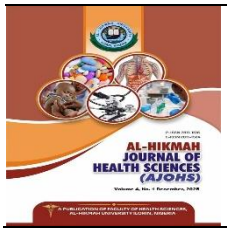
P-ISSN: 2811-1516
E-ISSN: 2811-1524



AL-HIKMAH JOURNAL OF HEALTH SCIENCES (AJOHS)

Official Publication of Faculty of Basic Medical Sciences

Al-Hikmah University Ilorin, Nigeria

https://alhikmahuniversity.edu.ng/AJOHS/index.php/journal

Original Article

Bacteriological Quality of Household Drinking Water and Its Association with Diarrheal Diseases Among Under-Five Children in Ilorin, Nigeria: A Cross-Sectional Study

Musa Ayodele Mashood[1], Ajayi Folajimi Ajibola[2] and Abegunde Samuel Segun[3]

[1]Department of Microbiology, Kwara State College of Nursing Sciences, Ilorin, Nigeria.
[2]Department of Basic Science, Kwara State College of Nursing Sciences, Ilorin, Nigeria.
[3]Nursing Department, Kwara State College of Nursing Sciences, Ilorin, Nigeria.

ARTICLE INFO

Article History
Received: 28th March, 2026
Accepted: 3rd May, 2026
Available online: 1st June, 2026

Keywords:
Drinking water
Diarrhea
Under-five children

Corresponding Author:

Musa Ayodele Mashood
Department of Microbiology, Kwara State College of Nursing Sciences, Ilorin, Nigeria.
Phone number: +2348075807046
Email: musamashood@gmail.com

ABSTRACT

Introduction: Unsafe drinking water remains a major contributor to diarrheal diseases among children under five, particularly in low- and middle-income countries.

Aim: This study assessed the bacteriological quality of household drinking water and its association with diarrheal morbidity among under-five children in Ilorin, Nigeria.

Methods: A community-based cross-sectional study was conducted. A sample size of 288 households was calculated using Cochran's formula; however, 240 households were successfully surveyed and included in the final analysis. Data on water sources, handling practices, and recent diarrheal episodes were collected using structured questionnaires. Water samples were analyzed for Escherichia coli and total coliforms using membrane filtration techniques. Data were analyzed using descriptive and inferential statistics at a 95% confidence level.

Results: E. coli contamination was detected in 22.9% of samples, while 34.6% contained total coliforms. The two-week prevalence of diarrhea was 28.3%. A significant association was found between contaminated water and diarrheal disease ($\chi^2 = 17.89$, $p < 0.001$). Children consuming untreated water were more likely to develop diarrhea (AOR = 2.75; 95% CI: 1.58–4.80).

Conclusion: Microbiologically unsafe drinking water remains a key determinant of childhood diarrhea.

Please cite this article as: Musa, A.M., Ajayi, F.A. & Abegunde, S.S. (2026). Bacteriological Quality of Household Drinking Water and Its Association with Diarrheal Diseases Among Under-Five Children in Ilorin, Nigeria: A Cross-Sectional Study. *Al-Hikmah Journal of Health Sciences, 5*(2), 25-29.

1. Introduction

Access to safe and reliable drinking water is central to disease prevention and overall well-being. Despite global efforts, an estimated 2 billion people continue to consume water contaminated with fecal matter, exposing them to significant health risks (WHO, 2023). Among these risks, diarrheal diseases remain one of the leading causes of mortality in children under five years, particularly in sub-Saharan Africa (UNICEF, 2022).

P-ISSN: 2811-1516
E-ISSN: 2811-1524

Water contamination often arises from inadequate sanitation, poor waste disposal, and unsafe water handling practices. Microbial indicators such as Escherichia coli and total coliform bacteria are widely used to assess water safety, as their presence suggests fecal contamination and potential exposure to pathogenic organisms (WHO, 2023). The WHO recommends that E. coli should not be detectable in any 100 mL of drinking water intended for human consumption.

Nigeria continues to face challenges related to water supply and sanitation infrastructure. In many urban and peri-urban areas, households depend on alternative water sources such as wells, boreholes, and vendors, which are often subject to contamination (Mobolaji & Akinwumiju, 2025). Additionally, post-collection contamination during transportation and storage further compromises water safety.

While previous studies have established a link between contaminated water and diarrheal diseases, localized evidence is essential for guiding context-specific interventions. This study therefore evaluates the bacteriological quality of household drinking water and investigates its association with diarrheal diseases among under-five children in Ilorin, Nigeria.

2. Materials and Methods

2.1 Study Design and Setting

A community-based cross-sectional study was conducted in Ilorin, Kwara State, Nigeria. It enables examination of relationships between exposure variables and health outcomes without temporal follow-up (Setia, 2022). The study area comprises both urban and peri-urban settlements with varying access to improved water sources.

2.2 Study Population

The study population included households with at least one child under five years of age. Caregivers were selected as respondents due to their direct involvement in childcare and water handling.

2.3 Sample Size Determination

The sample size (n = 288) was calculated using Cochran's formula for cross-sectional studies, assuming a 95% confidence level, 5% margin of error, and an estimated prevalence of diarrheal disease from previous studies.

2.4 Sampling Technique

A multistage sampling technique was employed. In the first stage, four communities were selected using simple random sampling. In the second stage, A systematic random sampling technique was then used to select households. The first household was selected randomly, after which every kth household was included.

2.5 Data Collection

Questionnaire

The structured questionnaire was developed based on previously validated instruments from similar studies. It was pre-tested (pilot tested) among 30 caregivers in Offa. with similar characteristics. Feedback from the pilot study was used to refine question clarity, wording, and sequence.

The internal consistency was assessed using Cronbach's alpha, yielding a coefficient of 0.81. Content validity was ensured through expert review by professionals in microbiology and public health.

Water Sample Collection and Analysis

Water samples were aseptically collected from household storage containers. Microbiological analysis was conducted using the membrane filtration method to detect E. coli and total coliform. Results were expressed as colony-forming units (CFU/100 mL).

To ensure quality control and reliability of results, all culture media were prepared according to manufacturer specifications and sterilized using autoclaving procedures. Laboratory equipment was routinely calibrated. Strict aseptic techniques were maintained throughout sample handling and processing to prevent contamination. Standard operating procedures (SOPs) consistent with World Health Organization guidelines were strictly followed.

Water quality classification followed WHO guidelines:

Safe: 0 CFU/100 mL

Contaminated: ≥1 CFU/100 mL

2.6 Data Analysis

Data were analyzed using SPSS version 25. Descriptive statistics summarized variables, while inferential analysis (Chi-square and logistic regression) determined associations. Statistical significance was set at $p < 0.05$.

2.7 Ethical Considerations

Ethical approval was obtained from Kwara State Ministry of Health Ethical and Research Committee with Reference No ERC/MOH/2024/10/350. Informed consent was obtained from all participants prior to data collection.

3. Results

Out of the 288 questionnaires administered, 240 were properly completed and returned, representing a

P-ISSN: 2811-1516
E-ISSN: 2811-1524

response rate of 83.3%. This reduction in sample size may have led to a modest decrease in the statistical power of the study, potentially limiting the ability to detect smaller effect sizes. However, the achieved sample size remains adequate for cross-sectional analysis and is within acceptable thresholds for epidemiological studies, particularly given the strength and statistical significance of the observed associations ($p < 0.001$). Furthermore, the relatively high response rate minimizes the risk of substantial non-response bias.

3.1 Socio-Demographic Characteristics

Table 3.1: Socio-demographic characteristics (n = 240)

Variable	Categories	Frequency	Percentage
Age group(years)	18-24	38	15.8
	25-34	92	38.3
	35-44	74	30.8
	>44	36	15.0
Gender	Male	52	21.7
	Female	188	78.3
Education level	No formal	28	11.7
	Primary	60	25.0
	Secondary	92	38.3
	Tertiary	60	25.0

Field Survey (2025)

Table 1 shows that majority of respondents were females (78.3%), within the age group 25–34 years (38.3%), and had at least secondary education (63.3%). This reflects that caregivers, particularly mothers, were the primary respondents.

Sources of Drinking Water

Table 3.2: Main source of drinking water

Sources	Frequency	Percentage
Borehole	97	40.4
Well	85	35.4
Pipe-borne	30	12.5
Vendor	28	11.7

Field Survey (2025)

Table 3.2 reveals that Borehole water was the most commonly used source (40.4%), followed by well water (35.4%), indicating reliance on potentially unsafe water sources.

3.3 Bacteriological Quality of Water

Table 3.3: Laboratory results of water samples

Parameter	Frequency	Percentage
E. coli present	55	22.9
E. coli absent	185	77.1
Total coliform present	83	34.6
Total coliform absent	157	65.4

Field survey (2025)

Table 3.3 shows that a significant proportion of water samples were contaminated with E. coli (22.9%) and total coliforms (34.6%), exceeding WHO permissible limits.

3.4 Prevalence of Diarrhea

Table 3.4: Prevalence of diarrhea among under-five children (2-weeks prevalence)

Response	Frequency	Percentage
Yes	68	28.3
No	172	71.7

P-ISSN: 2811-1516
E-ISSN: 2811-1524

Table 3.4 reveals that the prevalence of diarrheal diseases among under-five children was 28.3%, indicating a significant public health concern.

3.5 Water Handling and Storage Practices

Table 3.5: Water handling and Storage practices

Variable	Frequency	Percentage
Water treated (Yes)	92	38.3
Water treated (No)	148	61.7
Covered storage	189	78.8
Uncovered storage	51	21.3

Table 3.5 shows that majority of households (61.7%) did not treat their drinking water, and 21.3% used uncovered storage containers, increasing contamination risk.

3.6 Association Between Water Quality and Diarrhea

Table 3.6: Chi-square analysis

Variable	χ^2	p-value
E. coli contamination	17.89	<0.001
Water treatment	14.22	<0.001
Storage method	10.45	0.001

There was a statistically significant association between water contamination, poor water handling practices, and diarrheal diseases among under-five children ($p < 0.05$).

3.7 Logistic Regression Analysis (Predictors of Diarrhea)

Table 3.7: Multivariate logistic regression

Variable	AOR	95%CI	p-value
Contaminated water	2.75	1.58–4.80	<0.001
No water treatment	2.41	1.32–4.39	0.004
Poor storage practice	1.96	1.10–3.48	0.021

Children from households consuming contaminated water were 2.75 times more likely to develop diarrhea. Lack of water treatment and poor storage practices were also significant predictors.

4. Discussion

The study demonstrates that a substantial proportion of household drinking water is microbiologically unsafe, indicating persistent exposure to fecal contamination, consistent with findings from similar studies in sub-Saharan Africa (Khabo-Mmekoa *et al*., 2022; Bain *et al*., 2021). The presence of E. coli confirms recent contamination and highlights the risk of pathogen transmission through drinking water. The contamination of drinking water likely occurs through multiple pathways: arise at the source, particularly in wells and boreholes that are inadequately protected; may result from unsafe water handling practices such as dipping utensils into storage containers, use of uncovered vessels, and lack of routine cleaning; Additionally, intermittent water supply and prolonged storage create conditions that facilitate microbial regrowth and biofilm formation (Tadesse et al., 2024; Bain *et al*., 2023).

The prevalence (28.3%) of diarrheal disease observed aligns with regional estimates reported in similar settings (Tadesse *et al*., 2024; Rahman *et al*., 2022; UNICEF, 2022). The strong association between contaminated water and diarrheal morbidity reinforces existing evidence linking unsafe water to adverse child health outcomes (Bain *et al*., 2023; WHO, 2023). Similar associations have been reported in Nigeria and other African countries, where untreated or poorly managed water sources contribute substantially to disease burden (Oluwaseun *et al*., 2025; Rabiu *et al*., 2024).

Furthermore, household-level practices such as a lack of water treatment and unsafe storage significantly contributed to contamination. This supports findings from recent studies indicating that water contamination often occurs at the point of use due to improper handling, even when the original source is relatively safe (Tadesse et al., 2024; Rabiu et al., 2024; Rahman *et al*., 2022).

P-ISSN: 2811-1516
E-ISSN: 2811-1524

Beyond individual and household-level factors, these findings have broader public health and policy implications. Access to safe drinking water is central to achieving Sustainable Development Goal (SDG) 6, which aims to ensure availability and sustainable management of water and sanitation for all. The persistence of contaminated household water observed in this study suggests that progress toward safely managed drinking water services remains uneven, particularly in rapidly growing urban and peri-urban areas. Strengthening Water, Sanitation, and Hygiene (WASH) programs is therefore essential. Evidence from recent WASH interventions indicates that combined approaches addressing both infrastructure and behavior yield the most sustainable health benefits (Bain *et al*., 2023).

5. Conclusion

Microbial contamination of household drinking water remains a critical public health issue in Ilorin. The study establishes a clear association between unsafe water and diarrheal diseases among under-five children. Addressing both water quality and household practices is essential to reducing disease burden.

6. Study limitation

The study has limitations that should be considered. The cross-sectional design limits the ability to establish causal relationships between water quality and diarrheal disease. Diarrheal episodes were self-reported by caregivers, which may be subject to recall bias or misclassification. The reduction in sample size may have slightly reduced the statistical power and precision of estimates. Additionally, microbiological analysis focused on indicator organisms (E. coli and total coliforms) and did not include specific pathogenic organisms or viral agents.

7. Recommendations

i. Promote household water treatment methods (boiling, filtration, chlorination)
ii. Conduct community-based health education on water hygiene
iii. Integrate water, sanitation, and hygiene (WASH) interventions

References

Babbie, E. (2021). *The practice of social research* (15th ed.). Cengage Learning.

Bain, R., Johnston, R., Mitis, F., Chatterley, C., & Slaymaker, T. (2023). Drinking water quality and child health outcomes in low- and middle-income countries. *Water Research*, 235,119789.https://doi.org/10.1016/j.watres.2023.119789

Khabo-Mmekoa, M., Momba, M. N. B., & Adefisoye, M. A. (2022). Microbial contamination of household drinking water and associated health risks in South Africa. *International Journal of Environmental Research and Public Health, 19(8)*, 4431. https://doi.org/10.3390/ijerph19084431

Mobolaji, J. W., & Akinwumiju, A. S. (2025). Geospatial assessment of household water, sanitation and hygiene conditions and associated factors in Nigeria: A causal relationship model. *PLOS ONE*. https://doi.org/10.1371/journal.pone.0330167

Oluwaseun, A. M., Ekesiobi, A. O., Olarewaju, S. O., & Akinleye, C. (2025). The effect of water sanitation and hygiene on the occurrence of helminthiasis infection in tropical communities of Nigeria. *African Journal of Pure and Applied Sciences*.https://doi.org/10.33886/ajpas.v6i1.648

Rabiu, A., Abdullahi, M., Sani, A., & Bello, M. (2024). Occurrence and public health implications of *Escherichia coli* in drinking water across Africa: A systematic review. *Science of the Total Environment,* 912, 169234. https://doi.org/10.1016/j.scitotenv.2024.169234

Rahman, M. S., Hasan, M. T., Rahman, M. M., & Islam, M. A. (2022). Household water contamination and associated diarrheal risk among children in Bangladesh. *International Journal of Environmental Research and Public Health, 19(15)*, 9234. https://doi.org/10.3390/ijerph19159234

Setia, M. S. (2022). Methodology series module 3: Cross-sectional studies. *Indian Journal of Dermatology, 67(2)*, 95–98. https://doi.org/10.4103/ijd.ijd_123_21

Tadesse, B., Alemu, T., Gebremariam, B., & Desta, H. (2024). Household drinking water contamination and associated factors in rural Ethiopia: A cross-sectional study. *BMC Public Health, 24,* 1123. https://doi.org/10.1186/s12889-024-1123

UNICEF. (2022). Diarrhoeal disease and child health report. United Nations Children's Fund.

World Health Organization. (2023). Guidelines for drinking-water quality (4th ed.). WHO Press.

World Health Organization & UNICEF Joint Monitoring Programme. (2023). Progress on household drinking water, sanitation and hygiene. WHO Press.