Chapter

Household Water Handling Practices in the Arid and Semi-Arid Lands in Kenya

Edith J. Kurui, George M. Ogendi, Wilkister N. Moturi and Dishon O. Nyawanga

Abstract

Utilisation of water from unimproved water sources coupled with inadequate access to sanitation can adversely affect human health. This study undertaken from November 2014 to March, 2015 sought to assess the household water handling practices and relate them to the prevalent diseases in Baringo Central and South, Kenya. A Household sanitary survey was conducted and questionnaires were administered to 100 household heads within the study area. The data was analysed using descriptive and inferential statistics. The results indicated that 72% of the households (n = 100) collected water for cooking and drinking from the water pans. Only 34% of the households treated water commonly using boiling (19%), filtration with cloth (2%), chlorine (11%) before using it for drinking. There was a positive correlation between methods used in accessing water from drinking water storage containers and water related diseases prevalent in the study area ($p < 0.05$). Household drinking water in the study area did not meet the WHO drinking water quality guidelines mainly due to poor handling practices at the household level. There is a need to promote water, sanitation and hygiene campaigns in the study area to prevent water related diseases at the household level.

Keywords: drinking water, sanitary survey, storage containers, water pan users, Baringo

1. Introduction

Despite numerous efforts and interventions by the private and government sectors, 1.3 billion people in the developing world lack adequate access to clean and safe drinking water [1]. Recent statistics indicate that approximately 770 million people still use unimproved water sources, whereas 36 per cent of the world's population lack improved sanitation facilities [2].

Kenya is considered chronically water scarce. The ASALs in Kenya are highly affected, with water scarcity leaving the majority of the inhabitants dependent on unimproved water sources. According to the 2014 Joint Monitoring Program (JMP) report, Kenya was ranked to be among countries with inadequate sanitation facilities in the rural areas, where some open defecation cases have been reported [3]. Water sources for most households in ASALs is drawn from water pans, dams, unprotected springs, unprotected wells, water vendors and rivers.

Like many other ASALs in Kenya, Central and South Baringo is characterised by inadequate access to water and sanitation. The main water sources in the region are unprotected water pans and dam. The existing high morbidity and mortality from communicable diseases in households in ASAL areas can partly be attributed to inadequate access to sanitation [4]. According to 2014 survey by the Ministry of Health (MoH) in Kenya, Baringo County was ranked 38 out of 47 on County sanitation. Twenty four percent of the Baringo County population uses improved water sources, whereas 39% uses improved sanitation facilities [5]. It is against this background that this study was conceived to assess the household water handling practices in relation to the prevalent water-related diseases in Central and South Baringo.

This study focussed on the arid and semi -arid lands of Eldama Ravine, Mogotio and Marigat sub-counties. Literature shows that the areas are water scarce and the major water sources that augment the river water are the excavated water pans [6]. WHO, in 2008 categorised open water sources without protection as unimproved water sources.

2. Methods

2.1 Study area

Central and South Baringo is located at the longitudes and latitudes of 35° 30" 0° E and 0° 30" 0° N (**Figure 1**). Geographically, Central and South Baringo is made up of; Marigat sub-county at the central point of Baringo county, to the south is Eldama Ravine and Mogotio sub-counties which form the Southern part of the County. The population size of the study area was estimated to be 239,405, distributed among the three sub- counties as follows; Mogotio sub county; 60,959, Eldama/Ravine; 105,273 and Marigat Sub-County; 73,173 [7]. The population dwelling in Eldama Ravine and parts of Mogotio Sub-Counties practice mixed farming and marginal mixed farming [7]. The climatic condition ranges from arid to semi-arid lands. The temperatures experienced ranges from a minimum of 10°C to a maximum of 35°C. Annual rainfall varies from 1000 to 1500 mm in the highlands of Eldama Ravine sub-county, and varies between 250 and 500 mm per annum in Mogotio and Marigat sub-county.

2.2 Research design

A cross sectional survey study was used in conducting this research. The study was conducted among the water pan users utilising the six randomly selected water pans in Central and South Baringo. The water pans used in the study were; protected (Cheraik) and unprotected (Kures, Kapchelukuny, Chepnyorgin, Kaptipsegem and Kinyach) water pans. Protected water pans as used in this study were those water pans that were fenced and had distinct water points for human access and livestock watering, whereas the unprotected water pans were those water pans that had no fence and there was free access for both humans and livestock to the water, increasing the level of contamination.

Nassiuma [8] formula was used to determine the household sample size that was used to administer the questionnaires and conducting the sanitary surveys. A preliminary survey was conducted prior the data collection to be able to identify the total number of households using the water pans. The total number of household were retrieved from the water pan committee members of the various water pans who verified the number of households using the water pans to be a total of 1130 households.

$$n = NC^2/C^2 + (N-1)e^2 \quad (1)$$

Figure 1.
Map showing the study area.

Where, N: represents the total number of households using the water pans (1130). n: represents the study sample size, C: coefficient of variation (30%) e: margin of error(2.9%).

Using the above formula;

$$n = 1133 \times 0.3^2/0.3^2 + (1133–1)0.02^2 \quad (2)$$

$$n = 98 \approx 100 \quad (3)$$

100 households were used in conducting the household survey and administration of the household questionnaires. They were proportionately selected from the water pan users using each water pan as shown in **Table 1**.

Primary data collection was done using observations and scheduled interviews of the selected households. Secondary data on the prevalence of water-related diseases in the study area was collected based on health records from health centres located in the study area.

2.3 Data analysis

Descriptive statistics were used to analyse the data on the demographic information. Pearson correlation was used in assessing the association of household water handling practices to the prevalence of water related diseases in the study area.

Name of the water pan (site)	N(n)
Cheraik	91(8%)
Kapchelukuny	396(35%)
Kures	46(4%)
Chepnyorgin	249(22%)
Kaptipsegem	57(5%)
Kinyach	294(26%)
Total	**1133(100%)**

Key: N is the total number of households using the water pans, whereas, n is the sample size selected from the water pan.

Table 1.
Showing the proportionate distribution of the sample size per water pan.

3. Results

3.1 Demographic information of the respondents

Out of the 100 respondents randomly selected for this study 35% (n = 35) were male whereas the rest (65%) were female. The majority of the respondents were in the age bracket of 31–40 (32%) and 21–30 (30%) years of age respectively while the rest of the respondents were below 20 years. The age bracket of the respondents depicts a younger and youthful age of most of the resident communities in the study area. This was slightly higher than the national age bracket of 21–30(18.1%) and 31–40(14.5%), respectively in Kenya. The education level of the respondents from the study area is shown below (**Table 2**).

3.2 Water sources in the study area

Water pans are open surface water and prone to contamination. Seventy-two percent of the households depended on water drawn from pans for cooking, drinking, bathing and livestock (**Figure 2**).

3.3 Time taken to and from the water sources

This study found out that water pans have eased the time spent by the water pan users within the study area in search of water for cooking and drinking with most of the respondents spending less than an hour on a round trip of water, some could spend as few as 10 minutes on a round trip due to the close proximity of the excavated water pans. (**Figure 3**).

Highest education level attained	Percentage (%)
University	3
Tertiary colleges	11
Secondary schools	35
Primary	45
Did not go to school	6
Total	100

Table 2.
Education level of the respondents.

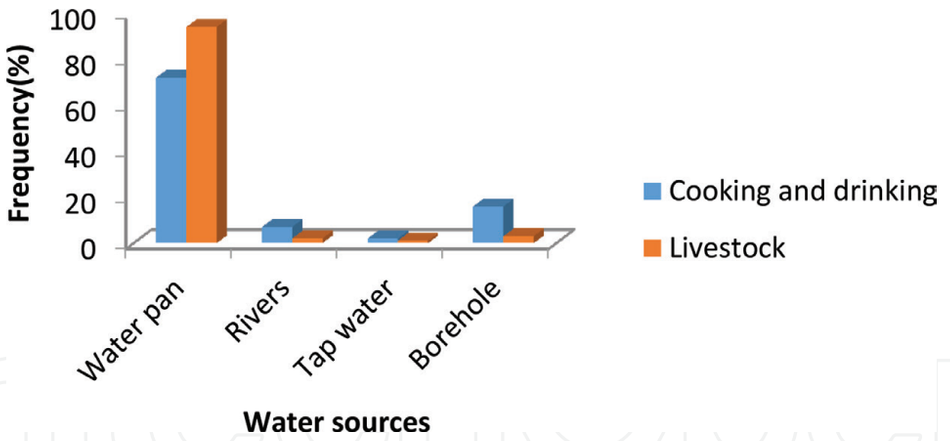

Figure 2.
A graph showing the water sources for cooking, drinking and livestock use.

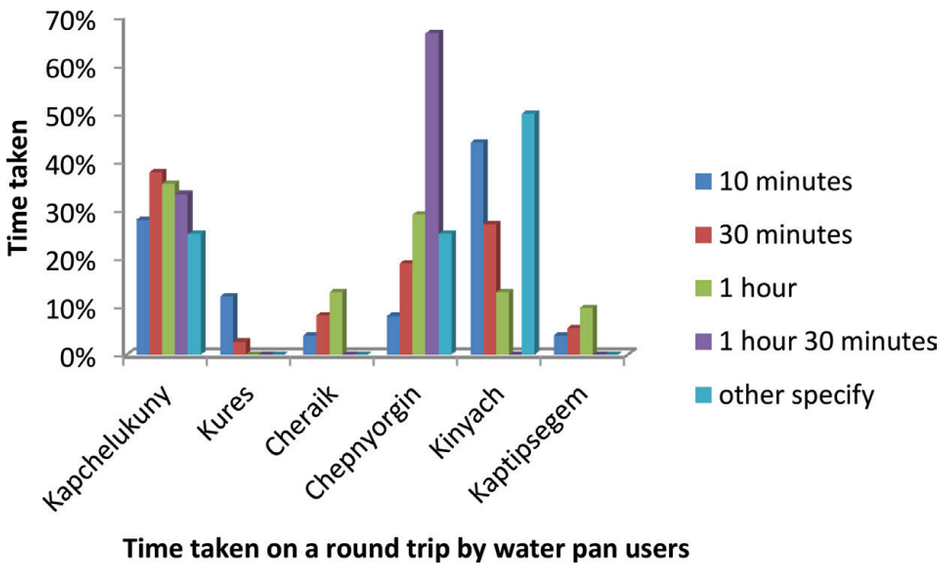

Figure 3.
A graph showing time taken on a round trip to nearby water sources.

3.4 Household knowledge and attitudes on drinking water

A Likert scale showed that 33% of the respondents perceived the water they drink from the water pans as good, 19% perceived them as bad since they were covered with algae and has a bad smell and 48% perceived the water they drink to be fair because they had never suffered from any disease while using the water pan water for drinking.

3.4.1 Household water handling practices

3.4.1.1 Drinking water storage containers

Approximately 71% of the respondents used plastic containers to store their drinking water. This was explained as easily affordable in the market and provided a good option for safe water storage at household level. Nineteen percent of the study population used jerry cans (**Figure 4**), this was explained by the respondents as easy to carry and readily available in the market. The jerry cans are available in various capacities that could also be carried by small children. Six percent used clay pots to store drinking water in their households, as it keeps water cold and reduces microbial contamination (**Figure 4**).

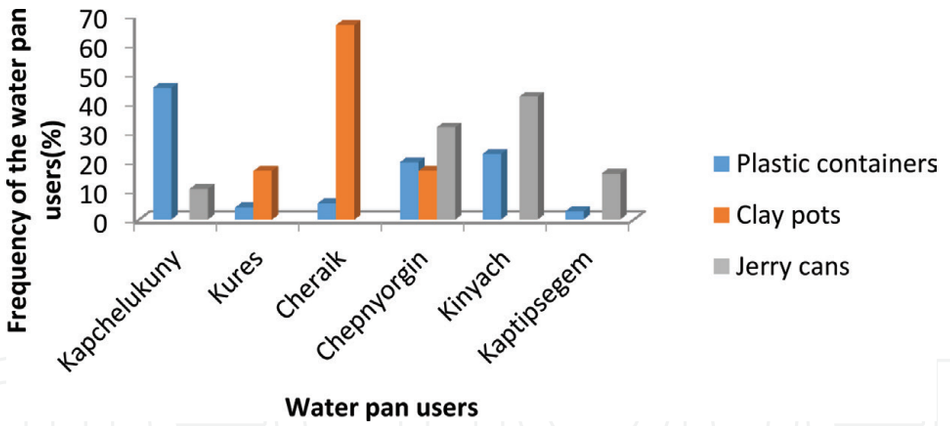

Figure 4.
A graph showing drinking water storage containers used by the water pan users.

3.4.1.2 Location of drinking water storage container in the house

The storage containers were located in different parts of the room. According to 57% of the respondents their drinking water storage containers were located in the corner of their living room. This was associated to protection of the drinking water storage container from contamination and damage. Seventeen percent of the respondents stored their drinking water storage containers in the kitchen, since it was easily accessed and also used for cooking. Fourteen percent of the respondents stored their drinking water storage containers at the door of the living room, since it was easily accessed and the living room was clean and safe from contaminants.

3.4.1.3 Water handling in the household

Ninety three percent of the respondents covered their drinking water storage containers. Eighty three percent used tight fitting lids of the containers, 3% covered them using a clean cloth and 4% did not cover their containers. According to this study, the drinking water storage containers were cleaned as per the following frequencies; daily (11%), after 2 days (16%), weekly (42%), and yearly (3%). The cleaning was conducted upon the presence of dirt in the drinking water storage container. Approximately 60% of the households in the study area cleaned their drinking water storage containers. On average 52% of the respondents used soap and water, 25% used sand and water whereas 13% used water only to clean their containers. This was believed to remove dirt in the storage container. Those using sand and water, believed that due to the abrasion nature of the sand, it was a good material that could remove the bio film formation in the drinking water storage container.

3.4.1.4 Mouth sizes of drinking water storage containers and mode of access

Mouth sizes of the drinking water storage containers varied from one household to another in the study area. The mouth sizes were categorised into narrow, small, wide and medium. The drinking water storage containers that were categorised as **Small** mouth size identified the 5 litre- 35 litre jerry cans that are used in the household for the purpose of storing drinking water in the household. **Medium** mouth sizes were those containers with a minimum volume of 50 litres to a maximum volume of 10,000 litres that had a tap fitted in it used in fetching water. **Wide** mouth sizes were used to identify the buckets that were used to store drinking water in the household.

Fifty-five percent of the respondents reported that adults fetched water for the young children; because children were likely to contaminate drinking water upon access. In 38% of the households children fetched their drinking water for themselves increasing the chances of fecally contaminating the household drinking water (**Figure 5**).

3.4.2 Household water treatment in the study area

Averagely, 34% respondents in the study area treated their drinking water. This was explained as a way of killing the pathogens in drinking water. On average 19% of the respondents boiled their water before drinking. This was attributed to the existing knowledge of killing the diseases causing pathogens in water before consumption. On average 11% of the respondents reported using chlorine and its constituents (5.25% NaOCl) to treat their drinking water, sodium hypochlorite was preferred by the respondents due to the residual effects they have in killing microbial contaminants.

3.4.3 Household solid wastes

Data from household questionnaires and observation schedules indicated that approximately 89% of the households disposed of their household solid waste through burning, thus there was no waste lying at the resident compounds at the time of visit. Eleven percent of the respondents reported throwing their solid wastes away in the open; it was observed that the latter had solid wastes lying within the proximity of their compounds.

3.4.4 Hand washing

Findings from this study indicated that 31% of the respondents washed their hands before eating, because of cultural beliefs and taboos. Seventeen percent washed their hands after visiting the toilet and reported to have been trained by the public health officers, after taking a sick child to the hospital. Other critical hand washing times identified in the study included; during cooking (4%) and after handling children faeces (9%).

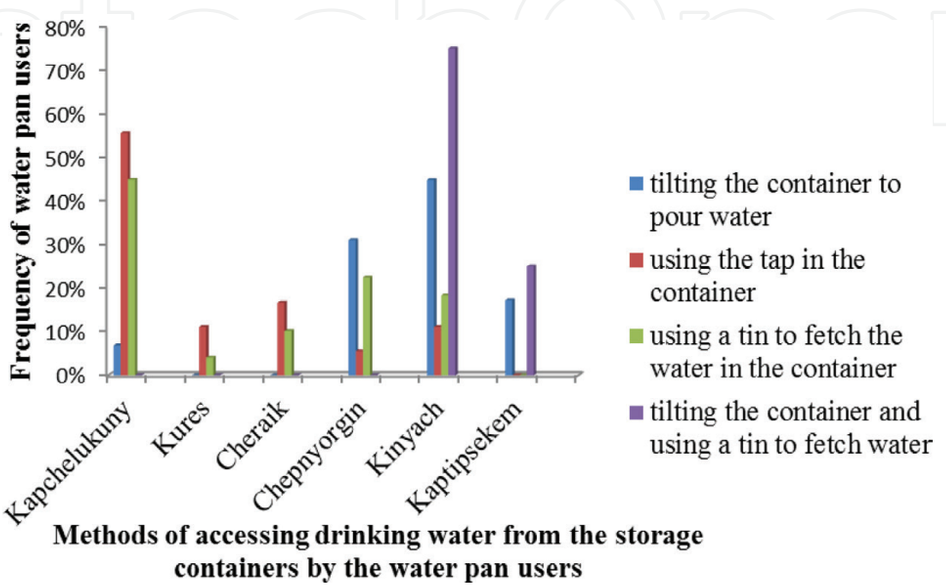

Figure 5.
Figure showing methods used to access drinking water from the storage containers.

Sources of hygiene advice	Percentage (%)
Public Health Officer	28
APHIA II	13
APHIA Plus	9
Clinics	3
School	2
SIDA	1
World Vision	1
WHO	1
Never heard	42
Total	100

Table 3.
The sources of information on personal hygiene in the study area.

The study results further indicated that respondents used the following materials to wash their hands; water only (13%), soap and water (86%) and mud and water (1%).

3.4.5 Sources of hygiene awareness

Fifty nine percent of the respondents had received information on personal and food hygiene, whereas, 27 and 13% indicated that they had received information on sanitation and hand washing. However, 12% of the respondents indicated that they had not received any hygiene awareness during the past 1 year (**Table 3**).

4. Discussion

The 2014 National Demographic and Health Survey showed that 5% of Kenyans had no education, 23.4% had primary level and 45.4% had secondary school education and above. From this survey, the level of education in Central and South Baringo was lower as compared to the national figures. The income level of the resident communities in the study area were far much below a dollar per day, and are categorised among the lowest wealth quintile in Kenya, reported to be at 14.8% [9].

Findings from related studies indicated that 51% of the respondents in Kakamega obtained their water from open sources that are prone to contamination [10], In Central and South Baringo resident communities reported using the water pans for sourcing their household water for use, since it was the only available water source within their reach. In Tanzania, a study documented that only 49.7% of the studied population had access to improved water sources [11], with the remaining portion dependent on unimproved water sources. Use of unimproved water sources for cooking and drinking at the household exposes the household members to consumption of fecally contaminated water causing water related diseases.

Findings from the current study indicated that respondents spent less time in accessing water compared to other studies. Afullo et al. [12] in their study found out that averagely 26.7% of the Kenyan households in ASALs spent under 30 minutes on a round walking trip to and from water sources. Another study by Mohammed et al. [6] found that 41.2% of the respondents in Dukem town Ethiopia spent less than 30 minutes in one round walking trip to obtain drinking water for their households.

Despite the efforts to increase water accessibility to the study population, some of the residents of Central and South Baringo are still spending a lot of time in search of this valuable resource. These study findings were in agreement with other study findings that found out that 42.8% of the households in Kenyan ASALs took more than 1 hour to fetch water in a one round trip. However, in this study majority spent 30 minutes and below on a round trip [12]. In Nakuru municipality 55.4% of the respondents were documented to spend more than 1 hour. in one round trip of fetching water, however, this study recorded 44% households spending 1 hour or more on a round trip of water accessibility [13]. Mohammed et al. [6] found that an average of 17.6% of the respondents took more than 30 minutes to obtain drinking water on a round trip.

With respect to the householder's perception towards water handling Our study findings showed similarities with those of Baig et al. [14] and Sibiya and Gambi [15]. A study in Northern Pakistan revealed that health was not a householder's areas of concern, since they had other pressing needs and that people were not concerned about the poor quality of drinking water as a result of floods [14]. Another study conducted in Nepal revealed that there was lack of knowledge and practices in rural areas regarding water source and sanitary facilities maintenance [16].

In terms of household water storage, the current study findings are similar to those of Mohammed et al. [6] who found out that most respondents (74.4%) in Dukem town used plastic jerry cans container to store drinking water. Safe water storage at the household level helps in preventing microbial water contamination causing water related diseases at the household level. This study finding contrasts with that of a study done in Kakamega that found out that respondents stored their water in different places in the house to make it cool for drinking [10]. Location of drinking water storage containers has not been of householder's concern in regard to microbial contamination of the drinking water, but in making the water cool for drinking. These findings were comparable to Mohammed et al. [6], who found out that 93.2% of the respondents covered their drinking water storage containers. Covering of drinking water storage containers provided a safer way of preventing household drinking water from the risk of microbial contamination.

Twenty nine percent of the households stored their drinking water in jerry cans with small mouth sizes. The containers were tilted to pour water, preventing contamination and was regarded a safer way of accessing drinking water. Forty nine percent of the households used a tin to fetch water from the drinking water storage container; this allowed the household members to place hands and or cups into the stored drinking water increasing the risk of faecal contamination of drinking water. Eighteen percent of the households used the tap fitted in the container to fetch drinking water from the containers, this was the safest way of accessing drinking water without contaminating the water in the storage container during water access. A study conducted in Nyakach in Kisumu found out that 4.8% of the respondents stored their water in a storage container which had a tap in it [17]. This study recorded the highest number of household using safe means of accessing drinking water from the containers. Point of use contamination of water has been perceived to be the leading microbial contamination of drinking water in the households among communities.

The findings of this study contrast greatly with those of Uwimphuwe et al. [18], in their study in Rwanda that showed 67% of the respondents treated their water. This study was comparable to other studies by Onyango and Angienda [5] in Western Kenya found out domestic water treatment practices to include boiling and use of sodium hypochlorite. Wasonga et al. [19] in their study found out that commonly used water treatment options in Nyakach, Kisumu County included use of chlorine. Household water treatment is significant in the reduction of water related diseases such as diarrhoea. Onyango and Angienda [5] study in Western

Kenya deduced that diarrhoea cases were significantly reduced as a result of domestic water treatment. A systematic review and Meta-analysis by Struntz et al. [16] revealed a reduced prevalence of soil transmitted helminths infection as a result of using treated water from a pre-intervention prevalence rates of 68.3% to the post intervention prevalence rates of 43.95%. Studies by Kipyegen et al. [20], revealed that high parasitic infections in Baringo County were associated with inadequate water availability, poor sanitation and lack of water treatment practices in the households.

Hand washing is important in the reduction of communicable diseases. This lack of basic hand washing hygiene adversely affects household water quality as the household members dip their hands in storage containers to access water for household tasks. This study finding contrasted greatly to observations made by Uwimphuwe et al. [18] in their study in Masaka Rwanda, in which they found that 97% of the respondents washed their hands before eating and 20% of the respondents washed their hands before preparing food and 31% of the respondents washed their hands after handling babies. The hand-washing practice is poorly observed in the study area. This study finding was comparable to a study conducted in Masaka Rwanda that indicated that the respondents used soap and water (87%), ash and water (1%) and water only (12%) to wash their hands [19]. Our findings were consistent with those of Wasonga et al. [19] that found out that only 7% of the respondents in Nyakach, Kisumu County reported using soap to wash their hands after visiting the toilets.

Despite the high level of household waste management observed in the study area, 11% of the unmanaged household solid waste can cause serious health problems during the rainy season, as the waste are carried off by run-off to the water pans, thus increasing the level of microbial contamination. Haphazard disposal of solid wastes provide breeding sites for disease vectors such as mosquitoes and flies. This study contrasted with that by Wasonga et al. [19] that observed that 37% of the respondents owned dumpsite within their homestead. Another study by Karija and Shihua [21] linked the high prevalence of typhoid, cholera and diarrhoea in Juba, South Sudan to solid wastes carried off by run-off during the rainy seasons.

Finally, our study findings were consistent with those of Wasonga et al. [19],who indicated that 41.5% of the respondents reported community health workers/clinics were their main source of information on hand washing, whereas 23.4, 20.2 and 9.6% indicated that media, schools and community gatherings, respectively, as their sources of information. Hygiene practices at home have been noted to provide a clean environment for children, thus reducing the threats to their health and provide the best chance of a prosperous living [19, 22–24].

5. Conclusions

The water, sanitation and hygiene (WASH) information received by the resident communities is inadequate in reducing the occurrences of water related diseases that occur as a result of improved household hygiene. Increasing the level of community awareness on adequate household, personal and behavioural hygiene is necessary in reducing the prevalent water related diseases in the study area.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Ethical approval

The participants were asked for consent prior to gathering of information and anonymity as well as confidentiality was highly maintained while carrying out the study.

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