

Prevalence and Determinants of Waterborne Diseases in Rural Pero–Shonge of Gombe State, Nigeria: From Laboratory to Community

Akafa, A. T*, Samaila, K., Udofia, U. M., Anche, A. D. & Aremu, F. O.

Department of Family Medicine & Geriatrics, Faculty of Clinical Sciences, College of Health, Federal University Wukari, Taraba State, Nigeria.

*Correspondent Author: akafatensaba@gmail.com

ABSTRACT

Waterborne diseases pose a significant public health threat in rural Nigeria, especially in communities lacking access to safe drinking water. This study explores the prevalence and underlying determinants of waterborne illnesses in the Pero–Shonge area of Shongom Local Government, Gombe State. A retrospective cross sectional study was conducted using five years of hospital health records, laboratory analysis of drinking water samples, and structured questionnaires administered to 398 residents. The sample size was determined using the Taro Yamane formula. Data were analyzed using descriptive statistics. The findings reveal a high frequency of these diseases, largely attributed to poor water quality, inadequate sanitation infrastructure, and limited health education. These interrelated factors perpetuate a cycle of infections that adversely impacts both individual well-being and community health. A high prevalence (53%) of waterborne diseases, primarily attributed to consumption of untreated water from rivers, ponds, and wells was documented. Socio-demographic factors such as age and seasonality were significant; 70% of respondents indicated that children aged 5–15 years were most affected, with peak incidence during the rainy season (May–October). Contributing factors included lack of boreholes, shared water sources with animals, and inadequate social health infrastructure. The study highlights the urgent need for improved water infrastructure and public health education in Pero–Shonge. Recommendations include government and community-led initiatives to install boreholes and raise awareness about water hygiene practices.

Keywords: Waterborne diseases; Rural health; Nigeria; Socio-demographic factors; Water sanitation

INTRODUCTION

Waterborne diseases causes immense public health crisis in Nigeria, especially in rural communities where access to clean water, sanitation, and hygiene is seriously limited. These diseases are caused by pathogenic microorganisms such as bacteria, viruses, protozoa, and fungi which are transmitted through the consumption or use of contaminated water (Essiet *et al.*, 2024). In areas like Pero–Shonge in Gombe State, outbreaks of typhoid fever, cholera, hepatitis A, and giardiasis are common, often due to unsafe water sources and inadequate health infrastructure (Baulch *et al.*, 2025).

Globally, the World Health Organization (WHO) estimates that approximately 1.8 million people die annually from diarrheal diseases, many of which are waterborne (IDOSR, 2023; Ogenyi, 2025). In Nigeria, the situation is particularly dreaded, with rural populations disproportionately affected due to poor sanitation, lack of health education, and limited access to potable water (Zerbo *et al.*, 2021; Mercy *et al.*, 2024). Children under five years and pregnant women are more vulnerable, with waterborne illnesses contributing significantly to infant mortality rates and frequent risk of miscarriages and preterm labor from poorly managed severe diarrhoeal diseases (Ogenyi, 2025).

Waterborne diseases in Nigeria are primarily caused by the ingestion or exposure to water contaminated with pathogenic microorganisms. These pathogens are transmitted through various routes such as drinking, cooking, bathing, and recreational water use (Nwabor *et al.*, 2016; Olowe *et al.* 2016). The common risk factors for these diseases include drinking untreated water from rivers or ponds, cooking with unsafe water, and bathing in polluted water bodies. Additional risk factors include poor food hygiene, contact with animals or their environments, and recreational exposure in inadequately treated pools or beaches (Chan *et al.*, 2021; Ahmad and Pyeng 2024).

Typhoid fever, caused by *Salmonella typhi*, is one of the most prevalent waterborne diseases in Nigeria. Despite government efforts to improve healthcare delivery and train personnel, the disease remains endemic due to cultural practices, poor health-seeking behavior, and inadequate diagnostic capacity in rural areas (Baulch *et al.*, 2025). Cholera, another deadly disease, thrives in environments with poor sanitation and can cause death within hours due to severe dehydration (Nkemnyi *et al.*, 2023). Giardiasis and dysentery are also widespread, often resulting from *Giardia lamblia*, Shigella, or *Entamoeba histolytica* infections, and can primarily spread through poor hygiene and contaminated water (Baulch *et al.*, 2025). *Escherichia coli* infections, particularly the dangerous strains, are frequently reported in communities where human and animal water sources overlap (Nwabor *et al.*, 2016; Ogenyi, 2025).

Waterborne diseases can be classified based on their transmission routes. These include oral-fecal (e.g., typhoid, cholera, hepatitis A), cutaneous (e.g., dracunculiasis, scabies), anal/urinary (e.g., schistosomiasis), ophthalmic (e.g., conjunctivitis), and oto-rhino (e.g., ear and nasal infections from water exposure). This classification helps in understanding the diverse pathways through which these diseases affect human health (Oluyeye *et al.*, 2016; Nkemnyi *et al.*, 2023). The determinants of waterborne disease prevalence in Nigeria are multifaceted. Environmental factors such as seasonal rainfall, flooding, and stagnant water bodies contribute to the spread of disease vectors. Socioeconomic conditions which include poverty, low literacy rates, and inadequate social infrastructure can further exacerbate the situation (Okpasuo *et al.*, 2020). Moreover, the lack of community-based health education and behavioral change initiatives limits the effectiveness of existing interventions (Baulch *et al.*, 2025).

Preventing waterborne diseases requires a combination of behavioral, infrastructural, and policy interventions. These include boiling or treating water before drinking, washing fruits and vegetables thoroughly, practicing good hygiene, avoiding stagnant water, and promoting vaccination—especially for hepatitis A (Chan *et al.*, 2021; Manetu and Karanja, 2021). However, in rural communities like

Pero–Shonge, these measures are often difficult to implement due to poverty and infrastructural deficits. Empirical studies have shown that disease prevalence is higher in villages near contaminated water sources and lower in communities with access to groundwater and better hygiene practices (Sawyer *et al.*, 2025; Baulch *et al.*, 2025).

This study aims to determine the prevalence of waterborne diseases in Pero–Shonge and identify the environmental, social, and infrastructural determinants contributing to their spread. By integrating laboratory diagnostics with community-level data, the research page seeks to inform targeted public health policies and sustainable interventions. Understanding the complex interplay between pathogen ecology, transmission pathways, and human behavior is essential for reducing the burden of waterborne diseases in rural Nigeria.

MATERIALS AND METHODS

This study examined the prevalence and determinants of waterborne diseases in Pero-Shonge, a locality within Shongom Local Government Area (LGA), Gombe State, Nigeria, situated approximately 80–89 km from Gombe metropolis (coordinates ~9°34' N, 11°06' E; climate ~31°C). The population of Pero-Shonge is estimated at 87,760 and the area comprises six wards and 54 polling units (Abbas *et al.*, 2020). A mixed-methods design (retrospective cross sectional study), incorporating retrospective and cross-sectional components, was employed to capture both historical and current patterns of disease burden over a five-year period (2018–2022).

A total of 398 literate participants, across multiple age groups and inclusive of all genders, were sampled using simple random sampling. Data collection integrated four primary methods: (1) pre-designed questionnaires administered to residents to collect information on water sources, hygiene practices, and sociodemographic characteristics; (2) microbial analysis of water samples from common sources (rivers, ponds, wells) to detect pathogenic organisms; (3) serological screening for Hepatitis A, B, and C among selected participants to assess viral infections linked to water contamination; only fifty (50) clients were randomly selected from the study population of 398 participants across the six wards of the study area, and each was allocated serial numbers ranging from 01 to 50 and (4) a retrospective review of medical records from local health facilities to document reported cases over the five-year window.

The sample size was determined using the Taro Yamane formula ($n=N/(1+N(e)^2)$); where n = sample size, N = population size of study area and e = margin of error (usually expressed as a decimal) $n= 87760/(1+87760(0.05)^2)$; $n= 87760/220$; $n=398$. $N = 87,760$ and a margin of error $e = 0.05$; yielding $n = 398$. Descriptive statistics were employed, and findings were presented using frequency distributions and visualizations (charts) to illustrate disease prevalence and associated factors. Ethical approval was obtained from the Head of the Shongom Health Department. Community leaders and clinic staff facilitated access, and all participants provided informed consent with assurances of confidentiality.

RESULTS

The study surveyed a total of 398 respondents as depicted in Table 1 below. The age distribution revealed that half of the participants (50.0%) were between 20 and 30 years, making this the largest age group. Respondents aged 31–40 years accounted

for 22.2%, while those aged 41–50 years were 19.9%. Only 7.8% of the respondents were above 50 years of age. The mean age of the sample was 33.7 years with a standard deviation of ± 10.1 , indicating a relatively young population. In terms of gender composition, males constituted a slight majority with 54.7% (217 respondents), while females made up 45.3% (181 respondents). The educational status of respondents varied considerably. A small proportion (10%) had nursery education, while 32% had completed primary education. Nearly half of the respondents (46%) had secondary education, making it the most common level of attainment. Only 12% of the sample reported having tertiary education, highlighting limited access to higher education among the study population.

Table 1: Socio-demographic characteristics of the Respondents

Variables (Age in years)	Frequency(n)=	Percentage (%)
20-30	398	50.0
31-40	199	22.2
41-50	88	19.9
Above 50 years	79	7.8
	32	

Mean age 33.7 ± 10.1 SD

Gender		
Male	217	54.7
Female	181	45.3
Educational Status		
Nursery	41	10
Primary	127	32
Nursery	41	10
Primary	127	32
Secondary	183	46
Tertiary	47	12

The findings in Table 2 below on respondents' sources of drinking water and related practices show that nearly half of the population (48.0%) relied on rivers and streams as their primary source of drinking water. Boreholes accounted for 23.7% of respondents, while wells and ponds contributed 11.0% and 10.0% respectively. A smaller proportion (7.3%) reported using other sources. This distribution highlights a heavy dependence on surface water, which is often vulnerable to contamination. Regarding water treatment practices, a majority of respondents (72.0%) indicated that they treated their drinking water before use, while 28.0% did not. Among those

who practiced treatment, settlement was the most common method (45.0%), followed by boiling (31.9%) and clarification (21.1%). Only 2.0% reported using titration, suggesting limited adoption of more technical treatment methods. The health outcomes associated with water consumption revealed that 28.5% of respondents had been infected with waterborne diseases, while 71.5% had not. Children appeared particularly vulnerable, with 36.5% reported as having suffered from waterborne infections compared to 63.5% who had no Knowledge of waterborne diseases was relatively high among the respondents, with 87.0% demonstrating awareness, while 13.0% lacked such knowledge. This suggests that although awareness is widespread, gaps remain in translating knowledge into consistent safe water practices, especially given the high reliance on untreated surface water sources.

Table 2: Distribution of Respondents' Sources of Drinking Water and Related Practices

Variable	Category	Frequency (n)	Percentage (%)
Sources of Drinking water	Well	44	
	Borehole	94	
	River/stream	191	
	Pond	40	11.0
	Others	29	23.7
Treatment of Water	Yes	287	48.0
	No	111	10.0
Methods of Water Treatments	Settlement	179	72.0
	Boiling	127	28.0
	Clarification	84	
	Titration	8	45.0
Infected with Waterborne Disease	Yes	113	31.9
	No	285	21.1
Children Infected	Yes	145	2.0
	No	253	28.5
Knowledge of Waterborne Diseases	Yes	346	71.5
	No	52	36.5
			87.0
			13.0

The frequency distribution of common waterborne diseases among respondents revealed that dysentery was the most prevalent, accounting for 187 cases, which

represented 47% of the total reported infections. Cholera followed with 119 cases, constituting 30% of the distribution. Typhoid was reported in 52 cases, making up 13%, while giardiasis was the least common with 40 cases, representing 10%. This pattern indicates that dysentery and cholera together accounted for more than three-quarters of all reported waterborne disease cases, underscoring their significant public health burden in the study area. Typhoid and giardiasis, though less frequent, still contributed to the overall disease profile, highlighting the diverse range of waterborne infections affecting the population as seen in Figure 1 below.

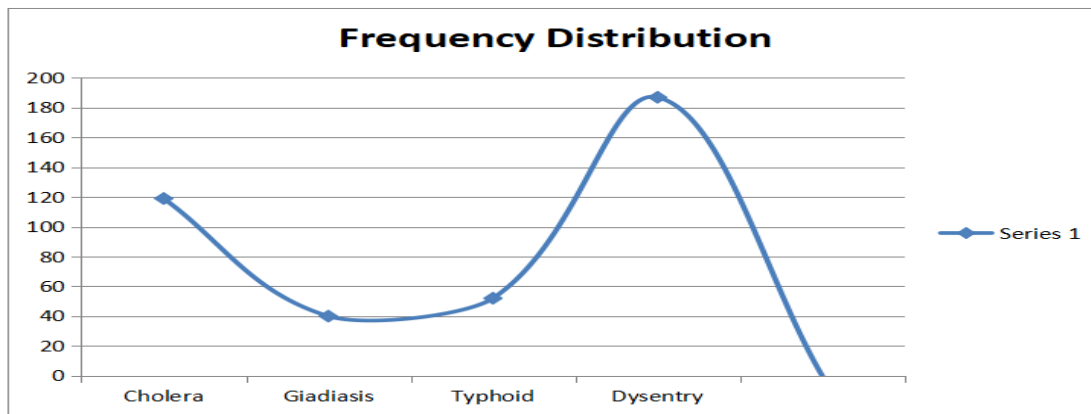


Figure 1: Frequency distribution curve of common waterborne diseases

Health facility records across the six wards of Pero-Chonge revealed varying trends in waterborne disease cases between 2018 and 2022. While some wards experienced fluctuations, Filiya stood out for showing a steady decline in reported cases. Specifically, the number of cases in Filiya dropped from 1,562 in 2018 to 621 in 2022, reflecting a consistent downward trend over the five-year period. This reduction suggests possible improvements in water access, sanitation practices, or health interventions within the ward. Overall, the data highlights both progress and ongoing challenges in managing waterborne diseases across the study area as seen in Table 3 below.

Table 3: Health Facility Records of Waterborne Diseases in Six Wards in Pero-Chonge

Wards	<u>Year (2018 - 2022)</u>				
	2018	2019	2020	2021	2022
Gwandum	1250	962	401	200	50
Filiya	1562	1121	902	750	621

Kushi	1027	1001	982	975	901
Gundale	1755	1602	1493	1301	1292
Burak	1511	1426	1301	1190	1002
Bangunji	1672	1600	1401	980	901

The laboratory analysis of drinking water samples from Pero-Chonge revealed significant contamination, with pathogenic microorganisms such as *Salmonella*, *Shigella*, and *Escherichia coli* isolated from cultured samples. This finding exposes the unsafe nature of community water sources. In addition, blood samples collected from clients confirmed the presence of Hepatitis A infection among some individuals. Their blood samples were tested for Hepatitis A, Hepatitis B, and Hepatitis C. The results in Table 4 below provided valuable insight into the distribution of viral infections within the community, highlighting viral threats linkage to unsafe water consumption.

Table 4: Laboratory analysis of drinking water samples from Pero-Chonge

Disaese Participants S/No.	Hepatitis A virus		Hepatitis B virus		Hepatitis C virus	
	Test Results (R = Reactive NR = Nonreactive)		R	NR	R	NR
01	R	NR	R	NR	R	NR
02	✓		✓	✓		✓
03		✓				✓
04		✓		✓	✓	
05	✓			✓		✓
06		✓	✓			✓
07		✓	✓			✓
08	✓			✓	✓	
09	✓			✓		✓
10		✓		✓		✓
11	✓		✓			✓
12		✓	✓			✓
13		✓		✓		✓
14	✓			✓		✓
15	✓			✓		✓
16		✓	✓			✓
17		✓		✓		✓
18		✓		✓		✓
19	✓			✓		✓
20		✓		✓	✓	
21		✓		✓		✓
22	✓			✓		✓

23	✓			✓		✓
24		✓		✓		✓
25	✓			✓		✓
26		✓		✓		✓
27		✓		✓		✓
28	✓		✓		✓	
29	✓			✓		✓
30		✓		✓		✓
31		✓		✓		✓
32		✓		✓		✓
33	✓			✓		✓
34		✓		✓		✓
35		✓		✓		✓
36	✓			✓		✓
37		✓		✓		✓
38		✓		✓	✓	
39		✓		✓		✓
40		✓		✓		✓
41	✓	✓		✓		✓
42	✓		✓			✓
43		✓		✓		✓
44		✓		✓	✓	
45		✓		✓		✓
46		✓		✓		✓
47		✓		✓		✓
48		✓		✓		✓
49		✓		✓		✓
50		✓		✓		✓
	✓			✓	✓	

Focus Group Discussion Findings

The focus group discussions conducted among community members and health care providers in Pero Chonge, Shongom LGA, revealed deep insights into the underlying factors driving the prevalence of waterborne diseases in the area. A recurring theme across all groups was the acute shortage of reliable sources of safe drinking water. Participants consistently described how most rural settlements lack access to potable water, forcing residents to depend on unsafe sources. Alarming, several respondents reported that they often share water sources with animals, a practice that significantly heightens the risk of contamination and disease transmission. Rivers were identified as the dominant source of drinking water, with reliance varying across communities: Gundale (82%), Kushi (70%), Filiya (61%), Bangunji (73%), Burak (58%), and Gwandum (54%). This heavy dependence on surface water underscores the vulnerability of these communities to waterborne infections. Seasonality emerged as another critical factor. Respondents emphasized that waterborne diseases are most prevalent during the rainy season, spanning May to October, when flooding and runoff exacerbate contamination of water sources. This seasonal pattern was consistently highlighted across different groups, pointing to the cyclical nature of disease outbreaks in the locality. The discussions also revealed

that children are disproportionately affected. Approximately 69% of participants indicated that children aged 5–15 years bear the greatest burden of waterborne diseases. This was attributed to their frequent contact with contaminated water sources, weaker immunity, and limited awareness of hygiene practices. Health care providers corroborated these accounts, noting that paediatric cases of dysentery, cholera, and typhoid are particularly common during peak transmission periods. Overall, the qualitative findings paint a picture of communities grappling with structural water scarcity, unsafe practices, and seasonal vulnerabilities. The voices of participants highlight the urgent need for interventions that prioritize safe water provision, improved sanitation, and targeted health education especially for children and caregivers.

DISCUSSION

This study revealed a persistently high prevalence of waterborne diseases in Pero–Shonge, with Burak, Bangunji, Gundale, and Kushi wards recording the most severe cases. In contrast, Filiya and Gwandum demonstrated notable declines between 2018 and 2022, largely attributable to improved borehole access provided by politicians and private entrepreneurs. Therefore, Filiya and Gwandum wards may no longer rely heavily on unsafe sources such as rivers and wells, which are often shared with animals, thereby decreasing the risk of water-borne diseases.

The overall ratio of wards with high prevalence to those with declining cases (2:1) underscores the continuing burden of waterborne diseases across the majority of the study area. Children aged 5–15 years were disproportionately affected, reflecting their heightened vulnerability to contaminated water and limited hygiene awareness (Oluyeye, 2016; Manetu & Karanga, 2021).

Environmental factors were central to disease transmission. Prevalence peaked during the rainy season, accounting for 60% of cases, when flooding and stagnant water facilitated contamination. Laboratory analyses confirmed the presence of *Escherichia coli*, *Salmonella typhi*, and Hepatitis A virus in local water sources, corresponding to high rates of dysentery and typhoid fever. Agricultural runoff further compounded contamination, introducing fecal matter and chemicals into streams and ponds, while reliance on untreated water for cooking and drinking sustained transmission. The dependence on rivers, ponds, wells, and rainwater—often shared with animals—was a major contributor to contamination. These findings align with previous studies linking unsafe water sources and poor sanitation to recurrent outbreaks of waterborne diseases (Nwabor et al., 2016; Olowe et al., 2016; Sawyer et al., 2025).

Socio-demographic disparities also shaped disease outcomes. Wards with better infrastructure, such as Filiya and Gwandum, benefited from boreholes and improved health services, resulting in rapid declines. Conversely, less developed wards continued to rely on unsafe water sources, with households of lower education and income levels disproportionately affected. Children were particularly vulnerable due to behavioral exposure and limited parental capacity to provide safe alternatives (Okpasuo et al., 2020; Okesanya et al., 2024). These disparities highlight how poverty, inadequate infrastructure, and weak health systems exacerbate vulnerability to waterborne diseases.

Overall, the findings emphasize unsafe water sources, seasonal contamination, and socio-demographic inequalities as the key drivers of waterborne diseases in Pero–Shonge. Addressing these challenges requires urgent interventions, including expansion of safe water infrastructure, improved sanitation systems, and sustained health education campaigns. Early detection of symptoms such as diarrhea, vomiting, dysentery, and dehydration should be prioritized to enable prompt treatment and reduce complications (Mutono et al., 2020; Nkemnyi et al., 2023). Without such measures, waterborne diseases will remain a major public health crisis in rural Nigeria.

CONCLUSION

This study established that waterborne diseases remain highly prevalent in Pero–Shonge, particularly in Burak, Bangunji, Gundale, and Kushi wards, where cases persisted between 2018 and 2022. In contrast, Filiya and Gwandum recorded declines due to improved borehole access and better health infrastructure. Children aged 5–15 years were the most affected, underscoring their vulnerability to unsafe water sources and limited hygiene awareness.

The persistence of high prevalence across most wards highlights the urgent need for integrated interventions. Expanding access to safe drinking water through boreholes, solar-powered water systems, and other sustainable technologies is critical. Equally important are investments in sanitation infrastructure, community-based hygiene education, and strengthened health services. Policymakers, politicians, business leaders, and community development organizations must collaborate to ensure equitable access to clean water. Public health practitioners should intensify awareness campaigns on water treatment and hygiene practices, while communities must be discouraged from sharing water sources with animals.

Ultimately, tackling waterborne diseases in rural Nigeria requires a holistic approach that combines infrastructure development, socio-demographic empowerment, and community engagement. Without such coordinated action, waterborne diseases will continue to undermine health and development in vulnerable populations.

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CONFLICT OF INTEREST: The authors declare no conflicts of interest.

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