0.009
	Common use of HHs in building	5.78 (5.45–6.14)	0.001	1.21 (1.01–1.44)	0.043
	Public/community latrine with or without payment and others	4.60 (4.09–5.18)	0.001	2.79 (2.29–3.41)	0.001
Availability of water in or around the latrine used	Not available	Reference		Reference	
	Water/water with mud, etc.	0.28 (0.26–0.30)	0.001	0.24 (0.22–0.27)	0.001
	Water with soap/detergent	6.88 (6.33–7.48)	0.001	4.95 (4.52–5.42)	0.001
Whether received any benefits from government scheme during last 3 years for sanitation	Not received	Reference		Reference	
	Received	1.01 (0.91–1.12)	0.001	0.88 (0.77–1)	0.058

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.

whom 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: 1.76–2.20), 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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