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Original Research Article

A study on water, sanitation and hygiene practices among the urban slum dwellers of Vellore, Tamil Nadu, India

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ABSTRACT

Background: Water, sanitation and hygiene are global concerns for both WHO and UNICEF. The sustainable development goal had targeted improved water sources, but the target of improved sanitation facilities was missed by almost 700 million people worldwide. The less developed and developing nations (like India) did not meet both the targets.
Methods: A community-based cross sectional study was conducted in the urban slums of Vellore using the systematic random sampling method. Data was analyzed using frequency and WASH scoring. Further bi-variate and multivariate analyses was done using chi-square test and logistic regression. A total number of 140 households were surveyed using a semi-structured, pilot-tested questionnaire.
Results: It was found that 65% of the study population (n=140) had poor wash score (<8). Among the 12 exposure variables analyzed, it was found that three variables had significant association with a poor WASH score (<8), which were: having more than 4 members in a household; living in a kutcha house, and consumption of municipal water.
Conclusions: The study showed that the majority of the people dwelling in urban slums in Vellore do not have sufficient knowledge regarding good hygiene practices. A good knowledge regarding proper hygiene practices and the availability of proper facilities is crucial in improving sanitary conditions in the community.

Keywords: Hygiene, India, Sanitation, Urban slums, WASH

INTRODUCTION

Globally, 780 million people lack access to an improved water source, an estimated 2.5 billion people lack access to an improved sanitation (35% of world population), and when we look at deaths from diarrheal diseases in children, approximately 88% of them are due to unsafe drinking water and lack of access to proper sanitation.[1] How has the world responded to this crisis? One of WHO's efforts of the 2030 Agenda, called the WASH initiative, was set up with the goal "to (sic) ensure availability and sustainable management of water and sanitation for all" by the year 2030.[2] An earlier initiative known as the Millennium Development Goals had missed its target by 800 million people, most of them from underdeveloped and developing nations.[3]

In India, the Swachh Bharat Mission or Clean India campaign the flagship sanitation programme of the Indian government aims to realize the dream of a 'Clean India' by 2nd October 2019, the 150th birth anniversary of Mahatma Gandhi.[4] And the good work has already produced some fruits. As of July 2017, two states in India (out of 29) - Gujarat and Andhra Pradesh have been declared OPF (open defecation free).[5] But is it enough? In India, approximately 569 million (about half of the population) still practices open defecation, and it is estimated that more than 500 people under the age of 5 die from diarrhoea in India alone in a single day.[6]

A study done by the Water and Sanitation Program of the World Bank estimates that sanitation costs India the equivalent of 6.4% of its GDP.[7] Similar studies have been done in India, and in Vellore itself. However, limited data is available regarding the factors affecting the WASH practices in urban slums in South India. Keeping this in mind we carried out this study with the objective to study the availability, utilization and practices related to WASH and the factors affecting the same in the urban slums in Vellore District. This article can serve to identify bottlenecks so that appropriate interventions can be made in the future.

METHODS

The study was conducted in the month of March 2017 and deployed a community-based cross-sectional study design. Similar studies have been done previously, for example in Madhya Pradesh and in the Dibrugarh district of Assam.[8,9] This study was carried out in the urban slums of Vellore, which have been geographically divided into four zones: Tharapadavedu, Chenbekkam, Raja Theatre and Sathuvachari.

Table 1: Methodology of selecting households for study in each of the 4 slums.

Zone	Slum	No. of households	Sampling interval
Tharapadavedu	MGR Nagar	70	70/35=2nd house
Chenbakkam	Kansalpettai	163	163/35=5nd house
Raja Theatre	Ammananguttai	113	113/35=3rd house
Sathuvachari	Thalayari maniyam	105	10/35=3rd house

Table 2: Questions included in WASH scoring.

Q No.	Question	Options	Score
C3	How do you store water?	a. Closed	1
		b. Open	0
C4	Do you boil water before drinking?	a. Yes	1
		b. No	0
D1	Type of toilet	a//b/c. Using toilet	1
		d/e. Open defecation	0
D2	Presence of stagnant or sewage water?	a. Yes	1
		b. No	0
F2	When do you usually wash your hands with soap?	b,c,e,f - all four	1
		Less than above	0
F3	How often do your family members bathe?	a. Everyday	1
		b. Others	0
F5	Roughly after how many days of usage do you wash clothes?	a. Everyday	1
		b. Others	0
D3	Drainange System	a. Open	1
		b. Closed	0
E1	How do you dispose solid wastes?	a/b/c	1
		d	0
E2	How often are the above methods followed?	a. Everyday	1
		b. Others	0
E3	Presence of solid waste piles near the house?	a. Yes	0
		b. No	1
F1	How frequently do you cut your nails?	a. At least once in 2 weeks	1
		b. Others	0

A strict schedule for the study was created and followed. The study respondents were adults aged 18 years and above who are permanent residents of the household of interest. Mentally ill patients, bed ridden patients or those who were not permanently residing in the household of interest were excluded from the study. To obtain an appropriate sample size, we applied the formula:[10]

$n=Z^2[(p)(1-p)]/d^2$

According to the Committee on Slum Census and Statistics 2011, the prevalence of poor sanitation practices in Indian slums was as high as 81%.[11] Therefore based on anticipated population proportion P= 81%, and taking an absolute precision of 10%, and a design effect of 2:

$n = [(1.96)^2 \times 0.81 \times (1-0.81)] / (0.1)^2 \times 2$

$= 118$

Assuming a non-response rate of 10%, the final sample size was calculated to be 140 (rounded up from 135.12). Using an online true random number generator, one urban slum was selected from each of the 4 geographical zones of Vellore district.[12] Since the sample size is 140, each slum would contribute 35 households to the study. Using systematic random sampling method (Table 1), each of the 140 households were selected for the study. A semi-structured questionnaire adapted from the WHO WASH questionnaire consisting of 43 questions was used for this study.[13] The questionnaire was pilot-tested prior to the actual study and a few changes were made. The final questionnaire was then used for the duration of the study.

Informed written consent was obtained from the participants, who were assured confidentiality and anonymity of information collected. The independent study variables were age, gender, religion (Hindu/others), education and occupation of household head, socioeconomic status of family (Modified Kuppusamy Scale), type of family (extended/joint/nuclear). Dependent variables were water, sanitation and hygiene practices. By calculating and pre-selecting the households that we will interview (nth house, depending on the number of households in the slum), we are able to have a systematic approach to minimize selection bias. Doing the above also eliminates bias that comes from judging a household's SES based on the outward appearance of the house (mansion, pucca, kutcha etc). To reduce social-desirability bias, a walk was conducted around the dwellings in the slums and observations were made. The observations were then compared with the interviewee statements and assessment was made. To reduce interviewer bias, we had structured interviews (questionnaire) written in the local language to allow the interviewee to read while the questions were being asked. However being human, there would be a chance of some element of bias present. Out of the 32 questions in the questionnaire, 12 were selected and scored. A score of 1 was given for a good WASH option and a bad WASH option was scored 0. Out of a maximum possible score of 12, a score of 8 and above was considered as Good WASH status (75th percentile) while a score below 8 was regarded as a Poor WASH status (Table 2). Checklist used for observational walk: public toilets, open defecation, open drains, waste disposal sites, flood areas, market, school, community centre, animals, place of worship, public taps, surface water area. The data for each of the above variables was looked out for and compared side by side with the other 3 slums. For data analysis, we presented it as various data sets. Categorical variables were expressed as proportions while continuous variables were expressed as means with standard deviation. A chi square test was then performed to determine if there was a significant association between any of the variables with WASH status. Further multivariate logistic regression analysis was done to determine which variables had a significant effect on WASH practices.

RESULTS

Majority of the study participants belonged to the age group of 21-30 years (27%). Majority of the study participants who were interviewed were women (84%), as the men were mostly out at work during our visiting hours. More than ¾th of the study participants were Hindus (88%) and majority of them were either uneducated or had attended up till middle school (both 29% each). More than half of the study population had some form of unskilled work (54%).

A high number of them belonged to the upper lower socioeconomic group (68%) (According to the modified Kuppusamy's scale). Majority of the study population lived as a nuclear family (68%) and more than half lived in a pucca dwelling (52%) (Table 3). Of the 140 household studied, 35% of them scored a good WASH score of 8 and above (75th percentile) whereas the remaining 65% of them had a WASH score of below 8 (poor WASH) (Table 4). Out of the 4 slums, Kansalpettai registered the highest percentage of households with good WASH status (45.7%). Multivariate logistic regression analysis revealed that type of house and availability of municipal water had a significant association with WASH practices with a significance level of <0.01 (Table 6).

An observational walk was also carried out to observe 13 variables. It was found that only one slum had the public toilet facility, but it was not used by the locals. Open defecation was practiced by people from all four slums, and open drains were a common sight in all of the slums. Three out of four slums used drains as waste disposal areas, and flood areas were present in all four slums. There was no market in two slums, and only two out of four slums had schools in the vicinity. There were no community centres in each of the four slums, while centres of worship (temple/church/mosque) were present in all four slums.

Table 3: Socio-demographic profile of study population (n=140).

Variables	Characters	N (%)
Age (years)	11-20	11 (8)
	21-30	38 (27)
	31-40	31 (22)
	41-50	31 (21)
	51-60	18 (13)
	61-70	9 (7)
	71-80	2 (1)
Gender	Females	118 (84)
	Males	22 (16)
Religion	Hindu	123 (88)
	Muslim	12 (9)
	Christian	5 (3)
Education	Uneducated	41 (29)
	Primary	19 (14)
	Middle	40 (29)
	High	30 (21)
	Intermadiate	5 (4)
	graduate/PG	5 (4)
Occupation	Unemployed	8 (6)
	Unskilled	75 (54)
	Semiskilled	31 (22)
	Skilled	20 (14)
	Shopowner/farmer	3 (2)
	Miprofessional	2 (1)
	Professional	1 (1)
SES	Upper middle	8 (6)
	Lower middle	28 (20)
	Upper lower	96 (68)
	Lower	8 (6)
Type of family	Nuclear	95 (68)
	Extended	21 (15)
	Joint	24 (17)
Type of house	Kutcha/hut	57 (41)
	Pucca	73 (52)
	Mixed	2 (1)
	Mansion	8 (6)

Table 4: Univariate analysis of study population (n=140).

Good WASH (%)	Poor WASH (%)
49 (35)	91 (65)

Table 5: Bivariate analysis of the study population (n=140).

Exposure variable		Good WASH N (%)	Poor WASH N (%)	χ^2	P value
Slum	MGR Nagar	11 (13.4)	24 (68.6)		
	Kansalpettai	16 (45.7)	19 (54.3)		
	Ammananguttai	9 (25.7)	26 (74.3)		
	Thalayarimaniyam	13 (37.1)	22 (62.9)		
Religion	Hindu	82 (66.6)	41 (33.3)	1.237	0.266
	Others	9 (52.94)	8 (47.05)		
No. of family members	> 4	36 (57.14)	27 (42.83)	3.108	0.078
	4 and below	55 (71.42)	22 (28.57)		

Continued.

Exposure variable		Good WASH N (%)	Poor WASH N (%)	χ^2	P value
Education	Illiterate	30 (73.17)	11 (26.82)	1.701	0.192
	Literate	61 (61.61)	38 (38.38)		
Employment	Unemployed	7 (87.5)	1 (12.5)	1.888	0.169
	Employed	84 (63.63)	48 (36.36)		
Family type	Nuclear	62 (65.26)	33 (34.73)	0.009	0.924
	Joint/Extended	29 (64.44)	16 (35.55)		
House type	Kutcha/Hut	47 (82.45)	10 (17.54)	12.878	<0.05
	Pucca/Mixed/Mansion	44 (53.01)	39 (46.98)		
Drinking water	Munincipal network	75 (68.8)	34 (31.19)	3.137	0.077
	Other sources	16 (51.61)	15 (48.38)		
Cooking water	Drinking water	46 (67.64)	22 (32.35)	0.407	0.523
	Domestic water/ both	45 (62.5)	27 (37.5)		
Domestic water	Munincipal network	75 (68.8)	34 (31.19)	3.137	0.077
	Other sources	16 (51.61)	15 (48.38)		
Water supply	Adequate	61 (65.59)	32 (34.40)	0.043	0.837
	Inadequate	30 (63.82)	17 (36.17)		
Class	Upper and middle class	28 (73.68)	10 (26.31)	1.729	0.189
	Lower class	53 (61.76)	39 (38.23)		

Table 6: Multivariate logistic regression of the study population (n=140).

Study population	Beta coefficient	Significance value
>4 members per household	-0.062	0.88
Living in a kutcha house	1.097	0.012
Drinking municipal water	1.286	0.003

Table 7: Checklist for the observational walk around the slums (n=140).

Checklist	MGR colony	Thalayari maniyam	Ammanaguttai	Kansalpettai
Public toilets	Under construction	Absent	Closed down	Not in use
Open defecation	Yes	Yes	Yes	Yes (rail track)
Open drains	Yes (surface runoff)	Yes (sewage)	Yes	Yes (sewage)
Waste disposal sites	Drains, open dumping	Drains, behind house	Drains, in front of house	Near rail tracks
Flood areas	Yes	Yes	Yes	Yes
Market	Small Shops	No	No	Fish market
School	2 schools	No	No	Balwadi
Community centre	Nil	Nil	Nil	Nil
Animals	Cows, stray dogs, goats	Cows, stray dogs, goats	Cows, stray dogs, goats	Cows, stray dogs, goats
Places of worship	Church, temple	Temple	Temple	Temple, mosque
Food vending areas	Yes (within the slum)	Yes (on the mainroad)	Yes (within the slum)	Yes (within the slum)
Public taps	Present	Present	Present	Present
Surface water area	No	No	No	No

Animals co-existed with the people in all the slums: most commonly stray dogs, cows and goats. Of all the four slums, three had food vending areas within the slum, while the other's was located on the main road. Public taps were present in all four slums, and there was no surface water runoff in any of the slums (Table 7).

DISCUSSION

The availability, proper utilization and good WASH practices are directly or indirectly related to health. The current study was done in an urban slum taking into consideration the three aspects mentioned above and also the factors affecting the same. The majority of the study

population were middle aged people between the age 21-30 (27%), of the Hindu religion (88%), belonging to a varied population of people from upper lower SES (68%), were educated till middle school (29%) or uneducated (29%), and those living in a nuclear family (68%).

A similar study was done in rural south India (Vellore, Tamil Nadu) to assess the knowledge, attitudes and practices of water handling and usage, sanitation and defecation and the sociocultural factors affecting the same. It was reported that all households stored drinking water in open containers. The residents did not associate unclean water with diarrhoea but attributed it to 'heat', spicy food, ingesting hair, mud and mosquitoes. Among the participants, 30.9% had toilets but only 83.3% of them used the facility. Seventy-two (74.2%) of respondents defecated in fields, and there was no stigma associated with this traditional practice. Hand washing with soap after defecation and before meals was common only in children under 15 years (86.4%).[14] Supporting this result is a report from the National Family Health Survey (NFHS-3) which reported that approximately 74 % of Indians have no proper toilet.[15] Interestingly, the study done by Kuberan et al indicated that majority (86%) of the study population have access to sanitary latrines and 70% of them have their own latrines. Almost half (44.4%) of the common latrine users were sharing latrines with 5 or more families. About 17% of the study population still practices open field defecation, of which 1/5th had access to a sanitary latrine.

A study done in urban slums of South Delhi by Joshi et al arrived at the following conclusion that gastrointestinal tract infection was the most important health problem related to poor health practices (83%). 45% of the participants consumed water from a privately-owned tube well/bore well. Water shortage lasted two days or more (50%) at a stretch with severe scarcity occurring twice a year (40%). 45% of the participants had toilets within their households. 53% of the participants were drinking unclean water since the drinking water samples collected from storage containers showed positive bacteriological contamination.

Good hand hygiene practices have been known to reduce the number, and hence cost of nosocomial infections.[15] In fact, in light of the ongoing COVID-19 pandemic, the WHO along with the World Bank have step up efforts to promote and enforce more stringent practices related to water, sanitation and hygiene (WASH).[16]

The authors acknowledge that the study was limited in its geographic location and setting, the findings of this study maybe generalized to other slums within India, however it may not be the case in other countries. Potential sources of bias such as social desirability bias and interviewer bias has been accounted for (ref methods section) to the best of our ability, however it may not have been fully eliminated

CONCLUSION

This study clearly demonstrated that two thirds of the slum dwellers had poor knowledge regarding WASH practices. The observational walk highlighted bottlenecks in the available facilities. Despite political will with the introduction of the Swachh Bharat Abhiyan and the work towards Sustainable Development goals, there remains a gap in knowledge, implementation and utilization of services. We recommend strong community engagement and education regarding WASH in schools and communities is the key. Translational research to look at simple feasible and cost-effective interventions is the way ahead.

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