ORIGINAL RESEARCH ARTICLE

Determinants of Access to Improved Drinking Water Source and Sanitation Facilities Towards Achieving Sustainable Development Goal-6 in India: Results from National Family Health Survey-5 (2019-2021)

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DOI: 10.55489/njcm.150820244018

ABSTRACT

Background: Sustainable development Goal (SDG) 6 is to "ensure availability and sustainable management of water and sanitation for all". This study aimed to estimate the proportion of households with access to improved drinking water source and improved sanitation facilities and identify predictors of access to improved drinking water source and improved sanitation facilities.

Methodology: We used data from the National Family Health Survey (NFHS-5). Improved sources of drinking water and Improved sanitation facilities were stratified by different socio demographic variables. Multivariate logistic regression was performed to estimate the determinants of Improved sources of drinking water and Improved sanitation facilities.

Results: The national level proportion of households' access to improved drinking water was 93.7% (95%CI 93.6%-93.8%) and access to Improved sanitation facilities was 78.8% (95%CI 78.7%-78.9%). The household related factors which had strong association with greater access to improved drinking water and sanitation facilities were households' residing in urban areas, wealth index of richest, residing in pucca houses, nuclear families and household with female as Head of the family (Hof).

Conclusions: Improvement in access is to be ensured among rural areas, households with poor wealth index and north, central, west and east states for achievement of SDG 6 by 2030.

Keywords: Sustainable development goals, Improved drinking water, improved sanitation, NFHS, India

ARTICLE INFO

Financial Support: None declared

Conflict of Interest: None declared

Received: 16-04-2024, **Accepted**: 12-06-2024, **Published**: 01-08-2024

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How to cite this article: Kumar DSS, Rao GV, Kondagunta N, Subash KR. Determinants of Access to Improved Drinking Water Source and Sanitation Facilities Towards Achieving Sustainable Development Goal-6 in India: Results from National Family Health Survey-5 (2019-2021). Natl J Community Med 2024;15(8):632-641. DOI: 10.55489/njcm.150820244018

www.njcmindia.com | pISSN: 0976-3325 | eISSN: 2229-6816 | Published by Medsci Publications

INTRODUCTION

Access to basic sanitation and to safe water is a fundamental human right and also a necessary step in maintaining and improving the living standards, health, human growth and development of the population. It is an important hurdle to achieve sustainable development.[1] Sanitation is a public measure that is essential for the health and wellbeing of any country. Improved Sanitation facilities are available only in 68% of the world's population with South Asian and Sub-Saharan Africa population having only 47% and 30% of the improved sanitation facilities respectively.[2-4] Among world population 13% of population are still practising open field defecation.[5] In 2015, the proportion of the global population with access to properly managed sanitation services was only 39%. Out of a total population of 5 billion, the majority had access to basic sanitation services. However, almost 600 million people had access to just minimal sanitation facilities. Additionally, a staggering 892 million individuals resorted to open field defecation or relied on unsatisfactory sanitation facilities.[6]

Sustainable Development Goal (SDG) 6 is to ensure universal access to clean water and sanitation, while also promoting responsible and long-term water resource management, by the year 2030.[7] The prevalence of infectious diseases such as typhoid, cholera, schistosomiasis, respiratory infections, and eye and skin infections can be mostly attributed to inadequate sanitation and lack of access to clean drinking water.[1,8,9] Current evidence suggest that, novel corona virus disease pandemic could prevented by providing safe water, sanitation and hygienic conditions. [10]

Globally, 123 million DALYs and more than 1.9 million deaths might have been prevented by improved access to water, hygiene and sanitation (WASH). More than 40% of the population in the world is affected by water scarcity and the percentage will rise in near future.[11] Water usage is more compared to restoration in the river basins where over 1.7 billion people are residing. At least 1000 children die daily because of water and sanitation related diarrheal diseases which are preventable. [5,6]

Various factors affect the access to improved sanitation and improved drinking water facilities. Most studies showed that, region of country, Sex of household heads, residence, age of household head, family size, educational level and marital status of the household heads predict the availability of the safe drinking water facilities and toilet facilities. [2,11-15]

Currently, a significant number of individuals, particularly those residing in rural regions, lack access to improved sanitation facilities, despite numerous efforts made to enhance sanitation facilities. Deshpande *et al* observed that even though sanitation facilities were improved in some regions, geographical disparity and poor quality of sanitation services are important barriers to accessibility to sanitary facilities and also in achieving SGD target.[16]

Srayasi Prakash et al observed that 50% of the population had access to improved sanitation services, while 21% of the population utilised unimproved facilities, which includes those who had no access to any services. Government should formulate state-oriented schemes so as to make betterment of the sanitation services as depicted by the State-level Deferential. The rural and urban differences in terms of accessibility to sanitation facilities should also be reduced. [17] Almost 88% of disease burden is attributed to lack of safe water and sanitation facilities. [18]

The UN Sustainable Development Goals (SDGs) include ambitious new targets to eliminate open defecation and achieve universal access to safely managed sanitation and drinking water services by 2030. India has also committed to achieve these goals by 2030. [19] In India there are no national level studies on improved access to safe sanitation and drinking water source by using latest National Family health survey-5 which was conducted in 2019-21. The present study is aimed to estimate the proportion of household access to improved drinking water source and improved sanitation facilities and to identify predictors of access to improved drinking water source and improved sanitation facilities.

METHODOLOGY

We used data from the 2019–2020, National Family Health Survey (NFHS-5) household level (IAHR7CFL) data which is a nationally representative household survey that covered each district in all 29 states and 7 union territories of India. [20]

The NFHS-5 has implemented uniform sample design that represents the entire nation, as well as individual states/union territories and districts. The methodology employed a two-stage cluster sampling technique. The initial phase was the selection of primary sampling units (PSUs), which are villages in rural regions and census enumeration blocks (CEBs) in urban areas. This selection was done using the probability proportional to size (PPS) technique.[21] In the second stage, a fixed number of 22 houses per cluster (i.e., PSUs) were chosen using the method of systematic random sampling from newly compiled lists of households residing in the selected PSUs. The list of households is generated by the process of mapping and listing households in each specified PSU prior to the household selection in the second step.[20]

The NFHS-5 survey collected data from a total of 636,699 households, 724,115 women, and 101,839 men. The collection of data was carried out by using 1,061 field teams. The composition of each team included a field supervisor, three female interviewers, one male interviewer, two health investigators, and a driver.

Among 636,699 households', 1939 households' data regarding sanitation facility and 2424 households' data drinking water facility was missing. Finally, 634760 households' and 634275 households were included for final analysis for improved sanitation and improved source of drinking water respectively.

Ethical approval was not needed as the analysis used secondary data available in the public domain. However Institutional Review board of Demographic and Health surveys programme approved the study protocol (AuthLetter_173946 dated 30, Sep 2022). The guidelines for data use as required by the DHS programme were strictly followed.

Dependant variable:

Improved sources of drinking water: Defined as household with piped water, public taps, standpipes, tube wells, boreholes, protected dug wells and springs, rainwater, tanker truck, cart with small tank, bottled water, and community reverse osmosis (RO) plants.[22,23]

Improved toilet facilities: Defined as household with any non-shared toilet of the following types: flush/pour flush toilets to piped sewer systems, septic tanks, pit latrines, or an unknown destination; ventilated improved pit (VIP)/biogas latrines; pit latrines with slabs; and twin pit/composting toilets.[22,23]

Independent variables:

Number of household members, Type of place of residence (rural/urban), gender of head of household (Hof), education of Hof (No education, Primary, secondary and higher), religion (Hindu, Muslim, Christian and others), caste (SC, ST, OBC, others), type of house (Pucca, Semi pucca, Kutcha), household structure (Nuclear and non-nuclear), Region of country (North, Central, East, North east, West and South), Wealth index (Poorest, poorer, middle, Richer and Richest).

Data analysis: House hold recode file (IAHR7CFL) having household level data was accessed from Demographic and Health surveys (DHS) programme.[20] The proportions of household with improved drinking water source and Improved sanitation facilities along with 95% confidence intervals (95% CI) has been estimated. The association between socio-demographic factors and improved drinking water source, Improved sanitation facilities was assessed through a bivariate analysis. A multivariate logistic regression model was used to examine the association between households' socio-demographic factors and improved drinking water source and improved toilet facilities. Variables with a p value <0.05 on bivariate analysis, variables with contextual importance were included in the final multivariate logistic regression. A p value <0.05 was considered statistically significant. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp was used for analysis.

RESULTS

Sample characteristics: During NFHS-5 survey, data from 636,699 households were collected during 2019-20. (Household recode file IAHR7CFL). Among them three fourths of households had less than 5 members in the family (74.2%) and were rural residents (74.6%). Majority of them were headed by men (82.5%) and age of Hof was more than 40 years (69.3%). Almost half of households' heads were educated up to secondary school (42.1%). Majority of household' heads were married (83.4%) and households belong to poorest wealth index (23.3%), other backward caste (36.6%). More than half of the households were living in pucca type of houses (53.8%) and nuclear families (58.6%). Three fourths of households belonged to Hindu religion (75.4%). One-fifth of households belong to population of central region (21.8%).

Among 636,699 households', 501,811 (78.8%, 95% CI 78.7%-78.9%) households had improved sanitation facility and 596,699 (93.7%, 95% CI 93.6%-93.8%) had improved drinking water source. 115137 (18.1%) of households had no toilet facility (i.e., open-filed defecation).

Table 1: Distribution according to source of drinking water in India (NFHS 5, 2019-20)

Source of drinking water	Households (%)
Piped into dwelling	121970 (19.2)
Piped to yard/plot	97198 (15.3)
Piped to neighbour	10726 (1.7)
Public tap/standpipe	80308 (12.6)
Tube well or borehole	212311 (33.3)
Protected well	23265 (3.7)
Unprotected well	23009 (3.6)
Protected spring	7183 (1.1)
Unprotected spring	6304 (1)
River/dam/lake/ponds/stream/ canal/irrigation channel	8263 (1.3)
Rainwater	2927 (0.5)
Tanker truck	7249 (1.1)
Cart with small tank	1404 (0.2)
Bottled water	15881 (2.5)
Community RO plant	16277 (2.6)
Other	2424 (0.4)
Total	636699 (100)

Table 2: Distribution according to type of toilet facility in India (NFHS 5, 2019-20)

Type of toilet facility	Households (%)
Flush to piped sewer system	46562 (7.3)
Flush to septic tank	285642 (44.9)
Flush to pit latrine	87929 (13.8)
Flush to somewhere else	4959 (0.8)
Flush, don't know where	892 (0.1)
Ventilated Improved Pit latrine (VIP)	4085 (0.6)
Pit latrine with slab	41092 (6.5)
Pit latrine without slab/open pit	9826 (1.5)
No facility/bush/field	115137 (18.1)
Composting toilet	30650 (4.8)
Dry toilet	7986 (1.3)
Other	1938 (0.3)
Total	636698 (100)

It is observed that majority of households had piped water supply (36.1%) followed by tube well or bore-hole (33.3%). 2.5% and 2.6% of households were using bottled water and community RO plant respectively. (Table 1)

Majority of households had flush to septic tank type of toilet (44.9%) followed by flush to pit latrine (13.8%). 18.1% households had no toilet facility i.e., open filed defecation. (Table 2)

From table 3 it was observed that households' residing in urban areas, households' with female head of the family (Hof), Hof with age >40 years, Hof with higher education status, Hof with marital status separated/divorced/widow/widowed, households' of Muslims religion, Caste other than SC/ST/OBC, wealth index of richest, residing in pucca houses, nuclear families and households' belonging to southern states had significantly better access to improved sources of drinking water.

Table 3: Socio demographic factors wise distribution of improved sources of drinking water and Improved sanitation facilities in India (NFHS 5, 2019-20)

Variable	*Households'	Improved sources of drinking water % (95% CI)	Improved toilet Facilities % (95% CI)
No. of household members			
<5	472218	94.1 (93.9-94.2)	79.4 (79.3-79.5)
≥5	162542	93.9 (93.8-94.1)	78.0 (77.8-78.2)
Place of residence			
Urban	159513	98.4 (98.3-98.5)	93.6 (93.5-93.7)
Rural	475247	92.5 (92.4-92.6)	74.2 (74.0-74.3)
Sex of Hof			
Male	525669	93.9 (93.8-94.0)	79.5 (79.4-79.7)
Female	109075	94.4 (94.3-94.5)	76.7 (76.4-79.0)
Age of Hof			
<40 years	192854	93.5 (93.4-93.6)	74.0 (73.8-74.2)
≥40 years	441906	94.2 (94.1-94.3)	81.2 (81.1-81.4)
Education of Hof			
No education	188449	93.1 (92.9-93.2)	67.4 (67.2-67.6)
Primary	117369	92.9 (92.7-93.0)	76.9 (76.7-77.2)
Secondary	268334	94.5 (94.4-94.6)	84.7 (84.5-84.8)
Higher	60052	97.2 (97.0-97.3)	94.7 (94.5-94.9)
Marital status of Hof			
Never married	12671	94.1 (93.7-94.6)	80.9 (80.2-81.6)
Married/living together	531920	94.0 (93.9-94.1)	79.2 (79.1-79.3)
Separated/divorced/widow/widowed	90057	94.3 (94.1-94.4)	78.0 (77.7-79.3)
Wealth index			
Poorest	147949	87.5 (87.4-87.7)	48.8 (48.5-49.1)
Poorer	140635	92.7 (92.5-92.8)	72.3 (72.0-72.5)
Middle	128704	95.7 (95.5-95.8)	88.4 (88.2-88.5)
Richer	114800	97.7 (97.6-97.8)	97.4 (97.3-97.6)
Richest	102672	99.0 (98.9-99.1)	99.7 (99.6-99.8)
Caste			
SC	122525	96.0 (95.9-96.1)	73.4 (73.1-73.6)
ST	123019	86.5 (86.3-86.7)	73.9 (73.6-74.1)
OBC	233453	95.7 (95.6-95.8)	78.6 (78.4-78.8)
Others	124064	96.2 (96.1-96.3)	89.9 (89.7-90.0)
Type of house			
Kachha	37516	89.5 (89.2-89.9)	58.5 (58.0-89.0)
Semi-pucca	245319	91.4 (91.3-91.5)	68.5 (68.3-68.7)
Pucca	343250	96.4 (96.3-96.5)	88.9 (88.8-89.0)
Type of family			
Nuclear	373429	93.8 (93.7-93.9)	77.5 (77.4-77.7)
Non-Nuclear	261331	94.4 (94.3-94.5)	81.2 (81.0-81.4)
Religion			
Hindu	480803	94.7 (94.6-94.8)	76.5 (76.4-76.6)
Muslim	72195	95.7 (95.6-95.9)	83.1 (82.8-83.4)
Christian	49531	85.6 (85.3-85.9)	91.7 (91.5-92.0)
Others	32231	93.4 (93.1-93.7)	88.4 (88.1-88.8)
Region of states			
North	121524	96.0 (95.9-96.2)	86.4 (86.2-86.6)
Central	138488	94.9 (94.8-95.1)	74.2 (74.0-74.4)
East	103207	93.4 (93.2-93.5)	64.1 (63.8-64.4)
Northeast	93803	86.4 (86.2-86.7)	89.7 (89.5-89.9)
West	65344	94.8 (94.6-95.0)	78.1 (77.8-78.5)
South	112394	97.1 (96.9-97.2)	82.5 (82.2-82.7)

*Missing values were excluded from analysis; Hof-Head of the Family

Table 4: Association between sociodemographic factors and improved sources of drinking water and Improved sanitation facilities in India (NFHS 5, 2019-20)

Variable	Improved sources of drinking water		Improved toilet facilities	
	UOR (95% CI)	AOR (95% CI)	UOR (95% CI)	AOR (95% CI)
Household members				
<5	1	1	1	1
≥5	0.920 (0.907-0.933)	0.99 (0.96-1.02)	0.99 (0.96-1.01)	0.87 (0.86-0.89)†
Place of residence				
Urban	1	1	1	1
Rural	0.20 (0.19-0.21)	0.49 (0.47-0.52)†	0.19 (0.19-0.20)	0.84 (0.82-0.87)†
Sex of Hof				
Male	1	1	1	1
Female	1.08 (1.05-1.11)	0.95 (0.93-0.98)†	0.85 (0.83-0.86)	1.01 (0.98-1.03)
Age of Hof				
<40 years	1	1	1	1
≥40 years	1.16 (1.14-1.19)	1.39 (1.36-1.41)†	1.52 (1.50-1.54)	1.38 (1.35-1.40)†
Education of Hof				
No education	1	1	1	1
Primary	0.97 (0.94-1.00)	1.23 (1.20-1.25)†	1.61 (1.58-1.64)	1.23 (1.20-1.25)†
Secondary	1.29 (1.26-1.33)	1.25 (1.23-1.28)†	2.67 (2.63-2.71)	1.25 (1.23-1.28)†
Higher	2.85 (2.70-3.01)	1.42 (1.36-1.49)†	8.70 (8.38-9.03)	1.40 (1.32-1.47)†
Marital status of Hof				
Never married	1	1	1	1
Married	0.99 (0.92-1.7)	0.83 (0.76-0.90)†	0.90 (0.86-0.94)	0.89 (0.84-0.94)†
Widow/ widower	1.04 (0.96-1.13)	0.84 (0.77-0.92)†	0.84 (0.80-0.88)	0.98 (0.93-1.04)
Wealth index				
Poorest	1	1	1	1
Poorer	1.84 (1.79-1.88)	2.08 (2.02-2.14)†	2.73 (2.69-2.77)	3.18 (3.12-3.24)†
Middle	3.29 (3.19-3.39)	3.64 (3.50-3.79)†	7.99 (7.80-8.11)	10.99 (10.70-11.29)†
Richer	6.56 (6.28-6.85)	6.61 (6.26-6.98)†	40.03 (38.54-41.58)	56.79 (54.29-59.40)†
Richest	18.28 (17.02-19.62)	16.07 (14.73-17.52)†	382.18 (339.80-429.84)	491.39 (433.39-556.28)†
Caste				
SC	1	1	1	1
ST	0.26 (0.25-0.27)	0.45 (0.43-0.46)†	1.03 (1.01-1.04)	1.20 (1.00-1.05)†
OBC	0.94 (0.90-0.97)	0.78 (0.75-0.81)†	1.34 (1.31-1.36)	0.99 (0.97-1.01)
Others	1.08 (1.04-1.13)	0.69 (0.66-0.72)†	3.22 (3.15-3.29)	1.36 (1.32-1.39)†
Type of house				
Kachha	1	1	1	1
Semi-pucca	1.26 (1.22-1.31)	0.88 (0.84-0.91)†	1.54 (1.51-1.58)	0.96 (0.94-0.99)†
Pucca	3.29 (3.17-3.42)	0.64 (0.61-0.67)†	5.69 (5.56-5.82)	0.77 (0.75-0.79)†
Type of family				
Nuclear	1	1	1	1
Non-Nuclear	1.14 (1.11-1.16)	0.89 (0.87-0.91)†	1.25 (1.23-1.27)	1.02 (1.00-1.04)†
Religion				
Hindu	1	1	1	1
Muslim	1.20 (1.15-1.24)	1.14 (1.09-1.20)†	1.51 (1.48-1.54)	1.31 (1.28-1.35)†
Christian	0.33 (0.32-0.34)	0.81 (0.78-0.85)†	3.40 (3.29-3.51)	2.12 (1.03-2.21)†
Others	0.83 (0.80-0.87)	1.09 (1.03-1.15)†	2.34 (2.26-2.42)	1.32 (1.27-1.39)†
Region of states				
North	1	1	1	1
Central	0.76 (0.73-0.79)	1.39 (1.33-1.45)†	0.45 (0.44-0.46)	1.40 (1.37-1.44)†
East	0.58 (0.56-0.61)	1.25 (1.20-1.30)†	0.28 (0.27-0.29)	1.03 (1.00-1.06)†
Northeast	0.26 (0.25-0.27)	0.61 (0.59-0.61)†	1.37 (1.33-1.40)	4.21 (4.06-4.37)†
West	0.74 (0.71-0.77)	1.01 (0.97-1.06)	0.56 (0.55-0.57)	0.73 (0.71-0.75)†
South	1.42 (1.35-1.48)	1.45 (1.37-1.52)†	0.74 (0.72-0.75)	0.80 (0.78-0.82)†

*Missing values were excluded from analysis, Hof-Head of the family, UOR-Unadjusted odds ratio, AOR- Adjusted odds ratio, †=statistically significant

53479 (10.3%) of household had shared toilet facility with other households. Households' residing in urban areas, households' with less than 5 individuals in the family, households' with male head of the family (Hof), households' with Hof age more than 40 years, Hof with higher education status, Hof with marital status married and living together, households' of Muslims religion, Caste other than SC/ST/OBC, wealth index of richest, residing in pucca houses, non-nuclear families and households' belonging to northeast states had significantly better access to improved sanitation facilities. (Table 3)

Table 4 showed that rural residents had a 50.1% less likelihood of having access to improved drinking water sources compared to urban residents (AOR=0.498, 95% CI 0.475-0.521). Female-headed households had a 5% less likelihood of having access to improved drinking water sources compared to

male-headed households (AOR=0.951, 95% CI 0.927-0.976). Households where the head of the family is above 40 years old were 1.38 times more likely to have access to improved drinking water sources compared to households where the head of the family is below 40 years old (AOR=1.388, 95% CI 1.365-1.411).

Households with heads who had higher education were 1.42 times more likely to have improved drinking water sources compared to households with heads who had no formal education (AOR=1.423, 95% CI 1.360-1.489). The probability of having access to improved drinking water sources was 16% less in households where the head of the family was widowed, compared to households where the head of the household had never been married (AOR=0.844, 95% CI 0.773-0.923).

Compared to the poorest households, households with poorer wealth index had a 2.07 times higher probability of having access to improved drinking water sources. Middle-income households had a 3.64 times higher probability, richer households had a 6.61 times higher probability, and the richest households had a 16.06 times higher probability of having access to improved drinking water sources. ST households had a 55.2% less likelihood of having access to improved drinking water sources compared to SC families (AOR=0.448, 95% CI 0.431-0.464).

Households living in pucca houses had a 35.7% less likelihood of having access to improved drinking water sources compared to households living in kachha houses (AOR=0.643, 95% CI 0.614-0.673). Non-nuclear families were 11.1% less likely to have access to improved drinking water sources compared to nuclear families (AOR= 0.889, 95% CI 0.866-0.912). Muslim families were 1.14 times more likely to have access to improved drinking water sources compared to Hindus (AOR=1.143, 95% CI 1.090-1.199). Additionally, households in southern states were 1.45 times more likely to have access to improved drinking water sources compared to households in northern states (AOR=1.446, 95% CI 1.375-1.520).

Rural households had a 15.7% less likelihood of having access to improved sanitation facilities compared to urban residents (AOR=0.843, 95% CI 0.821-0.866). Households consisting of more than 5 family members had a 12.5% less likelihood of having access to improved sanitation facilities compared to households with less than 5 family members (AOR=0.875, 95% CI 0.858-0.892). Households where the head of the family is above 40 years old had a 1.37 times higher likelihood of having access to better sanitation facilities compared to households where the head of the family is below 40 years old (AOR=1.376, 95% CI 1.353-1.399).

Households with heads who had higher education were 1.40 times more likely to have improved sanitation facilities compared to households with heads who had no formal education (AOR=1.402, 95% CI 1.339-1.467). The probability of having access to improved sanitation facilities was 10.8% less in households with married heads compared to those who were never married (AOR=0.892, 95% CI 0.844-0.942).

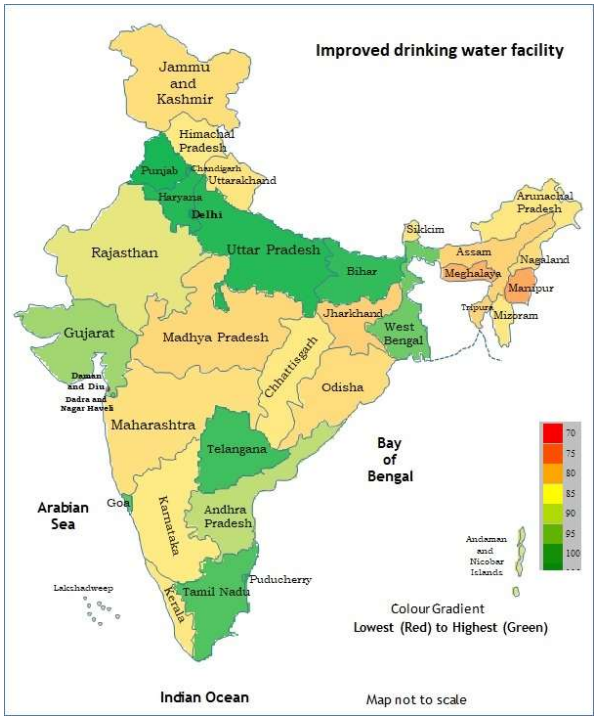

Figure 1: Heat map of India map showing prevalence of improved drinking water source (NFHS 5, 2019-20)

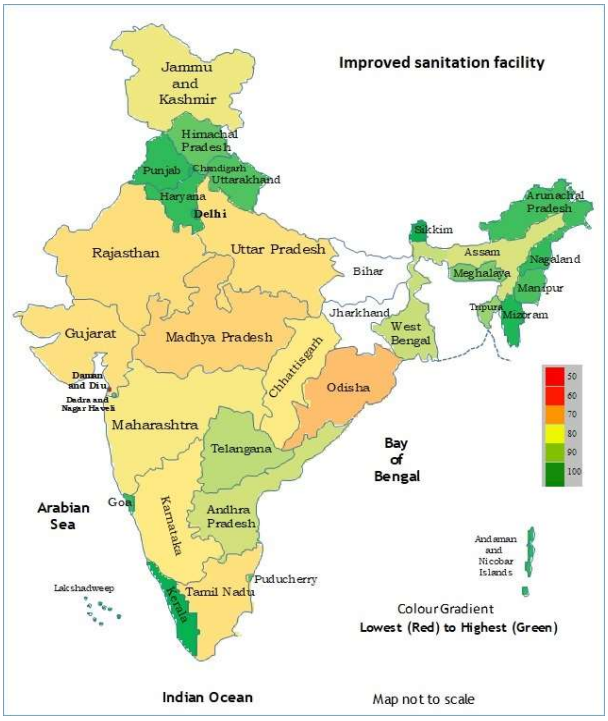

Figure 2: Heat map of India map showing prevalence of sanitation facility in states (NFHS 5, 2019-20)

Compared with poorest households, poorer (AOR=3.179, 95% CI 3.118-3.240), middle-income (AOR=10.99, 95% CI 10.705-11.294), richer (AOR=56.790, 95% CI 54.292-59.404) and richest (AOR=491.39, 95% CI 433.39-556.27) households were 3.17, 10.95, 56.79 and 491.39-times higher likelihood of having access to improved sanitation facilities, respectively.

Households not belonging to the ST, SC, or OBC castes had a 1.35 times higher likelihood of having access to better sanitation facilities (AOR=1.356, 95% CI 1.320-1.393). Households residing in pucca houses had a 23.1% less likelihood of having access to improved sanitary facilities (AOR=0.769, 95% CI 0.746-0.793) compared to families living in kutcha houses. Non-nuclear families were 1.01 times more likely to have access to improved sanitary facilities compared to nuclear families (AOR= 1.018, 95% CI 1.000-1.036). Christian families were 2.21 times more likely to have access to improved sanitary facilities compared to Hindu families (AOR=2.121, 95% CI 1.033-2.212). Households from the North East states were 4.21 times more likely to have access to improved sanitary facilities compared to households in the North states. (AOR=4.213, 95% CI 4.062-4.370). (Table 4)

Figure 1 shows the variation among states and union territories in the proportion of households with improved drinking water facility and sanitation facility. Households with improved drinking water source varied from 69.5% (95% CI 68.5%-70.6%) in Manipur to 99.8% (95% CI 99.7%-99.9%) in NCT of Delhi. Households with improved sanitation facility varied from 57% (95% CI 56.5%-57.6%) in Bihar to 99.5% (95% CI 99.3%-99.6%) in Kerala and 100% in Lakshadweep.

Discussion

In this study, we aimed to estimate the proportion of households with access to improved drinking water source and improved sanitation facilities and identify predictors. The national level proportion of households' access to improved drinking water was 93.7% (95% CI 93.6%-93.8%) and access to Improved sanitation facilities was 78.8% (95% CI 78.7%-78.9%).

In this study, living in urban areas, having wealth index of the richest, living in pucca houses, being a member of a nuclear family, and having a woman as the head of the household were among the household-related characteristics that were substantially connected with having greater access to better drinking water and sanitation services. Households in southern states had greater access to improved drinking water while those in northern states and those with higher educational status had better access to improved sanitary facilities.

The national level data shows that 93.7% (95% CI 93.6%-93.8%) of households had improved access to drinking water. The percentage of households in Ethiopia that have access to improved drinking water sources was 69.94% (95% CI 69.23% to 70.63%)[4] which was lower than this study and studies from Ghana[2], Viet Nam[15] and Eswatini[13] Also a Nepalese study reported lower than in present study.[14]

The percentage of households with improved access to sanitary facilities was 78.8% (95% CI 78.7%-78.9%). An analysis of the National Sample Survey (NSS) 2018 data, using the JMP global ladder for sanitation, revealed that the highest proportion (52%) in India is accounted for by safely managed sanitation facilities, followed by no services (20.2%), basic services (14.8%), and limited services (11.4%).[17] In Ethiopia, the proportion of households with access to toilet facilities was 25.36% (95% CI: 24.69% to 26.03%).[4] The findings of this study were comparatively lower than those of the studies conducted in Ghana[2], Nigeria[24], and Vietnam[15]. The disparities may arise from variations in the countries' gross domestic product (GDP) status, literacy rate, study period, and setting.

This study found that the proportion of Households with access to improved sanitation is greater in the northeast states (89.7%) followed by northern states (86.4%). According to a study that analyzed NSS 2018 data, the central region had the greatest utilization rate of safely managed services at 62%, followed by the west region at 59.8%. Households in Central India are likely to have 0.452, East 0.280, Northeast 1.368, West 0.561 and South 0.738 times access to improved sanitation compared to households in North India. In comparison to the north region, the south region had a 2.98-fold higher likelihood of having basic sanitation services, while the northeast region had a 2.49-fold higher likelihood. On the other hand, the eastern region had a 1.60-fold higher likelihood of having limited sanitation services. The likelihood of unimproved sanitary facilities in the northeast region was 78% less compared to the north region.[17]

Lakshadweep has the highest percentage of safely managed services at 96.8%, followed by Sikkim (89.0%), Himachal Pradesh (81.5%), and Kerala (81.5%).[17] This study found Kerala (99.50%) has the best access to improved sanitation closely followed by Sikkim (99.20%) and succeeded by NCT of Delhi (98.50%).

The survey revealed that families residing in urban areas had a higher likelihood of having access to better sanitation facilities (93.6%) compared to households in rural regions (6.4%). When compared to urban areas, rural areas are expected to have 0.196 times the access to better sanitation based in a related study[17], urban regions had a greater proportion (64.8%) of access to safely maintained sanitation services compared to rural areas (45.3%). Urban residences were 1.72 times more likely to have inadequate sanitary facilities than rural homes. Several

other earlier studies have also noted the gap between rural and urban populations' access to better supplies of drinking water and toilet facilities.[11,25,26] The disparity may be caused by the fact that most people in these regions reside in rural areas and have low economic standing. They lack the money necessary to access better drinking water sources and toilet facilities as a result.

In this study, houses with more than five people were 0.875 times likely to have access to better toilets than households with fewer people. Another study found that households consisting of four to six individuals were 24% less likely to have access to improved toilet facilities, as compared to households with one to three individuals.[17] This goes against the findings of an earlier study.[2] The theory is that the more people living in a place, the less money they have to spend on better sanitary facilities.

Households headed by women (Hof) had a considerably higher rate of access (94.4%) and were 1.081 times more likely to have access to improved sources of drinking water. Families headed by women in Ethiopia had a 1.18 times higher likelihood of having access to better drinking water sources compared to families headed by men.[4] Ghana [2], Vietnam [15], and Nigeria [15] all reported findings that were similar. Gender disparities may be a significant factor in how work is divided in developing nations. The majority of the time, women are responsible for more demanding home tasks like fetching water, cleaning the yard, caring for children, and preparing meals. In light of the possibility that women are busy with activities other than WASH on a daily basis, this may be directly related to water and sanitation.

In this study, families with a man as the head of the family had a higher percentage of access to improved sanitation (79.5%). Comparing male and female heads of households, it is anticipated that females will have 0.864 times more access to improved sanitation. According to a study, households with male heads had services that were more safely managed (52.7%) than those with female heads (47.2%). Female-headed homes had 1.28 times the likelihood of having minimal sanitation services, 1.12 times the likelihood of having unimproved sanitation facilities, and 1.10 times the likelihood of having basic sanitation services compared to male-headed households.[4]

In this study, families with head of the family having higher education had significantly higher percentage of access to improved sanitation (94.7%) and 1.402 times more access to improved sanitation. Better educational status among the head of the home increased the likelihood of using improved toilet facilities by 2.21 times. [17] Evidence from earlier studies lends credence to this study's findings. [13,24,27] Households with heads who lack education had a decreased likelihood of having access to toilet facilities. Education is a significant component for good health results in these regions, and educated individuals are typically more aware of the circumstance that ensures their wellbeing. This suggests that educated family heads may have employed their resources to upgrade the toilets in their homes.

In this study the percentage of households having access to improved sanitation is higher among Christians (91.7%). Muslim households are likely to have 1.509, Christians 3.396 and others 2.339 times more access to improved sanitation compared to Hindu Households. According to a study[17], the 'other' category of religion had a higher usage of safely managed sanitation services (60.5%). Muslims were 1.51 times more likely than non-Muslims to have only basic sanitary services and in the Hindu religion, compared to non-Muslims who were 1.04 times more probable. As Christians were grouped into other category the other category had better sanitation facilities compared to this study, where Christians as a separate category have better access to sanitation facilities. Both the studies agreed that Hindu Households have the least access to sanitation facilities.[17] One explanation for the unimproved services among Hindus may be due to some religious considerations of using toilet facilities inside the home. Religious convictions influencing the practise of open defecation were mentioned in another study carried out in the neighbouring nation of Nepal.[14]

This study found that the proportion of households with access to improved sanitation is greater among Castes other than SC/ST/OBC (89.9%), with OBC having the second highest percentage (78.6%). ST households are expected to have 1.026 times greater access to improved sanitation compared to SC households, whereas OBC households are expected to have 1.336 times greater access, and families from other categories are expected to have 3.126 times greater access. Based on the analysis of NSS 2018 data, the general category exhibits the highest percentage of safely managed services (66%), followed by the OBC category (51.1%).[17] Households belonging to the ST caste had a 4.68 times higher likelihood of having unimproved sanitation facilities and a 1.92 times higher likelihood of having basic sanitation services compared to the general category. SC caste households were 1.60 times more likely to have limited sanitary conditions.[17]

In this study the percentage of Households having access to improved sanitation is higher in wealth index of richest (99.7%). Poor households are likely to have 2.733 time, Middle 7.995, Rich 40.03, Richest 382.178 times more access to improved sanitation compared to Poorest households. According to a study, rich households had the highest percentage of services that were safely managed.[17] In comparison to the poor, the middle class and wealthy classes were 49% and 76% less likely, respectively, to have unimproved sanitation facilities, whereas the poor were 80% and 12% more likely, respectively, to have restricted sanitation services. According to Ethiopian study, families in the poorest, middle, and richest wealth index categories had odds of accessing im-

proved toilet facilities that were 3.97, 5.82, 8.58, and 23.94 times higher than those in the worst category.[4]

households in the poor, middle, richer, and richest wealth index categories had 1.48, 2.42, 3.26, and 6.97 times higher likelihood, respectively, of having access to improved sources of drinking water compared to families in the poorest category.[4] This study reveals that poor households have 2.076 times less access to improved drinking water compared to the richest households. Middle-income households have 3.642 times less access, while rich households have 6.610 times less access. The richest households have 16.067 times greater access to improved drinking water compared to the poorest households. This result is consistent with the findings made in previous studies.[4,12,13,28]

This study classified the outcome dependent variable into two categories as access to improved sanitation and no access to improved sanitation. A multivariate logistic regression model was used to examine the association between households' socio-demographic factors and access to improved sanitation. The model used no access to improved sanitation as reference category and Odds Ratios were calculated for socio-demographic factors. The study on NSS 2018 data and Ethiopian study classified the outcome dependent variable into five categories as safely managed services, basic services, limited services, unimproved services and no services. Secondly, to quantify the impact of various factors on sanitation services, a multinomial logistic regression and Multilevel binary logistic regression models were used in those studies.[4,17] To avoid a limited sample in either category, NSS study combined two categories "unimproved services" and "no services" to create this model. The model reported the relative risk ratio for each group, including basic, limited, and unimproved, with improved facility as the reference category.[17] The differences in outcomes and values of these studies could be explained due to the differences in the categorization of outcome dependent variables, the regression models and the reference categories used in the data analysis.

The study is conducted using a large and nationally representative sample that was obtained with a focus on ensuring adequate quality assurance and standard operational criteria. Hence, this study finding can be generalizable. The study conducted a stratified analysis that examined how access to improved drinking water and sanitation facilities varies based on different msociodemographic characteristics. However, the study has few limitations. There might be recall bias as information was collected retrospectively in NFHS-5, and the analysis was cross sectional, which prevents causal inferences.

Conclusion

Finally, we concluded that, Proportion of households with improved drinking water in India was more than 90% but improved sanitation was around 80%. Improvement in access is to be ensured among rural areas, households with poor wealth index and north, central, west and east states for achievement of SDG 6 by 2030. Government of India and policy makers need to focus among rural areas, households with poor wealth index and north, central, west and east states in India for achievement of SDG 6 by 2030. Health education should be directed towards specific households belonging to rural areas, Hindu religion, SC/ST Castes and households with no education background. Improving the economic situation and literacy of the household are the largest drivers to enhanced access to improved drinking water and sanitation facilities.

Acknowledgement

The authors would like to acknowledge and thank Demographic and Health Surveys (DHS) Program for providing the data set (survey ref no. 173946 downloaded on 30, Sep 2022) which helped in the development of the manuscript.

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