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Water and Sanitation Conditions and its Negative Impact as Disease Prevalence in India: A State Level Analysis

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ABSTRACT

In the present era of development, most of the cities in India are characterized by congestion, inadequate water supply and sanitation, which in turn affect the health of urban people. The objectives of this study are to examine spatial distribution of water and sanitation conditions and its association with morbidity with using NSSO 69^{th} round data. In the urban India, 90.8% Households have accessibility of water, 90.6% Households have latrine facility, 83.3% Households have bathroom facility, 60.4% Households have closed, 27.4% open, and 12.5% not have drainage system, 73.3% waste water disposed in drainage system and 59.7% garbage dumped at dumping sites. Odds ratios reveal statistically significant association between good housing, water and sanitation condition with lower disease prevalence. Households with unsafe drinking water are more likely to have any skin problem (OR: 1.49) and fever other than malaria (OR: 1.22) compared to those with safe drinking water. Findings of the study concludes that improvement in water and sanitation conditions can substantially reduce the rates of diseases prevalence and it can be expected to affect other aspects of human hygiene and health.

Key words: Water conditions, Sanitation, Urban health, Morbidity, Microenviorenment, Spatial Distribution, India

1 INTRODUCTION

In the 21st century, more than half of the global population is expected to live in towns and cities. In some of the cities, more than a quarter million people are added every year; it poses an enormous challenge to the urban municipal and planning bodies, which are responsible for providing infrastructure and essential services to the urban population. The growing cities of developing countries are facing crisis between demand and supply of the essential amenities like drinking water and adequate sanitation services and necessary infrastructure. India (where 7.5 % of reported deaths are sanitation and water-related) has been grappling with the problem of water and sanitation coverage, especially for the rural areas and poor in urban areas [1]. The most cities and towns of India are characterized by overcrowding, congestion, inadequate water supply and sanitation which include disposal of human excreta, wastewater, and garbage disposal, which in turn affects the health of urban people [2].

Water and sanitation have been the subjects of considerable recent attention as a result of the declaration by the United Nations General Assembly that the 1980s were the International Drinking-Water, Supply and Sanitation Decade (IDWSSD) and year 2008 has been declared the International Year of Sanitation [3]. Sanitation offers the opportunity to save the lives of 1.5 million children every year who would otherwise succumb to sanitation-related diseases, and it protects the health of many more [4]. Sanitation incorporates safe disposal of human waste, wastewater management, control of vector of disease, domestic and personal hygiene, food sanitation and lastly but not least housing condition [5]. The recent definitions of sanitation prominently state that the access to latrine is not the same as the adoption of sanitary practices in dealing with human waste, nor are access to a latrine the same as its hygienic use and

the adoption of other hygienic practices. Epidemiological investigations have shown that even in the absence of latrine, diarrheal morbidity can be reduced with the adoption of improved hygiene behavior [6]. Water and improved sanitation play a major role in the overall well-being of the people, with a significant bearing on the infant mortality, longevity and productivity [7]. Causes of contamination of water are indiscriminate use of chemical fertilizers and chemicals, poor hygienic environment of water sources, improper disposal of sewage and solid waste, pollution from untreated industrial effluents, over-exploitation leading to quality degradation. Thus, the supply of the additional quantity of water by itself does not ensure good health; proper handling of water and prevention of contamination are also equally important [8]. Contagious, infectious and waterborne diseases such as diarrhoea, amoebiasis, typhoid, infectious hepatitis, worm infestations, measles, malaria, tuberculosis, whooping cough, respiratory infections, pneumonia and reproductive tract infections dominate the morbidity pattern and prevalence in India [9]. Recent studies have shown the importance of washing one's hands with soap as it reduces diarrheal disease by 43 per cent. Respiratory problems such as sniffles and coughs were also brought down by 45 per cent when hands were washed five times a day [8].

The study of the sanitation facilities available to the households is an essential aspect of living facilities, and it is closely related to the health and hygiene of the household's members and its surrounding environment (NSSO 69^{th} round report, 2013). In this consideration, the objectives of this paper were to examine the water and sanitation conditions and the effects on diseases prevalence in urban areas of India.

2 METHODS

The study has used the data of NSSO 69^{th} round survey, conducted during July to December 2012 by the National Sample Survey Organization funded by Ministry of Statistics and Programme Implementation, Government of India. The NSSO 69^{th} survey conducted a nation-wide survey on 'Drinking water, Sanitation, Hygeine and Housing Condition'. The objective of the survey was to examine and stuty different aspects of living conditions necessary for decent and healthy living of the household members by developing suitable indicators built on the basis upon information collected. A stratified multi-stage design had been adopted for the 69^{th}round survey. The first stage units were the census villages (Panchayat wards in case of Kerala) in the rural sector and Urban Frame Survey (UFS) blocks in the urban sector. The ultimate stage units were households in both the sectors. In case of large FSUs, one intermediate stage of sampling was the selection of two hamlet-groups (hgs)/ sub-blocks (sbs) from each rural/urban FSU. The schedule of inquiry on 'Drinking Water, Sanitation, Hygiene and Housing Condition' (known as Schedule 1.2) was designed to collect information on housing condition with special emphasis on the aspects of drinking water, sanitation and hygiene. The total number of households in which Schedule 1.2 was canvassed was 53,393 in rural India and 42,155 in urban India. Thus the total sample size for the study is 42,155.

Bivariate and multivariate statistical techniques have been used to achieve the specific objectives of the study. The study has used the comprehensive cross tabulation for meeting the objectives, cross tabulation between sanitation variables, housing variables and background characteristics with disease prevalence. Binary logistic regression has been carried out to determine the factor associated with disease prevalence in urban India. Binary logistic regression model is commonly estimated by maximum likelihood function. For the dependent variable, logistic model follow the general form:

$$\text{Logit } P = \ln\left[\frac{p}{1-p}\right] = b_0 + b_1X_1 + b_2X_2 + - - - - + b_nX_n + e_n$$

Two types of models have been used in the logistic regressions Model one included the water sanitation variables whereas, model two included all the independent variable of WASH indicators.

3 RESULTS AND DISCUSSION

3.1 Water Conditions in Urban areas of India

Adequate sanitation, together with good hygiene and safe water, are fundamental to good health and social and economic development [10]. Figure 1 shows the improved drinking water sources and water for household activities' availability in urban areas of India. Improved water sources include the sources from 'bottled water', 'piped water into dwelling', 'piped water to yard/plot', 'public tap/standpipe', 'tube well/borehole', 'protected well', 'protected spring', and 'rainwater collection'. In urban areas of India, 95.3 percent and 93 % of households have accessibility to improved drinking water and water for household activities respectively. Kerala has the lowest availability of improved drinking water sources as 56.9 percent and followed by Manipur (69.8%), Jharkhand (88.3%). But in case of availability of improved water for household activities is the lowest in Manipur (38%) and followed by Kerala (53.7%), and Jharkhand (69.8%) etc..

In case of insufficiency of drinking water during months in a year, the household reported that they faced the highest inadequacy in May followed by June. And in August, September and October, households have sufficient water availability in urban areas of India. The demand for water during April, May and June is same as in both rural and urban areas of India. It may be due to the fact that during these month there is no rainfall received or decidedly less in India, as the Indian monsoon starts during the last week of June (Figure 2).

Figure 3 shows the accessibility of water sources in households in urban areas in India. Overall, more than three-fourths households have the water source within their premises followed by 18.4 percent household have it less than 0.2 km, and 4.1 percent have access o.2 km perimeter and more distance away from their household. Households

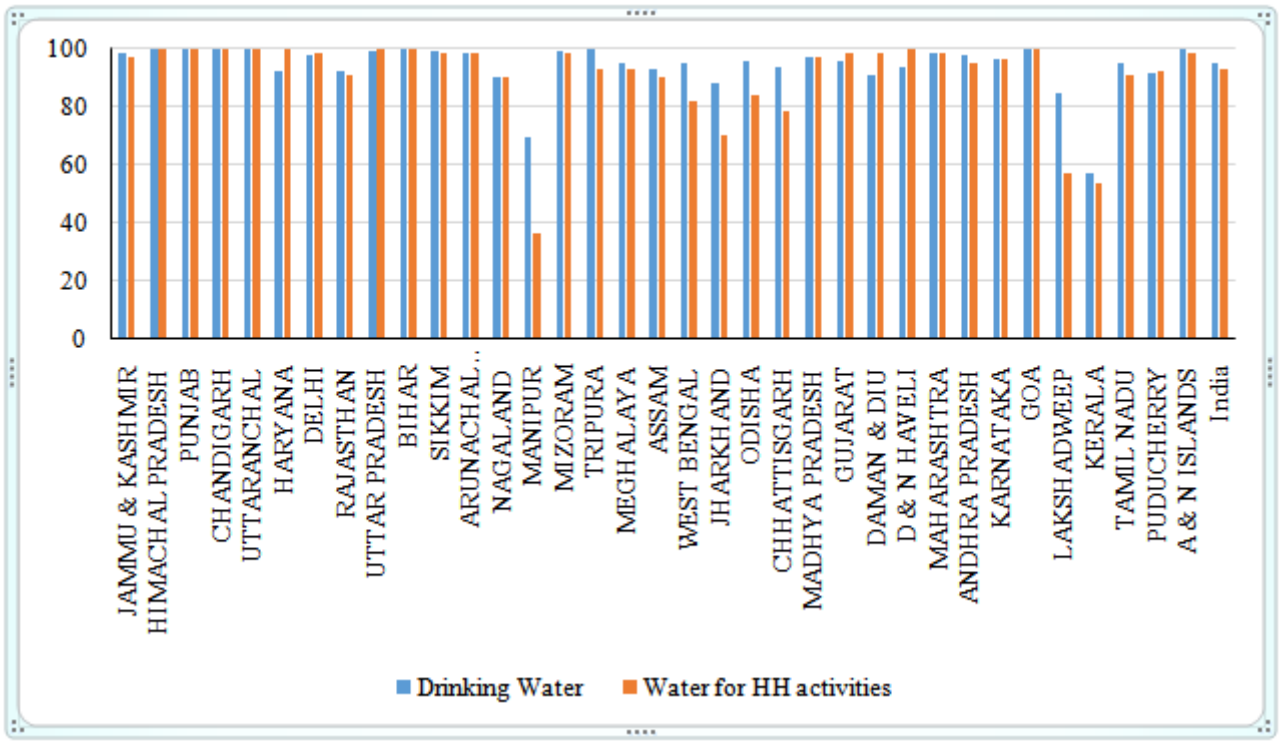

Figure 1. Improved source of Water in urban area of India

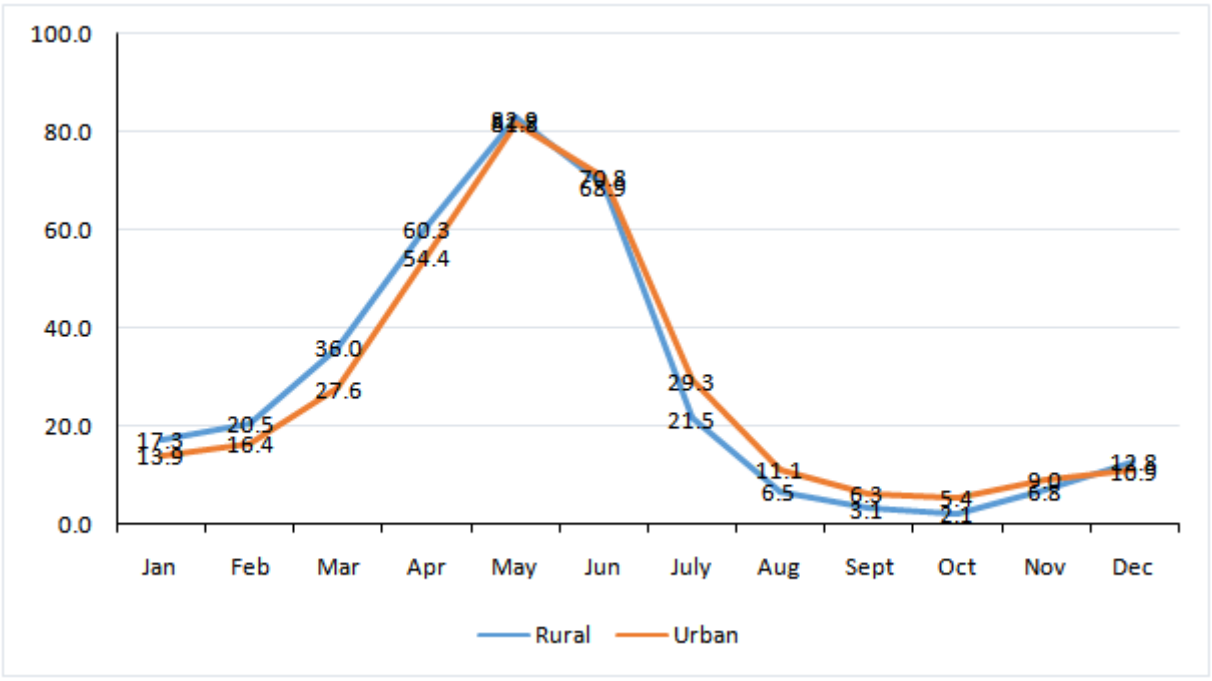

Figure 2. Insufficiency of drinking water during months of year in India

from Manipur (48.9%), West Bengal (50.6%), Chhattisgarh (61.9%) Tamil Nadu (64.7%) Madhya Pradesh (70.8%) and Odisha (73.9%) have accessibility of water within their premises, however these are the states which are having water accessibility within their premises below the national average.

3.2 Sanitation Conditions in Urban areas of India

It is recognized that urban sanitation is dependant on a combination of sewerage and otheron-site options and a great majority of urban residents are and will remain dependent on on-site sanitation facilities such as pour flush toilets discharging to leach pits or septictanks [11].

Table 1 shows the percentage distribution of households having the different type of sanitation conditions in urban areas of India. Results reveal that the availability of bathroom facility varies from state to state across urban areas in India. Taking consideration of attached bathroom facility to the household is highest in Mizoram (93.9 %) followed by Goa (90.8 %) and lowest in Manipur (11.8 %) followed by Tripura where only 18.9percenthouseholds have the facility of attached bathroom. In case of the detached bathroom to the household availability shows that it is highest in Nagaland (59.4%) followed by Manipur (58.2 %), whereas in case of lowest availability, Mizoram (5.2%) followed by Goa (6.9%) are the state having detached bathroom facility. But the problematic situation founds in those state that has not bathroom facility in the households. In case of not having bathroom facility, Tripura (48.8 %), Bihar (38.9 %), Manipur & Jharkhand (29%), West Bengal (26.6%) etc. have lowest than the average available facility in urban areas of India (16.7 %). Due to inadequate infrastructure, the distance of the bathing place from household matters a lot in both rural as well as in urban areas. Findings of the study reveal that very few states have 100 percent bathing facility within their premises such as Nagaland, Dadar & Nagar Haveli, Goa and Lakshadweep. It is lowest in the state Chhattisgarh (76.4 %) followed by Chandigarh (83.5 %). There are still urban areas in certain states where people have to go 0.2 km & more distance from their households for taking a bath, such states are Chhattisgarh (9.7 %) followed by Odisha (8.9%).

The government of India had set a target of universal household sanitation coverage by 2012 when it was launched its flagship of Total Sanitation Campaign (TSC) in 1991. But evidence showed that these targets were not achieved by many states. Several states in India were lagging behind in availability of latrine facility to the households in both rural and urban areas.

Poor sanitation can sometimes be the initial domino that starts a cascading wave of other problems. In the case of India, poor sanitation and open defecation have allowed for an overwhelmingly unhygienic environment and a variety of widespread health problems. Table 1 reveals that 8.8 % households in urban areas have no latrine facility at all in India. The states like Chhattisgarh (24.9 %), Bihar (20.8 %), Odisha (18.3%), Jharkhand, Rajasthan, Madhya Pradesh, Tamil Nadu, Uttar Pradesh and Karnataka have the higher percentage of households who have not any latrine facilities. In this regard, the North East states are having good conditions because every urban area of these states has at least any type of latrine facilities. If we take the consideration of quality/ types of latrine facilities in urban areas, then it is divided into two categories such as improved and unimproved types of latrine facilities. Improved types include sources such as 'flush/pour-flush to piped sewer system/septic tank/pit latrine', 'ventilated improved pit latrine', 'pit latrine with slab' and 'compositing toilet'. Table 1 depicts that only 89.6 percent households have improved type of latrine facilities in overall urban areas of India. In urban areas of each of the bigger states, more than 75 percent of households had access to 'improved source' of latrine and it was highest in Kerala (98.8 %) followed by Arunachal Pradesh (98.5%), Assam (97%) Maharashtra (92.8 %) and lowest (74.9%) in Chhattisgarh followed by Rajasthan, Bihar (78%), Jammu & Kashmir etc..

3.3 Micro-Environmental conditions in urban areas in India

Urban sanitation in India faces many challenges. Nearly 60 million people in urban areas lack access to improved sanitation arrangements, and more than two-thirds of wastewater is let out untreated into the environment, polluting land and water bodies [12]. The environment in which members of household live is crucial in maintaining their health and hygiene. So, it is vital for maintaining environmental balance and overall cleanliness of the household surroundings. Proper drainage arrangement meant a system of easy carrying-off waste water and liquid waste of the house without any overflow or seepage. Another important aspect of good household's environment is the garbage collection system. This is an arrangement to carry away the refuse and waste of households to some dumping place away from the residential areas. These two aspects, viz., drainage arrangement and garbage disposal system, are the aspects mainly associated with hygiene and cleanliness of the house (NSS, 2012). The third important factor of micro-environmental conditions is the problem of flies and mosquitoes.

Drainage and sewerage system in urban areas is an important priority in Indian setting because of rapid urbanization, industrialization, and population growth, along with increase in slum population and migration [13]. In urban areas, there is 45.3 percent households have connectivity with underground drainage, whereas 14.9 percent have covered pucca type, 22.4 percent have open pucca type, and 5 percent have open katcha type of drainage system connectivity. Around 13 percent of the households have not any type of drainage connectivity. They discharge their waste water and liquid waste at randomly in unhygienic conditions either on the road side or any open place which is very harmful to health and hygiene. In the urban areas of bigger states, one-fourth house have not connectivity of any kind of drainage system, these states are West Bengal, Kerala, Odisha, Assam, Jharkhand, Chhattisgarh etc..

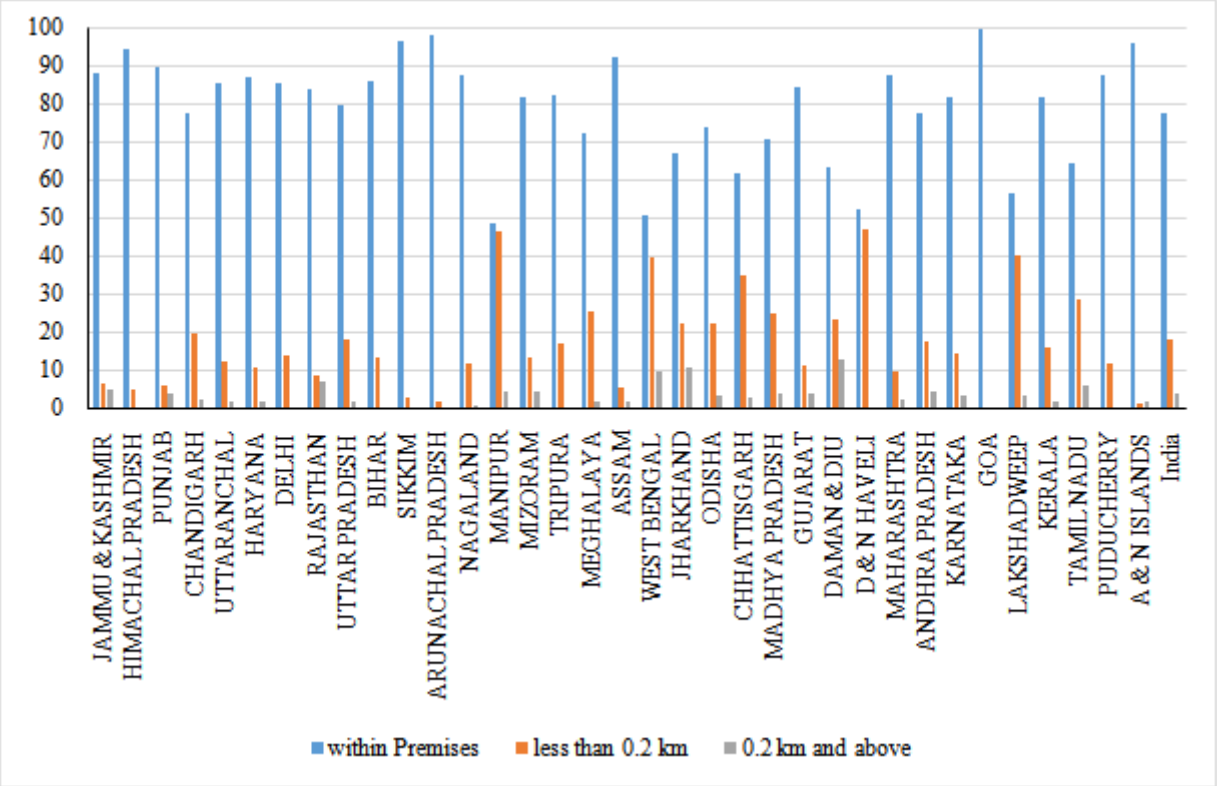

Figure 3. Access of drinking water sources in urban areas of India

Few states such as Haryana, Nagaland, Delhi, Sikkim, Uttaranchal, and Uttar Pradesh have the better conditions in reference to drainage system. The highest percentage of houses with connectivity with underground drainage is found in Chandigarh (82.0%) followed by Gujarat (78.5%), Punjab (62.1 %), Maharashtra (57.0%), Andhra Pradesh (54.0%), Uttar Pradesh (53.6%), etc. In the concern of lowest percentage, it is found in North-East states, where the underground drainage system connectivity is less than 1.0 percentage (Table 2).

Garbage collection is an arrangement to carry away the refuse and waste of households to some dumping place away from the residential areas. In India, the urban local bodies, particularly known as the municipal corporation/councils, are responsible for management of activities related to public health. However, with increasing public and political awareness as well as new possibilities opened by economic growth, solid waste management is starting to receive due attention [14]. Table 2 shows the micro environmental conditions in urban India by garbage collection methods. In urban areas of India, 26.6 percent houses have not any kinds of arrangement for garbage collection. In the bigger states like Kerala and Bihar have not any arrangement for garbage collection, the proportion of houses is 79.4% & 70.7 percent respectively. When we observe the states by the arrangement of garbage collection, there are two types of arrangement made, first by governing body like municipality or Municipal Corporation and second effort made by residents or any private body. In urban areas, there are 51.9% houses having garbage collection arrangement by municipal corporations or municipality and 21.5 percent have the arrangement by their own or residents of localities. In case of an arrangement made by a municipal body is highest in Sikkim (84.7 %) followed by Uttarakhand and Andhra Pradesh (77%), and in the second case, it is highest in Chandigarh, i.e. 95.2percent followed by Manipur (63.8%), Haryana (59.1 %).

The problem of flies and mosquitoes is the most common problem in India both in rural and urban areas. In India, The unplanned waste dumping places and open defecation become the sites of the growth of a number of disease carriers like flies, mosquitoes etc. These cause health hazards not only in slum areas but also in other nearby places [15] (Mishra et al., 2012). In urban areas, about 97 percent of houses faced the problem of flies and mosquitoes which is the major cause of vector-borne diseases (Table 2). When it is divided by problem of severity into severe and moderate, the highly severely affected states are Jharkhand (75%), Bihar (72%), Uttar Pradesh (67%), and Chhattisgarh (65%). Sikkim is the state where the proportion of houses which have not the problem of flies and mosquitoes is 40 percent followed by the Arunachal Pradesh (25%), Meghalaya (23%), Himachal Pradesh (17%), and Nagaland (16%).

Table 1. Sanitation Conditions in Urban areas of India

State	Availability of bathroom			Distance of bathing place			Latrine facility		
	Attached	Detached	No bathroom	Within premises	Outside but less than 0.2 Km	0.2 Km and above	Improved	Unimproved	No latrine
Jammu & Kashmir	52.8	40	7.2	98.0	1.6	0.4	79.4	14.6	6.0
Himachal Pradesh	75.1	12.3	12.6	98.7	1.3	0.0	95.7	0.0	4.3
Punjab	43.0	38.8	18.1	98.8	1.2	0.1	93.2	0.6	6.2
Chandigarh	50.7	27.6	21.7	83.6	15.7	0.8	98.4	0.0	1.6
Uttaranchal	59.9	37.7	2.4	99.6	0.3	0	97.7	0.7	1.6
Haryana	59.4	36	4.6	99.2	0.5	0.3	98.3	0.3	1.4
Delhi	68.3	24.8	6.8	97.5	2.4	0.1	98.7	1.3	0.0
Rajasthan	55.6	28.6	15.8	96.6	2.6	0.8	78.2	7.5	14.2
Uttar Pradesh	58.9	16.8	24.2	98.1	1.8	0.1	86.9	2.4	10.7
Bihar	36.3	24.8	39	92.6	7.1	0.3	78.3	0.9	20.8
Sikkim	64.4	33.4	2.2	99.0	1.0	0.0	100.0	0.0	0.0
Arunachal Pradesh	59.7	38.9	1.4	98.9	1.1	0.1	98.5	1.5	0.0
Nagaland	38.4	59.4	2.2	100	0.0	0.0	99.2	0.8	0.0
Manipur	11.8	58.2	29.9	93.9	5.9	0.2	91.3	8.7	0.0
Mizoram	93.9	5.2	0.9	99.7	0.2	0.1	99.9	0.1	0.0
Tripura	18.9	32.2	48.9	87.2	12.8	0.0	98.5	1.4	0.1
Meghalaya	63.9	28.2	7.9	97.7	2.2	0.2	99.3	0.5	0.3
Assam	39.8	51	9.2	99.6	0.4	0.0	97.0	2.7	0.3
West Bengal	41.7	31.8	26.6	83.6	14.7	1.7	93.4	1.3	5.4
Jharkhand	39.3	30.8	29.9	85.8	9.6	4.6	80.1	2.2	17.7
Odisha	42.3	31.8	25.9	83.6	7.5	8.9	81.2	0.5	18.3
Chhattisgarh	35.7	29.8	34.5	76.4	13.9	9.7	75.0	0.1	24.9
Madhya Pradesh	58.1	27.0	14.9	97.3	2.2	0.5	84.9	1.1	14.0
Gujarat	68.7	15.6	15.7	98.7	1.2	0.1	93.7	0.1	6.2
Daman & Diu	23.0	8.8	68.3	89.1	10.9	0.0	99.9	0.0	0.1
D & N Haveli	25.0	7.4	67.6	100	0.0	0.0	67.8	0.0	32.2
Maharashtra	61.9	20.2	17.9	99.3	0.7	0.0	92.8	0.3	6.9
Andhra Pradesh	44.9	48.3	6.8	97.9	2.0	0.1	91.0	1.0	8.1
Karnataka	68.0	20.8	11.2	99.5	0.2	0.2	87.7	3.3	9.0
Goa	90.8	6.9	2.2	100	0.0	0.0	96.0	0.0	4.0
Lakshadweep	75.1	24.8	0.1	100	0.0	0.0	97.7	0.0	2.3
Kerala	67.1	27.5	5.4	98.8	1.1	0.1	98.8	0.1	1.2
Tamil Nadu	51.2	33.4	15.5	93.9	4.5	1.6	86.6	1.1	12.2
Puducherry	72.0	22.7	5.4	99.9	0.1	0.0	93.7	0.0	6.3
A & N Islands	82.4	8.4	9.2	97.4	2.6	0.0	95.0	0.0	5.0
India	55.4	27.9	16.7	95.8	3.4	0.8	89.7	1.5	8.8

Note: All data are in percentage form.

3.4 Disease Prevalence

In the NSSO 69^{th} round survey there is a question related to diseases prevalence in the last 30 days preceding the survey which includes those houses who's any member suffered from any types of illness such as stomach problem, malaria, skin diseases and fever due to disease other than malaria. The types of stomach problem and skin disease is not specified in the survey. So if the household member faced any type of stomach problem like stomach pain, loose motion etc, and skin diseases like itching and rashes in last 30 days of survey, the house is considered as faced of stomach problem and skin disease. Table 3 shows the selected disease prevalence in urban areas of Indian states such as stomach problem, skin disease, malaria and fever other than malaria.

Findings of the study revealed that inn urban areas of India, the highest prevalence of stomach problem is found in Assam (34.7 %) followed by Punjab (28.6 %), Uttar Pradesh (26.9 %) and Jharkhand (26.6 %).Further, the highest prevalence of Malaria is observed in Daman & Diu (24.3 %), followed by Arunachal Pradesh (16.3 %)in the urban areas of India.Southern and Western states of urban India has also show the high prevalence of malaria The prevalence of skin disease is found high in Bihar (13.1%) followed by Punjab (10.6%), Himachal Pradesh (10.0 %), Uttar Pradesh (8.6 %) and Jammu & Kashmir (8.7 %). Results show that, In urban areas of bigger states, prevalence of fever other than malaria is highest in Bihar (43.5%) ,

Table 2. Micro-Environmental conditions in urban areas of India

State	Drainage System					Garbage Collection			Problem Of Flies/Mosquitoes FacedBy Residents		
	Underground	Covered Pucca	Open Pucca	Open Katcha	No Drainage	Panchayet/ Muncipal Corp	Arrangement Made By Residents	No Arrangement	Yes: Sever	Moderate	No Problem Of Files And Mosq
Jammu & Kashmir	51.6	14.4	15.5	6.2	12.3	39.0	25.9	35.0	23.1	73.7	3.3
Himachal Pradesh	38.5	15.2	17.1	6.1	23.1	55.3	10.9	33.9	6.1	77.0	17.0
Punjab	62.1	2.8	24.1	3.2	7.8	25.2	40.3	34.5	38.8	58.5	2.7
Chandigarh	82.0	1.1	0.2	4.6	12.2	0.0	95.2	4.8	44.0	52.3	3.7
Uttaranchal	27.5	24.6	36.9	7.2	3.8	77.7	13.3	8.9	12.1	87.2	0.6
Haryana	61.1	5.1	28.7	4.4	0.6	26.3	59.1	14.6	46.6	52.1	1.3
Delhi	55.7	13.9	26.8	2.0	1.6	50.8	37.6	11.7	22.7	70.8	6.5
Rajasthan	36.9	15.3	27.4	6.4	14.1	40.1	17.0	42.9	45.9	47.7	6.4
Uttar Pradesh	53.6	16.4	19.9	5.6	4.5	43.4	21.8	34.8	67.4	31.6	1.0
Bihar	22.2	21.6	20.6	20.3	15.3	21.8	7.5	70.7	72.5	26.4	1.1
Sikkim	0.7	7.2	85.7	3.4	3.0	84.7	1.0	14.4	5.0	54.9	40.1
Arunachal Pradesh	1.8	9.4	57.4	12.2	19.2	19.4	26.4	54.2	11.6	62.4	26.0
Nagaland	5.7	15.5	47.7	29.9	1.2	68.0	22.4	9.6	1.5	82.9	15.6
Manipur	0.0	2.8	26.0	40.9	30.3	17.5	63.8	18.7	33.9	63.6	2.5
Mizoram	0.7	5.8	42.1	33.2	18.2	58.7	14.6	26.8	8.4	84.7	6.9
Tripura	0.5	4.7	30.1	11.6	53.1	22.6	7.0	70.4	57.1	42.6	0.3
Meghalaya	0.4	14.4	55.6	8.5	21.0	66.7	11.3	22.0	7.8	69.1	23.1
Assam	6.6	4.6	40.7	20.1	28.1	29.1	31.1	39.8	26.4	67.8	5.8
West Bengal	12.8	9.2	42.8	5.3	29.9	56.7	9.9	33.5	52.7	45.1	2.3
Jharkhand	13.5	14.9	33.9	11.8	25.9	32.7	5.2	62.1	75.1	24.9	0.0
Odisha	25.6	6.4	36.2	2.2	29.5	55.8	6.4	37.8	42.7	57.1	0.2
Chhattisgarh	15.4	15.6	30.3	9.4	29.3	42.2	11.5	46.3	65.1	29.8	5.1
Madhya Pradesh	48.9	15.2	17.7	9.9	8.4	52.2	11.4	36.4	57.1	38.6	4.3
Gujarat	78.5	2.8	6.0	3.0	9.7	62.3	20.9	16.8	22.1	70.2	7.6
Daman & Diu	29.8	31.2	36.8	0.0	2.2	24.7	9.3	66.0	48.8	41.4	9.8
D & N Haveli	30.0	16.5	0.0	0.0	53.4	9.3	12.8	77.9	47.6	52.5	0.0
Maharashtra	57.0	12.3	19.9	3.7	7.1	41.9	48.7	9.3	33.9	61.8	4.4
Andhra Pradesh	54.0	12.2	24.1	2.1	7.6	77.6	8.1	14.3	55.3	42.0	2.7
Karnataka	48.7	22.1	18.8	1.8	8.6	66.8	18.3	14.9	44.7	51.5	3.8
Goa	31.6	19.6	15.1	10.1	23.6	24.4	19.4	56.2	23.0	76.8	0.2
Lakshadweep	0.0	48.2	13.9	6.6	31.3	34.6	21.4	44.0	25.2	70.3	4.5
Kerala	22.7	32.4	9.4	5.8	29.8	12.6	8.0	79.4	40.6	56.5	2.9
Tamil Nadu	35.0	27.4	17.2	3.3	17.1	68.6	11.4	20.0	61.0	38.4	0.6
Puducherry	26.3	2.2	57.9	4.2	9.5	74.7	3.6	21.7	47.3	52.8	0.0
A & N Islands	13.3	19.2	48.8	5.4	13.3	80.3	0.0	19.7	5.4	94.3	0.3
India	45.3	14.9	22.4	5.0	12.5	51.9	21.5	26.6	47.6	49.1	3.3

followed by Uttar Pradesh (40.5%), Punjab (39.2%), and Jharkhand (38.9%) and lowest in Pondicherry (8.5%).

4 RESULTS OF LOGISTIC REGRESSIONS

Table 4 represents the results of the logistic regression model for disease prevalence among those households who have access and who have not access to safe water, inadequate sanitation and micro-environmental conditions. In this regard, there has been used two type of model for explaining the association between water, sanitation and micro-environmental conditions with disease prevalence in the households. In model one, water conditions have been included to explain the effects of these conditions on the prevalence of disease. In model two, water, sanitation and micro-environmental conditions variables have been included to determine the factor associated with the disease prevalence in urban India.

Findings of the study depict that the association between uses of water from improved sources and stomach problem are highly significant ($p<0.001$). Similarly, bathroom facility, drainage system facilities and garbage collection are significantly related to stomach problem. It means households having these facilities are less likely to prevail the diseases than those household who have inadequacy of these facilities. Results from the model-I clearly depict that the relationship between water and sanitation facilities with stomach problem are highly significant, as well as problem of flies and mosquitoes ($p < 0.001$). Findings evident that those households having no (OR=0.37, $p<0.001$) or moderate (OR=0.69, $p<0.001$) problem of flies and mosquitoes are significantly less likely to face stomach problem than those households having severe problem of flies and mosquitoes. Further, findings of the study revealed that those households having unimproved sources of water for households activities are significantly 1.20 ($p<0.001$) and 1.16 ($p<0.001$) times more likely to have skin diseases in model one and

Table 3. DiseasePrevalence in Urban areas of India

State	Stomach problem (%)	Malaria (%)	Skin diseases (%)	Fever other than Malaria (%)
Jammu & Kashmir	23.5	0.1	8.7	26.1
Himachal Pradesh	10.4	0.9	10.0	29.6
Punjab	28.6	3.1	10.6	39.2
Chandigarh	22.6	2.2	4.7	26.5
Uttaranchal	21.8	0.4	3.4	23.0
Haryana	17.5	5.3	3.9	32.5
Delhi	6.0	0.5	1.0	19.7
Rajasthan	15.1	7.1	7.2	36.4
Uttar Pradesh	26.9	5.1	8.6	40.5
Bihar	30.3	3.4	13.1	43.5
Sikkim	9.2	0.0	0.8	12.2
Arunachal Pradesh	20.1	16.3	8.2	34.5
Nagaland	23.5	0.1	6.0	37.3
Manipur	8.8	0.8	7.3	18.1
Mizoram	17.8	3.9	8.3	16.5
Tripura	14.1	0.8	1.2	30.2
Meghalaya	16.0	4.8	3.3	25.0
Assam	34.7	0.7	8.0	36.9
West Bengal	19.8	0.3	7.2	27.5
Jharkhand	26.6	5.7	5.8	38.9
Odisha	12.3	4.5	2.6	30.7
Chhattisgarh	12.4	3.1	2.6	36.3
Madhya Pradesh	21.8	9.2	7.1	31.1
Gujarat	8.7	3.5	3.0	19.3
Daman & Diu	13.1	24.3	1.7	10.7
D & N Haveli	14.3	0.9	0.2	30.9
Maharashtra	12.0	3.2	2.9	24.1
Andhra Pradesh	4.1	0.9	3.0	21.3
Karnataka	4.8	0.3	2.0	21.8
Goa	9.4	5.5	6.3	19.5
Lakshadweep	0.2	0.0	2.2	17.1
Kerala	5.7	0.1	5.8	26.2
Tamil Nadu	3.5	0.8	3.1	17.1
Puducherry	0.5	0.0	1.6	8.5
A & N Islands	9.0	0.0	3.3	34.1
India	13.5	2.8	4.9	26.9

in model two in urban India. Arrangement of drainage system, condition of house structure and problem of flies and mosquitoes are highly significant ($p < 0.001$) with skin diseases in urban India. Those households who have arrangement of underground type of drainage system are less likely to have skin diseases than those who have other types of drainage system. It may be due to the fact that drainage systems are developed as underground and covered pucca in urban India. In Millennium Development Goals (MDGs), there has been a goal concerning (goal 6- to combat HIV/AIDS malaria and other diseases) the eradication of malaria. The prevalence of Malaria is highly significantly associated with water use ($p < 0.001$), bathroom, latrine, drainage system ventilation in urban India. Malaria has also five-time highly prone in those households who have severe problem of flies and mosquitoes ($p < 0.001$). Fever other than malaria is also significantly associated with water conditions. The model one shows the significant result of fever other than malaria to water conditions. Those households who are without access to improved water, bathroom, latrine, and ventilation are more vulnerable to this type of disease than those household who have accessibility. Findings of the study also show that those households have severe problem of flies and mosquitoes are more likely to have fever other than Malaria.

5 CONCLUSION

The study of water and sanitation conditions is very important with the perspective of hygiene and health of human being. In conclusion, this study found that conditions of water, sanitation in households and surrounding micro-environment in certain states like Sikkim, Mizoram, and Gujarat has improved considerably and its effect is that disease prevalence is low in these states. The availability of improved latrine facility to the households has very significance relationship with diseases prevalence in urban areas of India, because it directly related to hygiene and health of human. In the absence of latrine facility, person have to go for open defecation and there is always chance to get contact with disease's vector i.e. flies, mosquitoes etc. So, the association between water, sanitation and micro-environmental conditions is highly significant r to the diseases prevalence. The results of this paper indicate that improvement in water and sanitation conditions can substantially reduce the rates of diseases prevalence and it can be expected to affect other aspects of human hygiene and health.

Table 4. Sanitation Conditions in Urban areas of India

Background Characteristics	Stomach Problem		Skin Disease		Malaria		Fever Other Than Malaria	
	Model-I Odds Ratio (N=94571)	Model-II Odds Ratio (N=94153)	Model-I Odds Ratio (N=95573)	Model-II Odds Ratio (N=94155)	Model-I Odds Ratio (N=94576)	Model-II Odds Ratio (N=94158)	Model-I Odds Ratio (N=94556)	Model-II Odds Ratio (N=94140)
Sources Of Drinking Water								
Improved®	1	1	1	1	1	1	1	1
Unimproved	0.83***	0.87***	0.85***	0.87***	0.96	1.08	0.91***	0.95*
Sources of Water for HH Activities								
Improved®	1	1	1	1	1	1	1	1
Unimproved	1.08***	1.00	1.20***	1.16***	1.07	0.95	1.02	0.96
Distance From Source Of Drinking Water								
Within Premises	1	1	1	1	1	1	1	1
Less Than 0.2 Km	1.10***	0.84***	1.15***	0.99	1.52***	1.15***	1.23***	0.95***
0.2 Km And Above	1.22***	0.97	1.33***	1.16***	2.05***	1.42***	1.35***	1.04
Bathroom Facility								
Attached		1		1		1		1
Detached		1.13***		1.16***		0.93		1.24***
No		1.46***		1.25***		1.07		1.56***
Distance From Bathing Place								
Within Premises		1		1		1		1
Less Than 0.2 Km		1.07**		1.03		1.01		0.93***
0.2 Km And Above		0.98		0.97		1.64***		0.95
Latrine Facility								
Improved®		1		1		1		1
Unimproved		1.48***		1.42***		1.58***		1.18***
No		1.03		1.01		1.52***		1.14***
Drainage System								
Underground		1		1		1		1
Covered Pucca		0.89***		0.99		0.98		0.96
Open Pucca		1.05		1.06		0.91*		1.05**
Open Katcha		1.31***		1.17***		0.89*		1.03
No Drainage		0.92***		0.90**		0.75***		0.91***
Garbage collection								
Panchayat/ Municipal Corp		1		1		1		1
Arrangement Made By Residents		1.13***		1.19***		1.27***		1.13***
No Arrangement		1.40***		1.37***		1.34***		1.33***
Problems Of Flies/Mosquitoes								
Severe®		1		1		1		1
Moderate		0.69***		0.68***		0.61***		0.75***
No		0.37***		0.34***		0.19***		0.38***
Sector								
Rural		1		1		1		1
Urban		0.87***		0.88***		0.81***		0.87***

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6.2 Conflicts of interest

There are no conflicts of interest between the authors of this paper.

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