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Data Article

Data on water, sanitation, and hygiene in six select metro cities of India

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ABSTRACT

The purpose of this data article is to describe the data and provide the methodological notes on the construction of availability, accessibility, and overall Water, Sanitation and Hygiene (WASH) performance index using a set of thirteen indicators for six metro cities in India. It also presents the details on survey design and the nature of data collected on WASH indicators in India Human Development Survey for 2004–05 (IHDS-I) and 2011–12 (IHDS-II). The principal component analysis (PCA) procedure was used in the construction of the WASH indices. The IHDS is the only survey that provides comprehensive data on WASH indicators for six metro cities in India (Delhi, Mumbai, Kolkata, Chennai, Hyderabad, & Bangalore). The IHDS has been jointly conducted by researchers from the National Council of Applied Economic Research (NCAER), New Delhi and the University of Maryland, the United States of America (USA). The database is hosted in the public repository at the Inter-University Consortium for Political and Social Research (ICPSR) and the reference number for IHDS-I and IHDS-II are ICPSR 22626 and ICPSR 36151 respectively. The data are publicly available through ICPSR. Interpretation of the present data can be found

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in the research article titled "Availability, accessibility, and inequalities of water, sanitation, and hygiene (WASH) services in Indian metro cities" (Saroj et al., 2019) [9].

Specifications Tables

Subject Area	Economics, Geography, Demography
Specific subject area	Household basic amenities (water, sanitation, & hygiene)
Type of Data	Tables and Figures
How data was acquired	The unit-level data of the IHDS-I & II were allowed to download upon registration and permission from the ICPSR.
Data Format	The unit-level raw data was recoded and analyzed in Stata and presented in the form of tables and figures https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/22626; https://www.icpsr.umich.edu/icpsrweb/ICPSR/studies/36151; https://data.mendeley.com/datasets/fjgkp5mcnj/1.
Parameters for data collection	IHDS data is a multi-topic panel survey of households in India. It covered the topics related to household characteristics, amenities, health, education, employment, economic status, demographic characteristics and gender relations, and social capital. It also surveyed separately the children's (8–11 years old) education quality (reading, writing and arithmetic tests). Additional information also collected at the village, school and medical facility levels. Further, information on the above-said indicators were also collected for the six metro cities [Delhi, Mumbai, Kolkata, Chennai, Bangalore, & Hyderabad] separately.
Description of data collection	IHDS data were collected in all states and union territories in India, except Andaman & Nicobar and Lakshadweep. It had surveyed household samples in IHDS-I round [N = 41,554] and re-interviewed 83% in IHDS-II round [42,152 households]. A stratified random sampling method was used to collect rural samples in 1503 villages and the probability proportional to size (PPS) method was used to collect urban samples in 971 blocks. Detail description of the data collection method has given in the following links: https://www.icpsr.umich.edu/icpsrweb/content/DSDR/idhs-data-guide.html & https://www.icpsr.umich.edu/icpsrweb/content/DSDR/idhs-II-data-guide.html
Data source location	National Council of Applied Economic Research (NCAER), New Delhi and the University of Maryland, USA.
Data accessibility	The raw data is located in the public repository of ICPSR: https://doi.org/10.3886/ICPSR22626.v12 for 2004–05 & ICPSR: https://doi.org/10.3886/ICPSR36151.v6 for 2011–12. The data is also included in this research.
Related research article	Shashi Kala Saroj, Srinivas Goli, Md. Juel Rana, and Bikramaditya K. Choudhary, Availability, Accessibility, and Inequalities of Water, Sanitation, and Hygiene (WASH) Services in Indian Metro Cities, Sustainable Cities and Society 2019, https://doi.org/10.1016/j.scs.2019.101878/In Press.

Value of the Data

- The data used in this article are freely available in the public domain at the ICPSR.
- The data for two panels (2004–05) & (2011–12) are processed and uploaded with this article so that other researchers working in this area will not have to download and process the raw data again.
- IHDS is a nationally representative, a multi-topic repeat survey with a huge sample of 41,554 and 42,152 households, also for the first-time separately available for eight major states of India.
- The datasets provide guidance on the analytical methods to research, monitor, and evaluate the WASH program in India.
- The information on WASH for eight major cities are valuable for the policy and practice in academia and the government.

1. Data description

The datasets presented in this article was collected as a part of India Human Development Survey (IHDS)-I (2004–5) and IHDS-II (2011–12) [5,6] with a special representative sampling design adopted for six largest populated cities in India, namely, Mumbai, Delhi, Bangalore, Hyderabad, Chennai, and Kolkata (Table 1). They are coded as 1–6 in the variable "Metro6". These metro cities are identified according to the census 2001, the definition of "urban agglomerations" [3,4]. These six cities also represent the major four geographical regions of India (Mumbai from the West, Delhi from the North, Kolkata from the East and Chennai, Bangalore and Hyderabad from the South). This article shows the data description and methodological note for preparing the WASH indices. Table 1 presents the descriptive statistics of the sample for selected six metro cities from the IHDS-I and IHDS-II. Table 2 describes the socio-economic characteristics of the households: educational level of the head of the household, economic status, occupation of the household's head; social and religious affiliation of the households among the six metro cities in both the rounds of IHDS. Table 3 describes the outcome variables, which were used in the WASH availability and accessibility index construction by the six metro cities for 2004–05 and 2011–12. About 13 indicators have been selected to create WASH availability and accessibility indices. Table 4 describes the Eigenvalues of the WASH availability and accessibility indices for 2004–05 and 2011–12. Similarly, Fig. 1 displays the scree plot of the Eigenvalues of the WASH availability components for the year 2004–05 and 2011–12; while Fig. 2 displays the scree plot of Eigenvalues for the WASH accessibility components, for both the year.

2. Experimental design, materials, and methods

2.1. Data

2.1.1. Sample

Table 1 describe the sample size of the selected six metro cities of India. The IHDS longitudinal surveys collected the household data for the selected cities in 2004–05 [N = 4133], and 2011–12 [N = 3912] [3]. The share of the sample in 2004–05, was 32.1%, 26.9%, 14.2%, 11.1%, 08.7%, and 07.0% for Delhi [n = 1326], Kolkata [n = 1114], Mumbai [n = 585], Hyderabad [n = 457], Bangalore [n = 360], and Chennai [n = 291] respectively. Almost, same pattern is visualized in the 2011-12 samples of these six metro cities.

2.1.2. Background variables

The socio-economic characteristics of the households are described in detail in Table 2. The table shows that the percentage of households with non-poor economic status has increased from 88.4% to 91.9% from 2004–05 to 2011–12. In 2004–05, among the socio-religious groups, the majority of the population belongs to the Hindu General Castes (32.6%), followed by Other Backward Classes (OBC) (27.6%), Scheduled Caste (SC) (24.2%), Muslims (11.4%), and Christian population (02.9%). In 2011–12,

Table 1
Descriptive statistics of the data for six Metro cities.

Metro cities	2004–05		2011–12	
	n	Percent	n	Percent
Mumbai	585	14.15	524	13.39
Delhi	1326	32.08	1266	32.36
Kolkata	1114	26.95	1079	27.58
Chennai	291	07.04	259	06.62
Bangalore	360	08.71	351	08.97
Hyderabad	457	11.06	433	11.07
Total	4133	100	3912	100

Source: IHDS-I & IHDS-II Round survey.

Table 2
Description of households' background characteristics among the six Metro cities of India, 2004–05 and 2011–12.

Background Characteristics	Mumbai		Delhi		Kolkata		Chennai		Bangalore		Hyderabad		Total	
	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12
Education level of the head of the household														
Illiterate	29.57	27.86	45.27	51.98	44.83	51.86	36.31	43.53	25.00	62.39	82.19	80.21	44.83	51.22
Primary	27.18	26.53	05.10	04.22	14.75	15.09	02.55	03.84	11.67	05.98	06.68	04.59	12.78	12.04
Secondary	36.58	38.17	39.64	33.53	30.54	26.32	55.86	41.79	53.61	24.79	08.77	12.00	34.65	29.28
Higher	06.67	07.44	09.99	10.28	09.89	06.73	05.28	10.84	09.72	6.84	02.35	03.19	07.74	07.46
Economic status														
Poor	13.16	00.57	11.28	06.33	16.42	13.54	04.74	14.27	03.33	04.84	07.29	04.49	11.60	08.07
Non Poor	86.84	99.43	88.72	93.67	83.58	86.46	95.26	85.73	96.67	95.16	92.71	95.51	88.40	91.93
Occupation of the head of the household														
Primary	37.44	59.54	36.44	38.94	49.37	47.52	47.60	27.15	36.94	39.60	69.17	68.82	46.36	48.57
Secondary	11.79	10.50	14.34	24.22	12.58	23.99	21.78	43.11	14.17	24.50	08.84	13.99	13.39	21.99
Tertiary	43.08	27.29	35.17	34.86	27.73	27.47	19.02	23.42	38.89	33.62	16.48	16.38	30.25	27.39
No Occupation	7.69	02.67	14.05	01.98	10.33	01.02	11.60	06.32	10.00	02.28	05.52	00.81	10.00	02.04
Social categories														
General Hindu	43.42	48.28	39.33	32.40	40.81	40.54	5.20	04.93	27.78	11.68	12.38	10.64	32.56	31.31
OBC	27.01	28.05	21.30	23.70	12.63	10.48	44.82	40.57	40.00	51.28	53.22	49.44	27.55	26.78
SC	17.95	15.46	18.53	24.58	25.50	27.25	44.25	46.29	11.67	20.51	26.12	29.38	24.20	26.19
ST	01.03	00.95	00.43	01.11	03.00	03.02	00.00	00.00	00.83	02.85	00.41	01.30	01.33	01.75
Muslims	05.64	03.63	16.49	15.33	17.87	18.52	02.42	03.61	08.61	07.69	06.35	08.22	11.44	11.76
Christians and Others	04.96	03.63	03.91	02.88	00.18	00.19	03.30	04.60	11.11	05.98	01.51	01.02	02.93	02.21
n	585	524	1326	1266	1114	1079	291	259	360	351	457	433	4133	3912

Source: IHDS-I & IHDS-II Round survey.

Table 3
Description of variables used in WASH Availability and Accessibility index in the six Metro cities of India, 2004–05 and 2011–12.

Variables	Mumbai		Delhi		Kolkata		Chennai		Bangalore		Hyderabad		Total	
	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12
WASH Availability index														
Source of drinking water														
(0) Open well, river, pond, truck, others	01.03	00.19	04.82	08.99	00.47	00.94	04.62	03.40	01.11	08.83	03.77	07.22	02.33	03.94
(1) Piped water, tube well, hand pump, covered well, rain and bottled water	98.97	99.81	95.18	91.01	99.53	99.06	95.38	96.60	98.89	91.17	96.23	92.78	97.67	96.06
Timing of water supply														
(0) < 1 hour	28.55	56.87	33.15	40.46	65.07	61.14	74.92	52.52	70.00	30.20	80.93	52.92	55.38	52.51
(1) > 1 hour	71.45	43.13	66.85	59.54	34.93	38.86	25.08	47.48	30.00	69.80	19.07	47.08	44.62	47.49
Toilet facility available														
(0) Open defecation	54.87	13.36	17.30	14.03	33.66	13.45	36.33	28.51	2.22	05.98	44.07	40.89	34.81	18.19
(1) Traditional latrine, VIP latrine, flush toilet	45.13	86.64	82.70	85.97	66.34	86.55	63.67	71.49	97.78	94.02	55.93	59.11	65.19	81.81
Hand wash after defecation														
(0) No	00.17	21.37	00.62	09.32	00.31	23.15	00.22	59.28	–	–	06.12	46.69	01.08	28.32
(0) Yes	99.83	78.63	99.38	90.68	99.69	76.85	99.78	40.72	–	–	93.88	53.31	98.92	71.68
Drinking water storage														
(0) Unhygienic storage (without lid)	01.54	08.40	14.25	29.16	13.36	17.74	01.34	18.60	49.72	14.81	–	25.80	10.10	19.28
(1) Hygienic storage (with lid)	98.46	91.60	85.75	70.84	86.64	82.26	98.66	81.40	50.28	85.19	–	74.20	89.90	80.72
Housing space														
(0) More than 3 persons per room	28.72	05.53	30.48	31.21	15.89	24.53	19.99	10.36	18.06	13.96	20.67	19.09	22.36	19.71
(1) 3 or less persons per room	71.28	94.47	69.52	68.79	84.11	75.47	80.01	89.64	81.94	86.04	79.33	80.91	77.64	80.29
Kitchen (Cooking place)														
(0) Within living area	34.53	26.34	28.98	35.21	35.68	30.76	35.40	20.44	3.06	06.27	44.84	41.27	33.67	29.84
(1) Separate from living area	65.47	73.66	71.02	64.79	64.32	69.24	64.60	79.56	96.94	93.73	55.16	58.73	66.33	70.16
Type of house														
(0) Kutcha	39.15	14.12	27.18	15.11	60.88	52.90	28.84	21.88	30.56	22.22	92.44	47.94	49.23	33.01
(1) Pucca	60.85	85.88	72.82	84.89	39.12	47.10	71.16	78.12	69.44	77.78	7.56	52.06	50.77	66.99
WASH Accessibility index														
Time taken to access to water														
(0) More than half an hour (>30 minutes)	08.38	06.87	19.82	47.43	45.41	79.06	62.15	55.46	02.78	34.47	56.35	39.96	34.44	49.50
(1) Less than half an hour (<30 minutes)	91.62	93.13	80.18	52.57	54.59	20.94	37.85	44.54	97.22	65.53	43.65	60.04	65.56	50.50

(*continued on next page*)

Table 3 (*continued*)

Variables	Mumbai		Delhi		Kolkata		Chennai		Bangalore		Hyderabad		Total	
	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12	2004–05	2011–12
Location of toilet														
(0) Open defecation	01.88	02.86	09.83	08.51	16.41	11.17	30.05	23.02	01.94	01.99	19.74	36.60	13.55	13.10
(1) Within dwelling, inside or outside the premises, public toilet	98.12	97.14	90.17	91.49	83.59	88.83	69.95	76.98	98.06	98.01	80.26	63.40	86.45	86.90
The material used for hand wash														
(0) Ash, mud, water only	06.32	03.05	10.41	07.66	38.28	27.43	58.56	46.56	02.78	22.22	55.64	42.21	29.51	22.51
(1) Soap	93.68	96.95	89.59	92.34	61.72	72.57	41.44	53.44	97.22	77.78	44.36	57.79	70.49	77.49
Purification of drinking water														
(0) Rarely, sometimes, never	86.15	75.00	85.25	79.39	90.79	91.91	99.06	89.81	97.78	78.63	91.09	72.29	90.19	82.70
(1) Always	13.85	25.00	14.75	20.61	9.21	8.09	0.94	10.19	2.22	21.37	8.91	27.71	09.81	17.30
Method of Pouring water														
(0) Cups, utensils, hand	68.89	64.89	39.61	58.63	77.10	82.45	95.60	97.71	93.89	59.26	98.43	93.44	74.27	76.02
(1) Long ladle or tap	31.11	35.11	60.39	41.37	22.90	17.55	04.40	02.29	6.11	40.74	01.57	06.56	25.73	23.98
Type of fuel used in cooking														
(0) Firewood, cow dung, crop residue, coal, or charcoal	83.25	61.45	90.06	92.62	79.25	75.55	93.57	86.18	96.11	80.06	89.48	78.93	85.93	78.04
(1) LPG and kerosene	16.75	38.55	09.94	07.38	20.75	24.45	06.43	13.82	03.89	19.94	10.52	21.07	14.07	21.96
n	585	524	1326	1266	1114	1079	291	259	360	351	457	433	4133	3912

Note: (0) represents the disadvantageous category, (1) represents the advantageous category.
(–) represents the lack of samples.
Source: IHDS- I & II Round survey

Table 4
Eigenvalues of the WASH indexes 2004–5 and 2011–12.

Components	2004–05		2011–12	
	Eigen values	Difference	Eigen values	Difference
WASH availability				
1	1.995	0.739	1.847	0.641
2	1.256	0.258	1.206	0.235
3	0.998	0.072	0.971	0.078
4	0.926	0.216	0.893	0.113
5	0.710	0.119	0.780	0.106
6	0.591	0.068	0.704	0.075
7	0.523	.	0.599	.
WASH accessibility				
1	1.563	0.535	1.650	0.596
2	1.028	0.025	1.054	0.097
3	1.003	0.074	0.957	0.083
4	0.929	0.083	0.874	0.083
5	0.846	0.215	0.791	0.117
6	0.631	.	0.674	.

Source: IHDS 2004–05 & 2011–12.

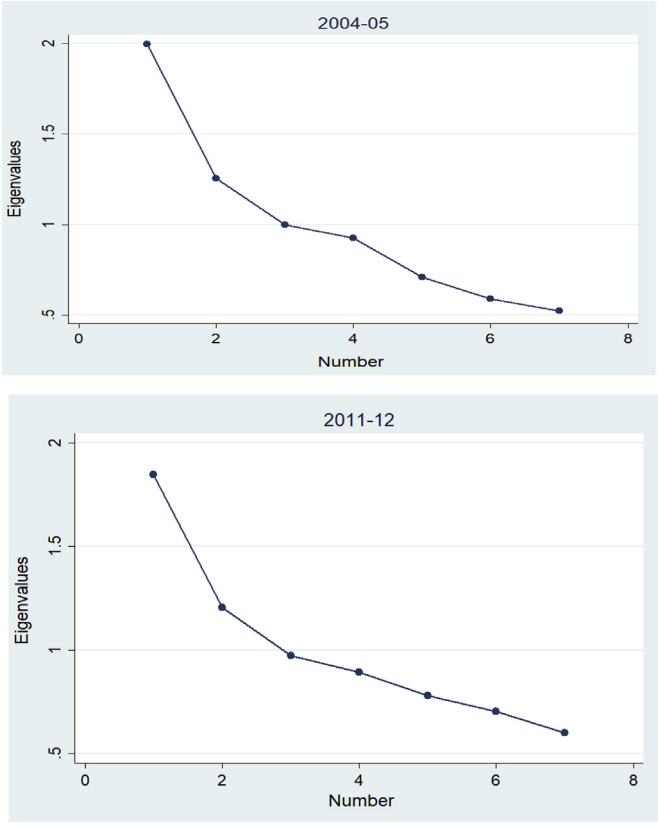

Fig. 1. Scree plots of Eigenvalues of WASH availability index in 2004–05 and 2011-12 Source: IHDS (2004–05 & 2011–12).

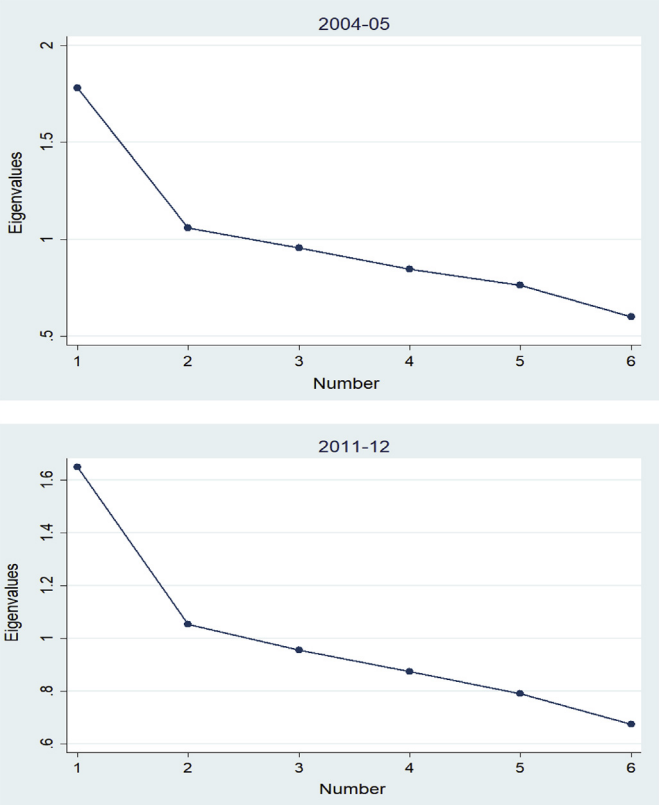

Fig. 2. Scree plots of Eigenvalues of WASH accessibility index in 2004–05 and 2011-12 Source: IHDS (2004–05 & 2011–12).

except for the SC population, the percentage of all other socio-religious categories have decreased during 2004–05 to 2011–12. In 2004–05, 46.4% of the households heads involved in the primary occupation, while 30.25% of them work in the tertiary sector followed by 13.4% in secondary sector occupation. In 2011–12, there is a decline in the tertiary sector, while an increase in primary and secondary occupations. Mumbai, Delhi, and Bangalore have a greater share of households with high socio-economic status vice-versa the Kolkata, Hyderabad, and Chennai.

2.1.3. Outcome indicators (WASH availability and accessibility)

Table 3 presents the description of the variables which were used in the construction of WASH availability and accessibility indices. In 2004–05, among these six metro cities, Mumbai (98.9%), Kolkata (99.5%), and Bangalore (98.8%) has larger number of households with improved source of drinking water (piped, tube well, hand pump, covered well, rain and bottled water) than Delhi (95.2%), Chennai (95.3%), and Hyderabad (96.2%). Except for Mumbai and Chennai, other cites show the decline in the availability of improved sources of drinking water from 2004–05 to 2011–12. All city average of availability of improved sources of drinking water has declined from 97.7% in 2004–05 to 96.1% in 2011–12. However, more than one-hour water supply has slightly increased from 44.6% to 47.5% from 2004–05 to 2011–12, especially in Hyderabad (19.1%–47.1%), Chennai (25.1%–47.5%) and Bangalore (30.0%–69.8%). The availability of improved toilet facilities has increased from 65.2% to 81.8%, mainly in Mumbai (45.1%–86.6%), Kolkata (66.3%–86.6%), Chennai (63.7%–71.5%), Delhi (82.7%–85.9%), and Hyderabad (55.9%–59.1%). Similarly, the housing density (three or < 3 persons per room) has also improved from 77.6% to 80.3% from 2004–05 to 2011–12, in which Mumbai (71.3%–94.5%), Chennai

(80.0%–89.6%), and Bangalore (81.9%–86.1%) have greater improvement than others. Similarly, the overall percentages of *pucca* houses have got better from 50.8% in 2004–05 to 66.9% in 2011–12, almost in all six cities. Furthermore, the separate kitchen from the living area has also increased from 66.3% to 70.2% for both the years, notably in Chennai (64.60%–79.56%), Mumbai (65.5%–73.7%), Kolkata (64.3%–69.2%), and Hyderabad (55.2%–58.7%), but Bangalore (96.9%–93.7%) and Delhi (71.0%–64.8%) have slight decline. In addition, the improved material used for hand wash (soap) is increased from 70.5% to 77.5%. Similarly, the percentage of households' always using purified drinking water (09.8%–17.3%) and improved cooking fuel (LPG and Kerosene) (14.1%–21.9%) has increased between 2004–05 and 2011–12. Whereas, the safe drinking water storage (hygienic storage with lid) has reduced from 89.9% to 80.7% and 25.7%–23.9%, respectively, within the same period.

2.2. Statistical analysis

The WASH availability, accessibility, and overall performance have been estimated, separately, for both the period, 2004–05 and 2011–12. The indicators taken for the construction of the composite indices of the WASH availability, accessibility, and overall performance are presented in Table 3. The variables considered for the availability and accessibility indicators were transformed into a generalized linear form by creating dummy variables, which dichotomized as '0' for disadvantageous and '1' for the advantageous group. PCA has been used to estimate the score for availability and accessibility separately for both survey rounds. Scree plots from the PCA have been displayed in Figs. 1 and 2. The Eigenvalues in the PCA of WASH availability and accessibility show the deviation between the components. The first two components (components 1 and 2) have Eigenvalue more than 1 and gives an 'elbow' like shape. The steep slope between the component 1 and 2 shows that the majority of the variables are explained by the first component, in both the WASH availability and accessibility indexes, for both the rounds [7]. Table 4 shows the values of the Eigenvalue of components, in which around 50% of the variance is explained by the first two dimensions in the component space. The overall performance of WASH is the average of availability and accessibility scores. The scores for availability, accessibility, and overall performance were ranked in ascending order and divided into three equal classes for both rounds of the survey which labeled as 'poor', 'middle' and 'better-off' WASH performance. The items used for the construction of both availability and accessibility were tested for their validity, reliability, and suitability. All analyses are carried out using the STATA software, version 13 (*pca, predict p1,* and *xtile*) (StataCorp) [10].

The WASH inequality had measured at the city level by using the Gini, Theil and Atkinson indices. The Gini coefficients provide city-wise households level inequality estimation. Along with the city level inequality estimates, the Theil and Atkinson indices allow estimating intra and inter-city inequalities. The Theil's index is the single parameters of the General Entropy class (GE a = 1); while the Atkinson index incorporates the social value judgment of the people about inequality in the society [1,2,8].

Association between the WASH and socioeconomic factors of the households was analyzed by using the *order logit* regression model as the WASH is the ordinal outcome variable [poor (1), middle (2) and better-off (3)]. Three separate regression models were carried out for availability, accessibility, and overall performance of WASH (see reference [9] for the results). The background characteristics are economic status, educational level, socio-religious groups and occupational status of the households is mentioned in Table 2.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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