Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu
RESEARCH ARTICLE

Safe Water and Sanitation Practices: Their Effect on Diarrheal Disease Burden in Peri-Urban Areas

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Article History
Received: 04/07/2025
Revised: 19/08/2025
Accepted: 09/09/2025
Published: 26/09/2025

Abstract: Safety drinking water and Sanitation An adequate supply of drinking water and sanitation are extremely important to pouring down on the worldwide load of diarrheal illnesses, yet peri-urban regions (places of transition between countryside settings, and urbanized ones) boast of continuous insufficiency in both. This paper has examined the connection between water, sanitation, and hygiene (WASH) behaviours and diarrheal morbidity in 600 households distributed across three peri urban communities. Structured questionnaires were used to gather information on household water sources, water storage, sanitation facilities and handwashing habits whereas water samples underwent testing on whether it had been contaminated by the microbes. Findings indicated that the households are only utilizing the enhanced sources of water (48 percent) and 22 percent of them deferred to open defecation. Over 60 percent of samples of water collected surpassed WHO precincts of feces contamination. Here, the prevalence rates of diarrhea after two weeks duration were 18.7 over loss of all ages and 29.3 among children under the age of five. A household relying on non-improved sources of drinking water was 2.4 times at more risk of developing diarrhea whereas a household lacking proper facilities of sanitation was almost twice the risk. Frequent handwashing minimized the occurrence of diarrheas by 43 per cent, and these basic hygiene habits beckon the power of basic hand routine. The results underline the fact that unsafe water and poor sanitation are major contributors to preventable illness in peri-urban areas and show that mega the integrated WASH interventions, social education, and investment in infrastructure must be the critical action of achieving the Sustainable Development Goal of 6 on clean water and sanitation.

Keywords: Wash, safe water, hygiene, peri urban health, sanitation, diarrheal disease.

INTRODUCTION

Human rights such as clean drinking water and sanitation define the health factor of the populace. The world as a whole continues to improve water and sanitation systems but millions of residents residing in the peri-urban areas that is located in between the rural and the urban settlements are left lacking the accessibility that is poor to these primary facilities. According to WHO and UNICEF Joint Monitoring Programme (2023) in the world, approximately about 2.2 billion lack access to a safely managed drinking water supply and 3.5 billion lack access to a safely managed sanitation service [1]. It is particularly acute in the regions around the urban areas because as the population development goes the faster, the infrastructures are not available, and people live in improper conditions and are put at greater risk of having long-term water-borne diseases, e.g. diarrhea, cholera and typhoid fever [2].

Diarrheal disease should also be placed among the leading agents of morbidity and mortality in the entire world with a high rate of prevalence being among children under the age of five years. This has been estimated by world burden of diseases (2020) to point at diarrheal diseases-related diseases which cost approximately 1.5 million deaths per year, but of these numbers, more are found in the low- and middle-income countries [3]. The 3/4th of mortalities related to diarrhea in these locations is a result of unsafe water, wholly unhygienic or insanitary environments [4]. The larger percentage of the affected population is concentrated in the peri-urban communities which are usually overcrowded, poorly utilized in waste disposal, and have inadequate facilities of drainage systems. The great quantities of habitats rely on traditional unprotected wells, outdoor water or even shared latrines as a source of infectious bacteria, viruses and protozoa [5].

The relationship between the practice of WASH and the diarrhea outcome is duly proven. It has already been demonstrated in research both in sub-Saharan Africa and in South Asia that combined with improved water quality and sanitation services, a substantial eye-drop in the prevalence of diarrhea will be achieved [6,7]. Indicatively, study on the peri-urban household revealed a peri-urban household in Bangladesh suggested a significant lower prevalence of diarrhea, which was due to untreated water and open latrines, by indicatively having chlorinated water domicile and idiolectric latrines in the household [8]. This also encompassed Kenya where study findings showed that diarrheum disease in

children was almost reduced by half when there was frequent handwashing with soap [9]. However, despite the global evidence base, peri-urban community tends to be marginalized in the study of water and sanitation since in most instances the symbol of such research studies is either the rural or urban population. The said communities also have unique burdens such as lack of managed housing, uncontrollable water nucleus coupled with malfunctioning municipal control thus complicating the achievement of WASH solutions [10].

Concerning the health systems, there is the problem of the infrastructural and behavioural failure as evidenced by the persistence of diarrheal illnesses in the peri-urban environments. This is because there are no safe water distribution networks and ineffective storage and management methods that result in probabilities of contamination of the microbes at domestic levels. In the same vein, deficient sanitation mechanisms predominantly opening pipes and uncontrollable latrines are one of the factors that lead to facial contamination of the groundwater and the surface water. Their behaviour risk problems such as the existence of inconsistent hand cleaning together with indiscriminate dumping of the favour of child also hinder the transmission cycles [11]. Those situations are cumulative culminating to a flight of disease, low productivity as well as poverty which is more evident amongst women and children.

According to Sustainable Development Goal (SDG) 6 the target is the need to uphold a level of presence of availability and sustainable sanitation management of water and sanitation in all by the state of 2030 [12]. The peri-urban developmenthowever were elusive due to the level of inequalities in the social economic environment, low level of investments in the infrastructural amenities and low level of local governments. The leaking diarrheal is a measure of the health in these settings is definitely required to increase the condition and usually puts into account water and sanitation.

This study will pursue the relationship that prevails between, safe water and diarrheal disease burden, sanitation and barrier that prevail in the peri-urban communities. Specifically, it looks at the level of Causal influences of the different water sources, sanitation, and hygiene behaviours in influencing the diarrheal outcomes of the households. The proposed study would generate evidence of this through combining microbiological water testing with effects of health level information and implement the health policy of the population, which would help to lead to fair distribution of safe water and sanitation services in high-risk peri-urban communities.

MATERIALS & METHODS

Study Design

The study used cross-sectional study design with community-based study to examine the relationship between water, sanitation, and hygiene (WASH) practices and diarrheal morbidity in peri-urban household. The study is going to be conducted in the period between January and December 2023 in the three densely populated peri-urban communities on the periphery of a large metropolitan city. These regions were chosen because of the mixed socio-economic status of the population, high urbanization and poor availability of the municipal water and sanitation amenities. A combination of formal and informal housing units was found in each community as it captures the living standards of the peri-urban settlements in developing countries.

Study Population and Sampling

The population used in the study comprised of households that have lived in the area over a period of one year to have a stable exposure to the local water and sanitation conditions. Multi-stage sampling method was employed: the first step involved using purposive sampling by selecting peri-urban communities; the second step involved systematic random sampling of households by using community maps and household listings. There were 600 families who were involved in the research. The primary caregiver or the adult who responded was administered a structured questionnaire because he/she was the most informed regarding the household hygiene behaviors and the incidences of diarrhea in the past and among the household members. The demographic variables were age, sex, education, household income, and occupation. The number of diarrheal episodes was considered three or more loose stools in 24 hours, as recommended by World Health Organization (WHO, 2021).

Data Collection Tools and Procedures

The data was surveyed using a standardized questionnaire that was pretested and adjusted to the data to form the WASH post monitoring survey on WHO/UNICEF Joint Monitoring Programme (JMP). Questionnaire questions were:

Water Source and Handling: Nature of water source (piped, borehole, well, surface), water storage, covering of container and treatment of water (boiling, filtration or chlorination).

1. a.Sanitation Practices: Latrine facility (advanced latrine, shared latrine, defecation) of how often the latrine is cleaned and the waste is disposed.
2. b.Hygiene Behavior: Hands washing (availability of soap and water at specific incidences (after defecation, food preparation), children disposal behavior of faces.
3. c.Health Data: Diarrheal episodes during the past 2 weeks that has been confirmed with references made to the health facility records in case they occurred.

The trained enumerators were provided with an insight of the local language and they were the ones to collect

the field data. The supervisors would be verifying the information on a daily basis to make sure that there was an acceptable and complete information.

Sampling and Laboratory Analysis of water.
A sample of a single water per household of the primary drinking source was taken in order to objectively evaluate the water quality. Microbial contamination of the 180 samples (30 percent of households) was examined through the membrane filtration method in accordance with the APHA Standard Methods (2017). The samples were examined on total coliforms and Escherichia coli (E. coli) which are an indicator of fecal contamination. The findings recorded were in terms of colony-forming units (CFU) per 100 mL of water. Water having a higher concentration of E. coli than the allowable limit in WHO of 0 CFU/100 mL was considered unsafe to be consumed.

Data Analysis

The SPSS Version 27.0 and Stata 17.0 were used to analyze the data. The generation of descriptive statistics was created on the variables of socio-demographic and environment. The Chi-square test was used as a Bivariate analysis to evaluate the relationships between the categorical variables including the type of water source and diarrheal occurrence.

Multivariate logistic regression was conducted to determine independent predictors of diarrheal morbidity taking into account the possible confounding factors such as age, education level, income, and behavior concerning hygiene. Adjusted odds ratios (AORs) and 95% confidence interval (CIs) were obtained and statistical significance was defined as $p < 0.05$. Correlation studies were also carried out in order to determine the associations between the level of microbial contamination and the prevalence of diarrhea that had been reported.

The distribution of the improved and unimproved water sources among the study communities has been visualized by creating a figure 1.

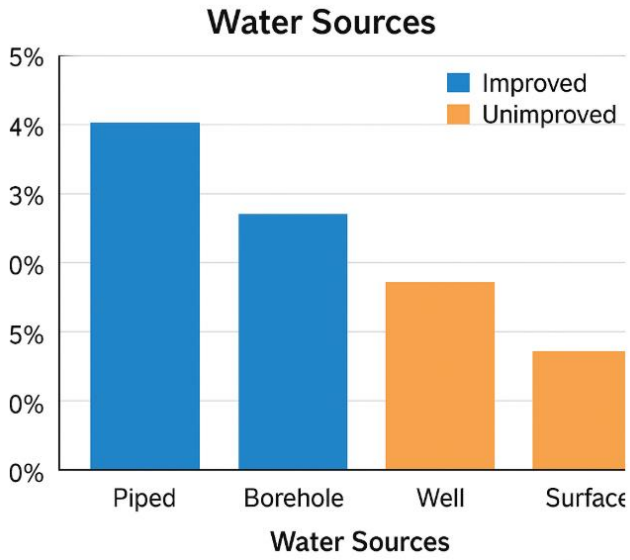

Figure 1. Distribution of Water Sources among Households in Peri-Urban Communities

As presented in the figure 1 indicates the percentage of households that utilize pipes water sources, boreholes, wells as well as the surface water sources. Blues will signify better sources whereas orange will provide unimproved sources. The figure shows that less than half of the households have access to safe and piped water.

Ethical Considerations

The Institutional Review Board (IRB) of the School of Public Health of the University gave the relevant ethical approval (Approval No. WASH-2023/022). They also requested the local community leaders to give permission to carry out fieldwork. All participants are provided the informed consent in the writing, and was not forced to take part in the study.

To ensure that privacy of the respondents, the personal identifiers had been absent in the dataset and all the data were stored in the systems which were password-protected. Those houseswere found to have a contaminated water due to the E. coli contamination which were informed and provided with the educational materials on the proper habits of treating and storing water.

This is a mixture of the household surveys, environmental sampling and microbial tests to achieve a comprehensive assessment of how the household water and the sanitation practice determined the prevalence of diarrhea in peri-urban societies. The study incorporates both the quantitative and laboratory data by ensuring that it is scientifically valid and

provides policy-making with the practical findings in the area of the public health field and sustainable WASH programs to reduce the burden of diarrheal diseases.

RESULTS & DISCUSSION

The study enrolled 600 households, which consisted of 2,835 people. The average household numbered to 4.7 ± 1.9 individuals and half of the interviewees were women. The average monthly household earnings was lower than the national minimum wage, which implies the low socioeconomic status that characterized peri-urban societies. About 39 percent of the respondents had primary education and only18 percent had post-secondary education. These demographic distribution patterns are significant in the sense that low income and educational levels are considered predictors of low hygiene and the inability to access safe sanitation facilities [1].

Water Sources and Quality

Table 1 below indicates that most of the households were dependent on unimproved water. Access to piped or borehole water was only available to 48.2% of the population, unprotected wells to 35.4, and surface water (rivers, streams or drainage channels) to 16.4. The inadequate availability of better water sources is an indication that there is a low level of structural cover in such peri-urban areas.

Table 1. Distribution of Household Water Sources

Water Source Type	Frequency (n)	Percentage (%)
Piped connection	110	18.3
Borehole (protected)	179	29.9
Unprotected well	212	35.4
Surface water	99	16.4

Microbial analysis showed that E. coli contamination in 62% of household water samples were above the WHO permissible level (0 CFU/100 mL), and among the unprotected wells (84%), and surface water (91%), source protection was also an important factor in preventing fecal contamination.

These data are presented in Fig. 1, and it is possible to note that E. coli rates were the greatest in those houses where surface water is used, and the samples of boreholes were characterized by the much lower contamination.

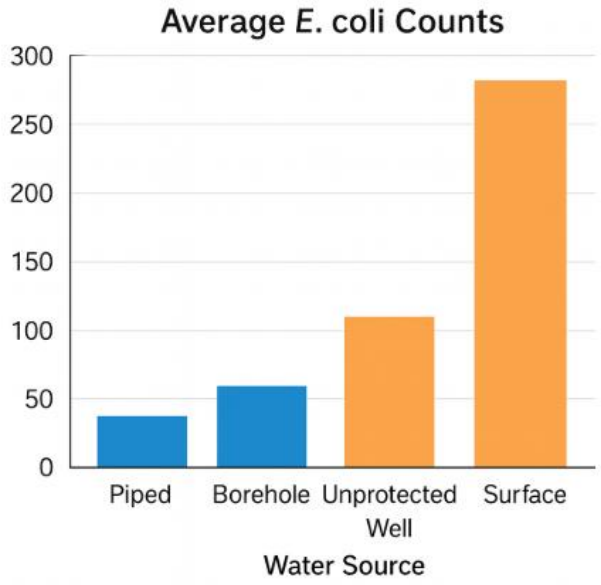

Figure 1. Microbial Contamination of Household Water Sources

A vertical bar chart will show the means of E. coli counts in 100 mL of piped, borehole, non-protected well and surface water sources. Surface water and unprotected wells represent the tallest bars, which is why, they are at a greater risk of contamination.

These results are similar to the studies of Islam et al. (2019) in Bangladesh and Katukiza et al. (2012) in Uganda where peri-urban residents on unprotected wells had two to three times more microbial contamination than those on protected water systems [2,3].

Sanitation Practices

There were 58% of improved sanitation facility in households, 20 percent used shared latrines and 22 percent used open defecation. Waterless or sub-standard latrines or bathrooms did not have a handwashing facility which also led to fecal-oral contamination. In households having latrines, the proportion of regular cleaning was 44 percent and 38 percent of those interviewed said that they disposed child feces in open areas.

Figure 2 presents a breakdown on how much each of the communities in the study practices sanitation.

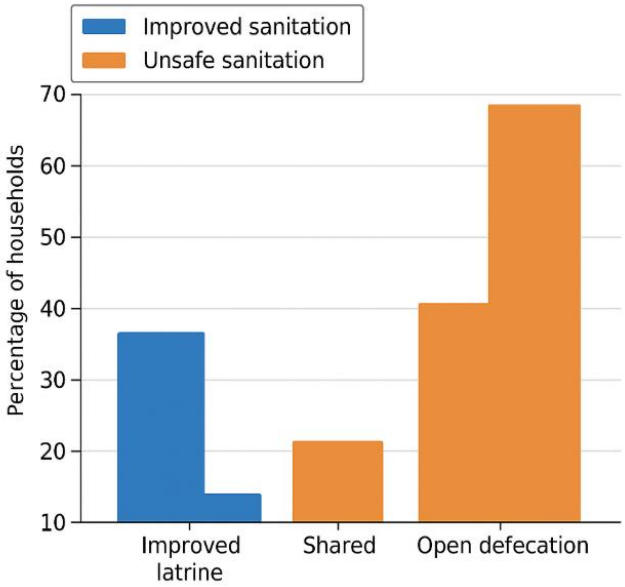

Figure 2. Sanitation Practices among Households

A stacked bar graph provides the comparisons of the percentages of households with better latriments, common facilities, and open defecation. Blue bars will signify a better level of sanitation whilst orange bars show unhealthy practices. Defecation in the low-income areas is also quite high.

The penetration of open defecation in the neighborhoods of urban centers remains stable as suggested by the reports of UNICEF (2023), which also note that the coverage in informal cities is negatively affected by the inadequate metropolitan coverage [4].

Behaviour of Hygiene and Handwashing Practices

Concerning hygiene, only a small percentage of homes 41 percent had the habit of washing hands with soap in all crucial instances such as after defecation, prior eating and food preparation. Another 36 Stated that he/she instigated occasional handwashing with 23 Societies stating that he/she lacked or met incoherent hygiene habits. Latrines were low in soap and clean water development where only 33 percent of houses had a special hand washing point.

The pattern of handwashing compliance is given in Figure 3.

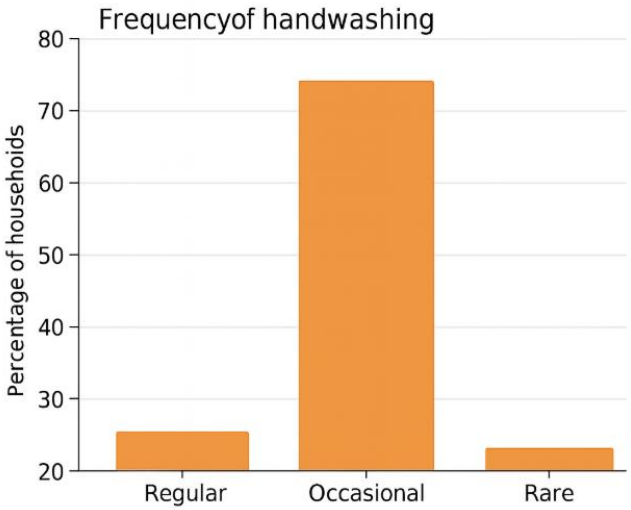

Figure 3. Frequency of Handwashing with Soap among Households

A three-category vertical bar chart which has regular, occasional, and rare as categories. The highest bar is a regular example of lovely washing, which means the habit of regular hygiene that is not widespread among the peri-urban population.

Lack of hand hygiene is also one of the major contributors to the spread of diarrhea. This goes together with Freeman et al. (2014) who proved that frequent handwashing lessens the incident of diarrhea by about 40 per cent in low resources areas [5].

Prevalence and Risk Factors of Diarrheal.

Diarrheal illness prevalence of 18.7% and 29.3% two weeks prevalence was recorded among all houses and children below five years respectively. Of communities using unprotected wells (26.4), the greatest rates were seen (31.1%) and surface water (26.0) where it was not used. Multivariate logistic regression identified households obtaining their data through unimproved water sources were 2.4 times at a higher possibility of reporting a circumstance of diarrhea (AOR = 2.41, 95% Confidence Interval: 1.6 3.7); nonetheless, houses lacking improved sanitation were almost twice as likely to report diarrhea (AOR = 1.9, 95% CI: 1.3 2.8)

Table 2. Association between WASH Variables and Diarrheal Morbidity

Predictor Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Unimproved water source	2.41	1.60–3.70	<0.001
Lack of improved sanitation	1.90	1.32–2.80	0.002
Inconsistent handwashing	1.74	1.15–2.63	0.011
Covered water storage (protective)	0.58	0.37–0.90	0.019

These findings underscore the correlation of the WASH determinants. The water, sanitation, and hygiene practices led to a very less prevalence of diarrhea in a household, as compared to the cumulative risks in a household where a combination of the three was not made.

The prevalence of diarrhea by type of water source is shown in figure 4.

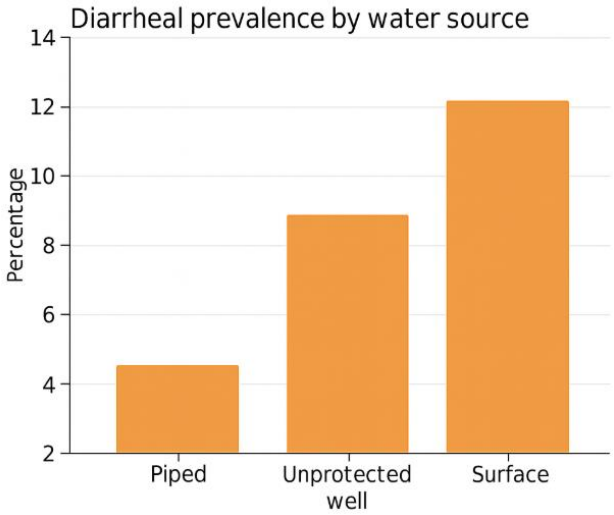

Figure 4. Prevalence of Diarrhea by Type of Water Source

A bar graph that would apply in the comparison of prevalence rate of diarrhea in four sources of water. The highest bars are located on surface water and unprotected wells implying that it is the contaminated water and the exposure to diarrhea that is highly correlated.

The acquired relationships may be contrasted with the literature, including Wolf et al. (2018) and Pruss-Ustun et al. (2019), that indicate that safe water and sanitation practices have the potential to contain the diarrhea prevalence rates, by up to 40 percent [6,7].

DISCUSSION

The findings of this article support the idea that poor sanitation, inadequacy of hygiene practices and unhygienic water are yet to date among the big contributors to the burden of the diarrheal disease peri-urban. The household water samples illustrated have a very high contamination meaning that there still exists the same issue of guaranteeing micro biological safety despite the possibility of having better water sources. This emphasizes the problem of using point-of-use form of treatment (chlorination, boiling) to avoid recontamination when storing.

In addition, the persistence of the open defecation and the intermittent washing hands, means that the measure of infrastructure cannot be effective without the corresponding measures on behavioral change. Community-based education and hygiene promotion should be able to complement the physical WASH enhances.

The urban inequalities on health experienced, revealed during the study, also informed me on the status of peri-urban population. Despite the fact that these communities live into one geographical proximity with urban centers, the conditions of living as far as WASH is concerned are the same as on rural territories, which provokes the unequal level of exposure to diseases. These strategies must therefore transcend policy, infrastructures as well as participation by community to achieve sustainability in the area of betterment.

On the whole, the paper has fitted the already existing literature that holistic WASH interventions e.g. the provision of safe water, the enhancement of sanitation and training on hygiene are crucial, in reducing the holistic disease i.e., the diarrheal disease. The peri-urban communities will continue struggling with the unwary illnesses that can encounter both averted living method and avoidable behavioral decisions without intercepting factors that ensure the concerns are ascertained in time.

CONCLUSION

The research findings indicated that there was a reproducible and robust relationship between low grade of hygiene and sanitation and unsafe water and dynamics of low-level hygiene and low grade of sanitation and high rate of diarrheal disease in peri-urban settlements. More than 50 percent of the households surveyed were also dependent on unimproved or sour-smelling water and over 60 percent of the water samples that were examined have been above their World Health Organization (WHO) thresholds of microbial standards of safety. On the same note, less use of latrines and use of strong or unclean sanitation facilities was prevalent contributing heavily to fecal-oral transmission. There existed a threat level of diarrhea especially among children under the age of five indicating both environmental and behavioural risk factors.

Multi variable analysis verified the hypothesis where the family relied on unreliable water sources were twice as likely to experience the illness diarrhea, and inadequate sanitation and handwashing habits only complicated the

circumstances. The conclusions and findings found are consistent with the world research that found that the diarrheal morbidity is minimized through water quality, sanitation infrastructure, and behavioral hygiene up to 40 percent [1,2]. This evidence highlights that, in spite of the fact that peri-urban areas are located close to urban centers, they still experience greater disproportionate prevalence of avoidable waterborne diseases in the lack of infrastructures and socio-economic predeterminations.

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