

# Assessment of sanitation and drinking water facilities among slum households in Bhubaneswar, Odisha – A cross-sectional study

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## ABSTRACT

**Aim:** The study aims to assess the practice of using unsafe drinking water and sanitary practices among the population dwelling in slum settings of Bhubaneswar city, Odisha, India. **Subjects and Methods:** A cross-sectional study was conducted among 288 households in the Bhubaneswar slums of Chandrasekharapur, Neeladri Vihar, and Trinatha basti. A questionnaire was administered face to face. Descriptive statistics were used to define the participants' sociodemographic characteristics, household information, drinking water, latrine characteristics, and waste disposal. **Results:** The majority (59.7%) resided in kutcha households in notified slum areas, and 89.6% were reportedly illiterate. About 92.7% resided in a deplorable condition, relying on piped water (79.5%) from the community sources and 20.5% used it for drinking and household purposes. Around 83% of the respondents stated they did not treat water before consumption. Bathroom facilities were found to be inadequate, and 74.3% used pit latrines. The majority of household wastes (83%) were managed by directly letting them to the drainage system untreated. As a consequence, 91% reported breeding of flies and mosquitoes near their household premises and 70.5% stated having fever in the past 6 months. **Conclusion:** Despite the government's initiatives to improve water, sanitation, and hygiene (WASH) strategies, an extensive gap in practice was observed. As a result, Bhubaneswar municipality must strictly enforce policy and regulatory guidelines concerning WASH to improve the sanitation practices, particularly in the areas of drinking water and household waste management.

**Keywords:** Drinking water, household waste management, India, sanitation, urban slums, WASH practices

## Introduction

In the year of 2020, the World health organization (WHO) stated sanitation is a vital aspect of human health; yet, more than the half of the global population still lacks basic sanitary

facilities.<sup>[1]</sup> Globally, it is estimated that around 2.5 billion people lack access to improved sanitation, while the overall illness burden associated with water, sanitation, and hygiene (WASH) accounts for 4.0% of all fatalities and 5.7% of total disease burden disability adjusted life years (in DALYs).<sup>[2,3]</sup> More than half of the population accounting for mortality and morbidity related to WASH is estimated to reside in low- and middle-income countries (LMICs).<sup>[3]</sup> According to a recent WHO report, one in every three individuals is deprived of access to safe drinking water facilities.<sup>[4]</sup> According to another report by the United Nations International Children's Emergency Fund (UNICEF), a minimum

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of 2 billion people globally consume fecally contaminated water,<sup>[5]</sup> which aggravates diseases such as parasitic infections, like hookworm infection, schistosomiasis, ascariasis, trichuriasis, trachoma,<sup>[6]</sup> and water-borne diseases such as diarrheal diseases, typhoid, and others,<sup>[7]</sup> resulting in approximately 1.4 million deaths.<sup>[6]</sup>

In the context of this rising public health concern, research has found that WASH-related issues are more prevalent in areas with urban poor and rural inhabitants. In the year 2005, an initiative was launched to enhance and achieve the Millennium Development Goals (MDG) Goal 7, Target 10, which intended to reduce to half the global population's reliance on inaccessible sanitation and safe drinking water. Unfortunately, the target to achieve the goal was not fulfilled.<sup>[2]</sup> Therefore, to keep continuity on the improvement of the water and sanitation facilities and to terminate the tradition of open field defecation by the year 2025, the 2030 agenda was established with the Sustainable Development Goals (SDGs) centered on the #6 Goal, "Ensuring availability and sustainable management of water and sanitation for all."<sup>[8]</sup>

On the other hand, LMICs like India have WASH conditions that are much worse in urban slums than in rural areas. This is due to increased urbanization as well as exceedingly poor living and environmental circumstances.<sup>[9]</sup> Earlier, a report released by the joint monitoring program (WHO/UNICEF JMP, 2014), stated India was "not up to the mark" in terms of WASH.<sup>[10]</sup> On the contrary, according to the recent findings from National Family Health Survey (NFHS) 5 data, 82% of the total Indian population reported practicing good sanitary practices, which is still far below the majority of developing countries throughout the world.<sup>[11]</sup> Evidence suggests that the rise of slum settings in the recent past is due to rapid urbanization, in which individuals relocate to cities in quest of opportunities such as jobs and better living conditions.<sup>[9]</sup> The concentration of such a population in a smaller area leads to insufficient clean drinking water, poor hygienic conditions, a lack of garbage collection and management, and insufficient health-care services.<sup>[9]</sup>

Although there are several programs, schemes, and regulations in place to fight WASH concerns, there are certain gaps in implementation that limit people's ability to adopt safe behaviors, particularly among the overcrowded slum population.<sup>[6]</sup> The National Sample Survey Office (NSSO) conducted a nationwide survey on sanitation and hygiene, drinking water, and housing conditions from July to December 2012, during its 69<sup>th</sup> cycle, in which Odisha participated. It was reported that in Odisha, around 69.3% of households shared a common source to obtain drinking water for community usage. The proportion of households without latrines was found to be 71%, and total dwelling space was also determined to be insufficient.<sup>[12,12]</sup> However, a lack of accurate data on WASH practices among Odisha's slum population has contributed to many health and social difficulties. As a result, this research was carried out in

three slum areas in Bhubaneswar to identify the gaps in WASH practices among slum households and uncover some of the real-time issues of the slum areas in Odisha, India.

## Subjects and Methods

### Study design and site

A community-based, descriptive, cross-sectional study was conducted from January to March 2020 in the slums of the state capital of Odisha, Bhubaneswar, present in the Khordha district. It is the largest city in Odisha with an area of 186 km<sup>2</sup> located on the southwestern bank of the Mahanadi river. According to Census 2011 provisional reports, the city has a population size of 843,402 households.<sup>[13]</sup> As per the Bhubaneswar Municipal Corporation (BMC), there are about 436 urban slums in Bhubaneswar city.<sup>[14]</sup>

### Study population and study sampling

The study population comprised slum dwellers who were willing to participate in the study and could give consent for the study. Multistage sampling was used to select the slum population. In the first phase of sampling technique, out of a total 436 slum areas in Bhubaneswar city, three slums were randomly selected, that is, Chandrasekharpur basti, Neeladri Vihar basti, and Trinatha basti. Computer-generated random draw technique was used for this random selection. Subsequently, after reaching each of the selected slums, the entire area was divided into different zones of about 100 households each. One zone was randomly selected among all the zones in each of the selected slum. Next, all households in the selected slum zone were visited to conduct interviews. In each household, the head of the household, usually the eldest person, was chosen as the preferred respondent. In case of inability or absence of such family member, any other adult member of the family who contributed to financial support to the family was interviewed.

### Sample size

Considering prevalence from a study carried out in a similar context in India,<sup>[15]</sup> the sample size was estimated using the universal formula for prevalence study, that is,  $n = \frac{z^2 pq}{d^2}$ , where  $n$  = desired sample,  $z$  = standard of error = 1.96 for 95% confidence interval (CI),  $P$  = prevalence = 78.5% = 0.785,  $q$  = 1 -  $P$  = (1 - 0.785), and  $d$  = permissible error at 95% CI = 0.05. Therefore,  $n = (1.96^2 \times 0.785 \times (1 - 0.785))/0.05^2 \approx 260$ . Considering nonresponse rate of 10%, the total sample size became 286, totaling to 290. Rounding this figure to 300, about 100 households were targeted in each of the selected slums. At the end of data collection, the total sample size achieved for the study was 288, which met the required sample size.

### Inclusion criteria and exclusion criteria

Head of the family or an adult person contributing financial support to the members of the household, who was willing to participate in the study and could provide consent before the study was included. Minors, that is, those below 15 years of age,

adults not willing to participate, terminally ill people, and persons unable to give consent were excluded from the study.

### Data collection tools and method

Study participants were thoroughly explained about the purpose of the study, and informed verbal consent was obtained from them after they expressed their willingness to participate in the study. Therefore, they were interviewed face to face using a semi-structured questionnaire that was translated to the local language “Odia” spoken natively. The questionnaire was pretested among 30 slum households outside the research setting, and necessary changes were made before its administration. For analysis, all data were entered in Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 25. Demographic characteristics were summarized using frequencies and percentage.

### Ethical consideration

The study was conducted in compliance with the protocol of the Institutional Ethics Committee (IEC) of Kalinga Institute of Medical Sciences (KIMS), KIIT University (IEC NO: KIIT/KIMS/IEC/226/2020) and after obtaining approval from the concerned organization.

## Results

### Sociodemographic characteristics

A total of 300 samples were contacted to participate in the study. The aggregate sample size was 288 as calculated, which yielded a response rate of 96%. The participants' mean age was 35.21 years (standard deviation [SD] = 12.26). About 62.5% of the respondents were aged between 15 and 45 years, 31.9% were between 41 and 60 years of age, while 5.6% of the respondents were beyond 60 years of age. About 59.4% of the respondents were female, majority (88.2%) belonged to Hindu religion, 84% belonged to general caste, 89.6% were illiterate, 78.5% worked as daily wage laborers, and majority (60.8%) had a monthly family income of between 5000 and 10,000 Indian rupees. The sociodemographic characteristics of the study group have been enlisted in Table 1 [Annexure 1a].

### Household characteristics

A total of 30.2% of the study subjects had more than five members in a single dwelling unit, which indicated a crowded environment, and majority (82.4%) of the study participants stated the “eldest male member” to be the head of the household. About 56.6% of the respondents belonged to the age group 20–40 years. Around 93% of slum dwellers reported their housing structure to be in a bad condition. The household characteristics have been enlisted in Table 2 [Annexure 1b].

### Drinking water characteristics

Majority (79.5%) stated the principal source of drinking water to be piped water primarily from community sources

supplied by the state municipal bodies for the slum households. [Figure 1 and Annexure 2a]. About 91% of the respondents fetched their drinking water from sources outside of their dwelling premises, which were present within 2 km from their houses. All the respondents (100%) had no complaint in regard to taste and quality of the drinking water. Surprisingly, around 83% did not treat their water before drinking, while only 17% treated water by boiling before consumption [Figure 2 and Annexure 2b]. For drinking, 78.8% of the respondents poured water directly into their glasses, while 12.8% said they used to dip their container directly into the water container with bare hands for taking water and 8.4% used container with a handle to take water for drinking purposes [Figure 3; Annexure 2c]. Also, 86.5% of the respondents stated they had sufficient water supply for their household purposes throughout the year. Whereas, when enquired about the frequency of water supply annually, 86% of the respondents denied getting regular water supply to their households. Majority of the respondents (99.7%) had also claimed stagnation of wastewater around their household premises.

### Bathroom characteristics

A total of 62.2% of the households agreed that they had attached bathroom facility, while 21.1% had detached facility and 16.7% said they had no bathroom at all [Figure 4 and Annexure 2d]. Also, 65.6% had access to toilet facility for the exclusive use of the household, 23.4% used the toilet meant for the community or public use, and 11% used common toilets in their household setting [Figure 5 and Annexure 2e]. Moreover, 62.5% had a bathing place within the dwelling unit, 19.1% had bathroom facility outside the dwelling premises, while 18.4% of the study population had bathroom outside the dwelling but within the premises. Surprisingly, 56.3% of the study population had latrine facility outside the dwelling premises and 43.8% had latrine facility within the dwelling premises. Also, 74.3% of the respondents' households had pit latrine facility, 16.3% had no latrine facility, and 9.4% had flush/pour latrine. Households with children below 5 years of age (59%) disposed of feces untreated directly to other facilities such as drains, ponds, tube wells, and water bodies, while 33.3% of the respondents said they used to throw the fecal matter of the under-five to garbage or dumping site, 6.9% of the respondents said they used flush latrine to dispose of the fecal matter, and only 0.8% of the respondents said they used diaper to collect fecal matter of the under-five children, which they disposed of in the communal dumping site [Figure 6 and Annexure 2f].

### Household waste disposal and treatment

Of all the respondents, 86.1% stated that all members of their families solely depended upon latrine facility for defecation, 10.4% stated that there was no certainty using household latrine or open field for fecal defecation as they either lacked a latrine facility in their dwelling unit or had no access to public toilets, while 3.5% of the respondents agreed to not using latrine and relied solely on open field for defecation [Figure 7 and Annexure 2g]. The entire slum setting (100%) had open kutchra drainage

facilities in front of their household premises, which remained uncovered and bred flies and mosquitoes that seemed to be a major problem in the slum setting, which was accepted by 91% study population. Eighty-three percent of respondents said they disposed of wastewater of the households directly to the drainage facility without treatment. Also, 82.6% of the respondents said there is facility for collection of solid waste garbage from the households, while 17.6% denied having any facilities for solid garbage collection. Moreover, 69.9% of the respondents revealed they disposed wastes to an exclusive community spot meant solely for garbage collection and disposal, while 30.2% said they had their own individual dumping spot for garbage disposal. Households also stated to have suffered from mild fever (70.5%), stomachache (24.3%), skin diseases (4.2%), and vomiting (1%) in the past 6 months [Figure 8 and Annexure 2h].

## Discussion

In India, majority of the issues related to WASH are extensively worse among the urban slums than the rural population. The present study has attempted to highlight the WASH-related issues faced by the slum dwellers of Bhubaneswar city located in the state of Odisha, India. Since the past few decades, WASH has remained a matter of concern among the slum population of the city. Although there are guidelines lined up by the government of the state to facilitate the provision of safe water and proper management of wastes generated by the slum community, various gaps have frequently been observed, indicating that good sanitation and hygiene practices are not followed to their full capacity.

Majority of the slum population who participated in the study lived in poor socioeconomic conditions; they lacked formal education and dwelt in housing structures having minimum space for each individual. Research studies have found close proximity among members of the households aggravate infectious diseases such as tuberculosis, skin infections, acute respiratory tract infections, and so on, which was also seen in our study population.<sup>[16,17]</sup> Similar findings were reported in a study by O'Neil,<sup>[18]</sup> which has suggested that focus should be applied on three pillars for a healthy dwelling space, that is, basic quality of housing and sanitation, dampness and molds, and overcrowding of the dwelling places.

Keeping in view the drinking characteristics with respect to the WASH strategy, majority of the slum population in this study depended mainly upon tube well and piped water sources supplied by the BMC for drinking purposes or for community use. A remarkably high proportion of the population in the current study (83%) did not treat the water before drinking, while only a smaller proportion of the study participants (12%) relied on boiling technique for its treatment. This finding is in concordance with a similar study conducted in Kolkata by Kanungo *et al.*,<sup>[19]</sup> where about 86%–90% of the population did not treat water before consumption as they thought water obtained from direct municipal sources is readily safe for consumption. However, there

are several health challenges found by various research studies; one of these is the outbreak of typhoid fever in a slum area of West Bengal, India, which was due to the consumption of piped water contaminated by feces.<sup>[20]</sup> A study by Sangra *et al.*<sup>[21]</sup> also suggested that water-borne infection or related diseases could easily be prevented if water is safely handled by following simple measures such as covering the water container using a lid and treating water before consumption with methods such as boiling, candle filtration, chlorination techniques, or fetching water using a long-handled ladle. However, it was observed that very less number of participants followed these habits in this study.

Another study by Kaniambady *et al.*<sup>[22]</sup> observed that 27% of slums all over India had no garbage disposal facility and revealed that majority of the slum population disposed their liquid wastes (68.3%) and solid waste (59.8%) haphazardly.<sup>[22,23]</sup> Similar results have been found in this study which revealed distorted ways of waste disposal among slum households. About 69.8% reported that they disposed the solid wastes at the community dumping spot set by the BMC, while 83% reportedly disposed liquid wastes in the open drainage system of kutchra origin. In addition to this, the households had other problems of water stagnation and open drainage system in front of their dwelling unit. Presence of such an open drainage system where the wastewater often remains stagnant acts as a breeding site for flies and mosquitoes. This acts as a primary source for aggravation of vector-borne diseases such as malaria, dengue, and chikungunya, along with infectious diseases such as diarrhea, vomiting, food poisoning, and others, which, in fact, contribute to the high mortality and morbidity among those residing across the slum areas.

According to the NFHS 5 report, “19% households do not have improved sanitary condition and prefer open fields for defecation,”<sup>[11]</sup> while similar findings had been obtained from this study, wherein about 16.3% of the population lacked latrine facility, which means they preferred open field for defecation. A unique finding from our study was that 74.3% of the study households had pit latrine, but it was located outside the dwelling premises; On the contrary, disposal of under-five children's feces is said to be open if it is disposed of directly on the ground or thrown away in the garbage untreated. Findings show that about 93% of under-five children's feces was disposed of in open fields, which indicates the ongoing practice of open defecation till date even when the government has equipped the slum households with basic sanitary facilities. This finding matches with the findings from another study by Sinha *et al.*,<sup>[6]</sup> which states that accessibility to latrines alone does not reduce open field defecation practices.

A study by Routray *et al.*<sup>[12]</sup> has reported that the overall issues of noncompliance to WASH services among the slum population could be managed by identifying key barriers such as lack of government subsidies, absence of water facility near the toilet site, social norms, socializing habits, rituals, and daily routines varying with caste, gender, marital status, age, and lifestyle. Addressing these issues through awareness campaigns for



a sustained behavior change using the IEC techniques and provision of accessible and available facilities initiated by the Government of India (GOI) could bring about change. Behavior change campaigns might be slow at initiation, but when adopted, they become self-supporting.<sup>[6,24]</sup> Therefore, to improve WASH facilities as per the SDG, there is an urgent need to focus on the developmental aspect and other complementary measures such as providing spatial position to low economic classes, providing education, and giving a special focus on the issues that need to be addressed in order to improve the WASH practices among the slum population.<sup>[8]</sup>

WASH strategies such as strengthening the current WASH supplies through finances and good governance should be formulated and implemented to make them effective. In addition to it, we should focus more on operation management and maintenance, development, and adaptation of newer technologies to reduce waste and make safe drinking water available to every slum household. Moreover, initiatives like routine monitoring of WASH practices and implementation must be carried out by government functionaries. Additionally, collaborative efforts must be initiated from the health professionals as well as community leaders to strengthen WASH implementation for improving accessibility to safe WASH services to all individuals at a global level.<sup>[25]</sup>

## Conclusion

Although the government has taken several initiatives to strengthen the WASH strategy, it still confronts a significant challenge in overall slum rehabilitation. While the government has facilitated WASH facilities such as piped drinking water, communal dumping sites, and toilet facilities to the families, the slum residents have repeatedly expressed hesitancy in accessing them. It is considered that the reason for poor health and a defective environment is mostly human behavior. Accepting adequate sanitary procedures becomes a barrier to adoption of such behavior. However, sanitation and hygiene practices must still be carried out. Slum residents must be made aware of these issues and their implications through behavior change activities in order to improve general health and sanitary well-being. Furthermore, as there is lack of accurate data from other slum regions of the state, the current study findings also set the criteria for future research.

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## Declaration of participant consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have

given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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## Annexure 1

**Table 1: Sociodemographic characteristics of the study group**

| Sociodemographic characteristics   | Frequency (n=288) | Percentage |
|------------------------------------|-------------------|------------|
| Age (years)                        |                   |            |
| 15-40                              | 180               | 62.5       |
| 41-60                              | 92                | 31.9       |
| >60                                | 16                | 5.6        |
| Sex                                |                   |            |
| Male                               | 117               | 40.6       |
| Female                             | 171               | 59.4       |
| Religion                           |                   |            |
| Hindu                              | 254               | 88.2       |
| Muslim                             | 14                | 4.9        |
| Christian                          | 20                | 6.9        |
| Caste                              |                   |            |
| General                            | 242               | 84.0       |
| Scheduled caste                    | 38                | 13.2       |
| Scheduled tribe                    | 8                 | 2.8        |
| Education                          |                   |            |
| Illiterate                         | 258               | 89.6       |
| Primary                            | 22                | 7.6        |
| Secondary                          | 6                 | 2.1        |
| Higher secondary degree            | 1                 | 0.3        |
| Occupation                         |                   |            |
| Driver                             | 13                | 4.5        |
| Laborer                            | 226               | 78.5       |
| Others <sup>a</sup>                | 49                | 17.0       |
| Total monthly income of the family |                   |            |
| 0-5000                             | 78                | 27.1       |
| 6000-10,000                        | 175               | 60.8       |
| >10,000                            | 35                | 12.2       |

<sup>a</sup>Includes tailoring, housekeeping, sweeping, and others**Table 2: Household characteristics of the study group**

| Household characteristics                              | Frequency (n=288) | Percentage |
|--|-------------------|------------|
| Household size   |                   |            |
| 1-5  | 200               | 69.4       |
| 6-10   | 87                | 30.2       |
| >10  | 1                 | 0.3        |
| Respondent type  |                   |            |
| Eldest male member                                     | 4                 | 1.4        |
| Eldest female member                                   | 2                 | 0.7        |
| Other adult male member                                | 237               | 82.4       |
| Other adult female member                              | 45                | 15.6       |
| Age of the respondent (years)                          |                   |            |
| 20-40  | 163               | 56.6       |
| 41-60  | 94                | 32.6       |
| >60  | 17                | 5.9        |
| Household type of the respondent's family              |                   |            |
| Kutcha   | 172               | 59.7       |
| Pucca  | 39                | 13.5       |
| Kutcha-pucca   | 77                | 26.7       |
| Condition of structure where the slum household dwells |                   |            |
| Good   | 1                 | 0.3        |
| Satisfactory   | 20                | 6.9        |
| Bad  | 267               | 92.7       |

## Annexure 2

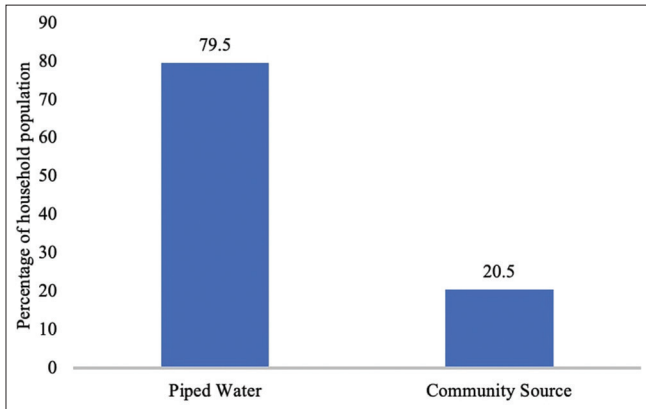


Figure 1: Principal source of drinking water

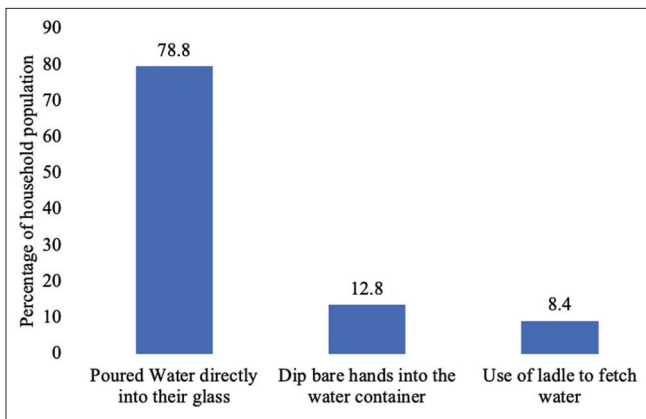


Figure 3: Method of fetching water for drinking

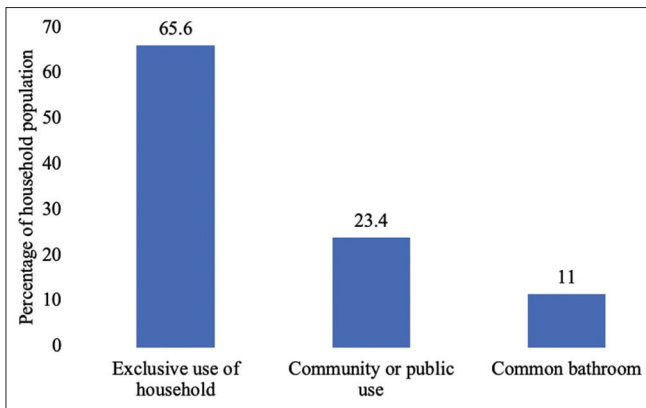


Figure 5: Access to toilet among households

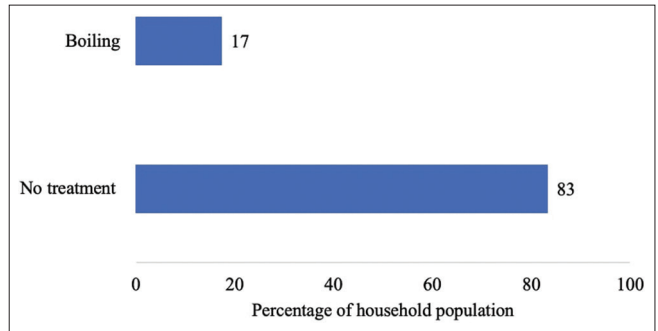


Figure 2: Treatment method of water

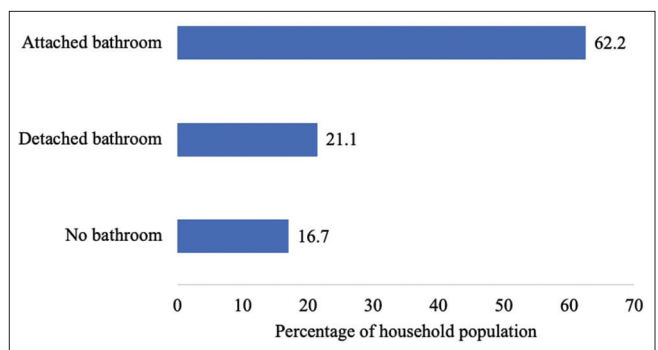


Figure 4: Bathroom facility in the household

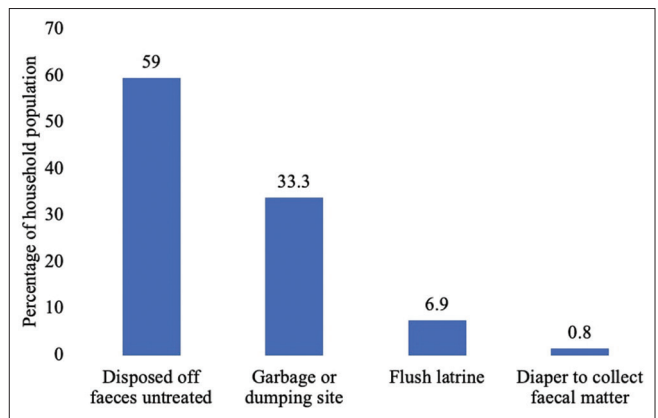


Figure 6: Facility used to dispose under-five fecal waste



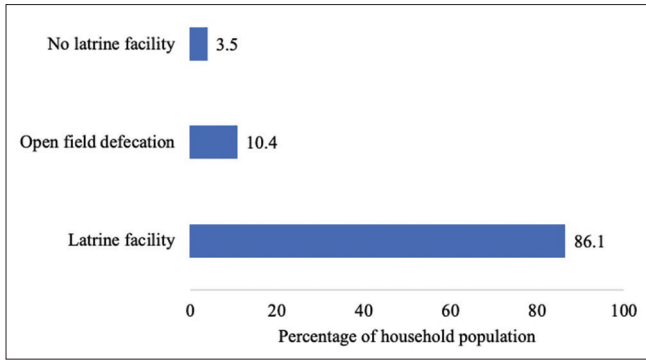


Figure 7: Household latrine use

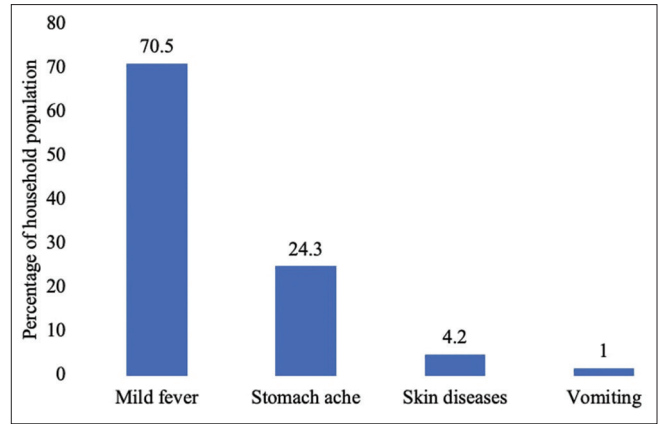


Figure 8: Illness suffered by households in the past 1 month