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Lack of Access to Safe Drinking Water and Prevalence of Waterborne Diseases: A Cross-sectional Study in Melong Centre Health Area in Cameroon

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Abstract

Access to safe drinking water remains a major public health challenge in many low- and middle-income countries, particularly in rural and peri-urban communities. This study aimed to assess the impact of limited access to potable water on the prevalence of waterborne diseases in the Melong Centre Health Area, Cameroon. A descriptive cross-sectional study was conducted from May to June 2025 among households, patients, and healthcare professionals in the Melong Health District. Data were collected using structured questionnaires, direct observations, and microbiological analysis of water samples. A total of 395 participants were enrolled, including households, patients, and health professionals. The majority of household heads were male (62.6%), with a mean age of 45.67 years. Rivers, lakes, and unprotected wells constituted the main sources of water supply for many households. Microbiological analysis revealed high levels of total coliform contamination in river water samples. Typhoid fever was the most prevalent waterborne disease (67.8%), followed by dysentery and acute gastroenteritis, as recalled by participants. Distance to water sources greater than 1 km and collection time exceeding 30 minutes were significantly associated with poor water accessibility ($p < 0.05$). Approximately 30% of households reported using no water treatment method before consumption. The findings demonstrate a strong association between inadequate access to safe drinking water and increased prevalence of waterborne diseases in Melong Centre. Strengthening potable water infrastructure, promoting household water treatment practices, and improving hygiene education are essential to reduce the burden of waterborne diseases in the community.

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Keywords: Safe drinking water, waterborne diseases, typhoid fever, water accessibility, Melong, Cameroon

1. Introduction

1.1 Global Importance of Access to Safe Drinking Water

Access to safe drinking water is a fundamental human right and an essential determinant of public health and socio-economic development (World Health Organization [WHO], 2023). Safe drinking water refers to water that is free from microbial pathogens, toxic chemical substances, and physical contaminants that may threaten human health (United Nations Children's Fund [UNICEF] & WHO, 2023). Adequate access to potable water is necessary for drinking, cooking, personal hygiene, sanitation, and disease prevention. However, despite global progress in water supply and sanitation services, millions of people worldwide continue to lack access to safe and affordable drinking water, particularly in low- and middle-income countries (UN-Water, 2022).

1.2 Global Burden of Waterborne Diseases

Globally, more than two billion people live in countries experiencing high water stress, and approximately 1.7 billion people consume water contaminated with fecal matter (WHO, 2023). Unsafe water, inadequate sanitation, and poor hygiene contribute substantially to the transmission of waterborne diseases such as cholera, typhoid fever, dysentery, gastroenteritis, and poliomyelitis (Prüss-Ustün et al., 2019). According to WHO (2023), contaminated drinking water causes approximately 505,000 diarrheal deaths annually worldwide, particularly among children under five years of age.

1.3 The Situation in Sub-Saharan Africa

Sub-Saharan Africa bears a disproportionate burden of water-related diseases due to poor sanitation infrastructure, rapid urbanization, poverty, climate change, and inadequate access to potable water (United Nations Development Programme [UNDP], 2021). UNICEF (2022) reported that nearly half of the global population lacking access to improved drinking water sources resides in sub-Saharan Africa. In rural communities, women and children often travel long distances to collect water from unsafe rivers, lakes, and unprotected wells, increasing exposure to contaminated water sources (GWP, 2020).

1.4 Access to Safe Drinking Water and Waterborne Diseases in Cameroon

In Cameroon, access to potable water remains a significant public health challenge despite the country's abundant water resources. National reports indicate that more than 27% of households do not have access to safe drinking water, and only a small proportion of households apply adequate water treatment methods before consumption (Cameroon Ministry of Public Health, 2022). Waterborne diseases remain among the leading causes of morbidity and mortality in the country, particularly in rural and peri-urban communities with inadequate sanitation systems (MINSANTE, 2021). Studies conducted in Cameroon have demonstrated that typhoid fever,

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cholera, dysentery, and acute diarrheal diseases are strongly associated with poor water quality and inadequate hygiene practices (Nana et al., 2020).

1.5 Water Supply and Sanitation Challenges in the Melong Health District

The Melong Health District, located in the Littoral Region of Cameroon, faces important challenges related to potable water accessibility and sanitation. Many households depend on rivers, streams, unprotected wells, and poorly maintained boreholes for daily water supply. Rapid urbanization, environmental degradation, poor infrastructure, and seasonal water shortages further compromise access to safe water in the region (GWP, 2020). Consequently, healthcare facilities in Melong continue to report increasing cases of typhoid fever, gastroenteritis, and other waterborne diseases.

1.6 Water Contamination and Household Water Treatment Practices

Water contamination may occur through microbial, chemical, and environmental pollutants. Fecal contamination of water sources remains one of the major causes of waterborne disease transmission in developing countries (WHO, 2023). The presence of total coliforms and pathogenic bacteria in drinking water indicates poor water quality and increased health risks (Prüss-Ustün et al., 2019). Household water treatment methods such as boiling, filtration, and chlorination have been shown to significantly reduce the burden of waterborne diseases when properly implemented (Clasen et al., 2015).

1.7 Determinants of Access to Safe Drinking Water

Several socio-demographic and environmental factors influence access to safe drinking water, including household income, educational level, distance to water sources, population density, and seasonal variations (UNICEF & WHO, 2023). Long distances to water sources and prolonged water collection time particularly affect women and children, limiting educational and economic opportunities while increasing vulnerability to disease transmission (Sorenson et al., 2011).

1.8 Research Gap, Study Rationale and objective

Although several studies have investigated water supply and sanitation challenges in Cameroon, limited research has specifically explored the relationship between lack of access to potable water and the prevalence of waterborne diseases in the Melong Health District. Understanding these local dynamics is essential for designing evidence-based public health interventions and improving water management policies in the region.

Therefore, this study aimed to assess the impact of inadequate access to safe drinking water on the prevalence of waterborne diseases in the Melong Centre Health Area, Cameroon.

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2. Methods

2.1 Study Design

A descriptive cross-sectional study was conducted in the Melong Centre Health Area.

2.2 Study Area

The study was carried out in the Melong Health District, located in the Littoral Region of Cameroon. The district covers approximately 641 km² and serves an estimated population of 113,938 inhabitants distributed across 10 health areas. Melong Centre Health Area comprises 17 communities with an estimated population of 49,519 inhabitants.

2.3 Study Population

The study population included:

- Households residing in Melong Centre;
- Patients diagnosed with waterborne diseases;
- Healthcare professionals working within the health area.

2.4 Sampling Technique and Sample Size Determination

A stratified random sampling technique was used to recruit participants from households, healthcare facilities, and the community. The minimum sample size was calculated using Cochran's formula for cross-sectional studies:

$n = Z^2P(1-P)/d^2$

Where:

- n = minimum required sample size
- Z = 1.96 corresponding to a 95% confidence level
- P = estimated prevalence (50%) due to lack of a precise local estimate
- d = margin of error of 5%

Substituting these values:

$n = (1.96)^2 \times 0.5 \times (1-0.5)/(0.05)^2$

$n = 384$

Considering possible non-response and incomplete questionnaires, a total of 395 participants were finally included.

2.5 Data Collection

Data were collected using structured questionnaires, interviews, direct observation, and microbiological analysis of water samples from selected water sources. Information collected included socio-demographic characteristics, water sources, water treatment methods, sanitation practices, and prevalence of waterborne diseases.

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2.6 Microbiological Analysis

Water samples obtained from rivers and community water sources were analyzed in an accredited laboratory for total coliforms, *Escherichia coli*, intestinal enterococci, *Salmonella spp., Shigella spp., Vibrio cholerae*, and other microbial indicators.

2.7 Data Analysis

Data were entered and analyzed using SPSS version 2020 and Microsoft Excel. Descriptive statistics including frequencies and percentages were used to summarize variables. Logistic regression analysis was performed to determine factors associated with poor water accessibility, with statistical significance set at $p < 0.05$.

3. Results

3.1 Socio-demographic characteristics of households

Table 1 presents the socio-demographic characteristics of household heads. The majority were male (62.6%), with a mean age of 45.67 years. Most households contained between 1 and 5 persons (68%), while 41.9% had at least one child under five years of age.

Table 1. Socio-demographic characteristics of household heads (N = 203)

Variable	Frequency	Percentage (%)
Male	127	62.6
Female	76	37.4
Secondary education	111	54.7
Formal sector employment	95	46.8
Households with children <5 years	85	41.9

3.2 Sources and Accessibility of Drinking Water

Table 2 shows the principal sources of water used by households and patients. Rivers, lakes, and streams constituted the major water source among households (40.4%), while public boreholes were the main source among patients (30.4%).

Table 2. Main Sources of Drinking Water among Participants

Water Source	Households n (%)	Patients n (%)
River/lake/stream	82 (40.4)	17 (12.3)
Unprotected well	48 (23.6)	29 (21.0)
Public borehole	12 (5.9)	42 (30.4)
Household tap water	25 (12.3)	29 (21.0)
Protected well	23 (11.3)	19 (13.8)

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3.3 Water Accessibility and Collection

Most households reported substantial challenges related to water accessibility. Figure 1 illustrates important challenges related to water accessibility among respondents. Although only 12.3% of participants reported traveling more than 1 km to collect water, a considerable proportion (29.1%) spent more than 30 minutes collecting water, suggesting delays related to waiting time, queuing, or difficult access routes. The figure further highlights that seasonal variation in water availability was reported by the vast majority of respondents (96.6%), indicating that water access remains highly unstable and dependent on seasonal conditions.

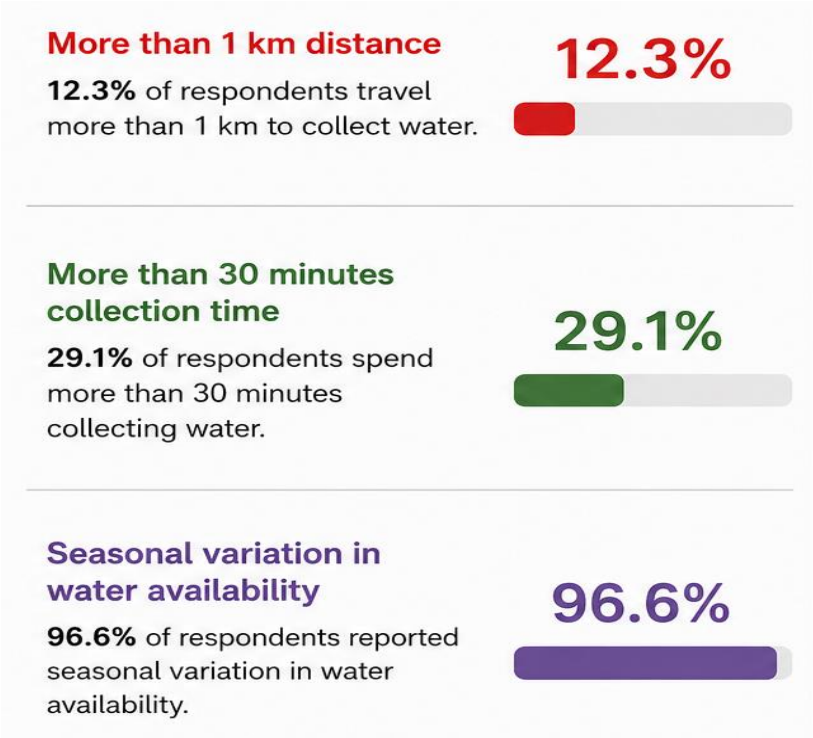

Figure 1. Distance and Time Spent Collecting Water

3.4 Water Quality and Household Treatment Methods

Table 3 presents perceptions of water quality and household water treatment practices. Most households considered their water quality to be average (71.9%) or poor (20.7%). Approximately 30% of households reported using no water treatment method before drinking.

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Table 3. Water quality perception and treatment practices

Variable	Frequency	Percentage (%)
Average water quality	146	71.9
Poor water quality	42	20.7
No water treatment method	61	30.0
Boiling	88	43.3
Filtration	31	15.3
Chlorination tablets	23	11.3

3.5 Microbiological Analysis of Water Samples

Microbiological analysis revealed contamination of river water samples by total coliform bacteria. Water samples from Quartier Haoussa and Nkongsoung showed high microbial loads exceeding WHO standards for potable water.

Table 4. Microbiological analysis of river water samples

Parameter	WHO Standard	Quartier Haoussa	Nkongsoung
Total germs at 36°C	<20/ml	105/ml	150/ml
Total coliforms	0/100 ml	26/100 ml	10/100 ml
Escherichia coli	0/100 ml	0	0
Salmonella spp.	Absence	Absence	Absence

3.6 Prevalence of Waterborne Diseases

Figure 2 shows that typhoid fever was the most commonly reported waterborne disease among participants, accounting for 67.8% of recalled cases. Acute gastroenteritis was the second most frequently reported condition (24.9%), while amoebic dysentery, giardiasis, hepatitis A, and cholera were reported at much lower proportions. These findings suggest that unsafe water sources and poor sanitation practices remain important contributors to the burden of waterborne diseases within the community.

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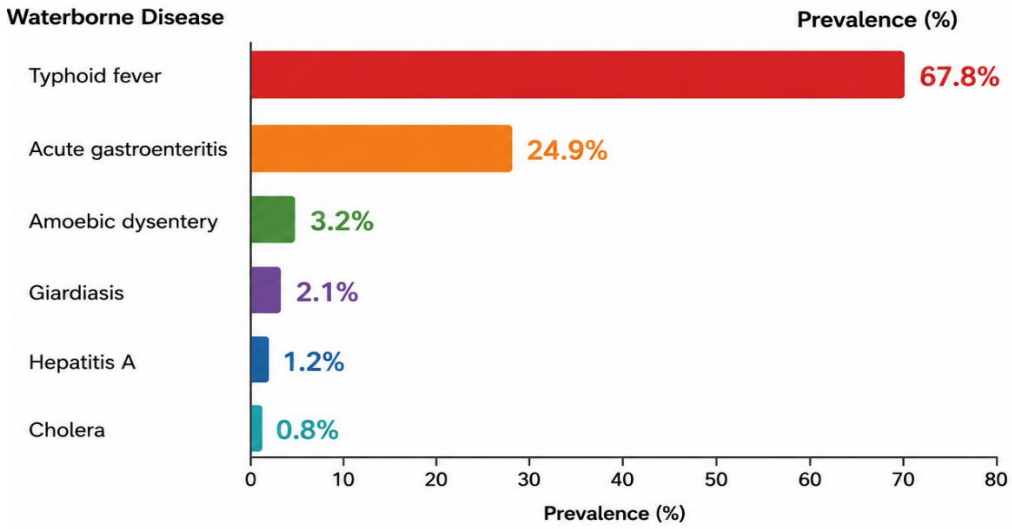

Figure 2. Prevalence of Waterborne Diseases as Recalled by Participants

4. Discussion

The present study demonstrated that inadequate access to safe drinking water remains a significant public health problem in the Melong Centre Health Area. Rivers, streams, and unprotected wells constituted the main sources of water for many households, exposing the population to considerable risks of microbial contamination and waterborne diseases. Similar findings have been reported in other sub-Saharan African settings where poor sanitation infrastructure and limited potable water supply contribute to increased disease burden (UNICEF, 2022).

The microbiological analysis conducted in this study revealed elevated levels of total coliform contamination in river water samples, indicating fecal contamination and poor microbiological water quality. These findings are consistent with WHO (2023), which emphasizes that microbial contamination of drinking water remains one of the leading causes of diarrheal diseases worldwide. Prüss-Ustün et al. (2019) similarly reported that contaminated water sources significantly contribute to cholera, typhoid fever, and dysentery outbreaks in developing countries.

Typhoid fever emerged as the most prevalent waterborne disease in this study. This observation corroborates reports from the Cameroon Ministry of Public Health indicating increasing typhoid fever prevalence in regions with inadequate water and sanitation infrastructure (MINSANTE, 2021). Nana et al. (2020) also demonstrated strong associations between consumption of untreated water and typhoid fever occurrence in Cameroonian communities.

Distance to water sources and prolonged water collection time were identified as major environmental factors influencing poor water accessibility. Households traveling more than 1 km

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or spending more than 30 minutes collecting water experienced significantly poorer access to potable water. Similar findings were reported by Sorenson et al. (2011), who showed that long-distance water collection disproportionately affects women and children while reducing opportunities for education and income-generating activities.

The study additionally revealed inadequate household water treatment practices, with approximately one-third of households consuming untreated water. Although boiling and filtration were used by some households, the proportion remained insufficient to effectively prevent waterborne diseases. Clasen et al. (2015) demonstrated that household water treatment interventions significantly reduce diarrheal disease prevalence when consistently applied.

Seasonal variation in water availability further aggravated water accessibility challenges in the study area. Most participants reported that access to potable water became particularly difficult during the dry season. Climate variability, rapid urbanization, and poor water management systems likely contribute to seasonal water shortages in Melong, as similarly reported by UNDP (2021).

Healthcare facilities in the study area also experienced important limitations in access to reliable potable water. More than half of health professionals reported unreliable water access in their facilities, potentially compromising infection prevention and patient care. WHO and UNICEF (2023) emphasize that adequate water supply in healthcare settings is essential for quality healthcare delivery and infection control.

An additional concern associated with contaminated water sources is the presence of Gram-negative bacteria and their endotoxins, particularly lipopolysaccharides (LPS). Although the present study focused primarily on microbiological indicators such as total coliforms and *Escherichia coli*, contaminated rivers, streams, and unprotected wells may harbor Gram-negative bacterial species capable of releasing endotoxins into the environment. Exposure to elevated levels of bacterial endotoxins through contaminated water has been associated with inflammatory responses and adverse health outcomes in vulnerable populations. Recent literature suggests that monitoring microbial contamination should extend beyond conventional bacterial indicators to include assessment of endotoxin-producing microorganisms and related toxins where feasible. Incorporating advanced water quality surveillance systems may therefore contribute to improved risk assessment and public health protection in communities with limited access to safe drinking water (Martins, 2018; Martins, 2017; Sharma & Martins, 2023).

Overall, the findings of this study highlight the urgent need for improved water supply infrastructure, community hygiene education, and strengthened water quality monitoring systems in Melong Centre. Public health interventions should prioritize expansion of protected water sources, promotion of household water treatment methods, and implementation of effective sanitation programs to reduce the burden of waterborne diseases in the community.

This study demonstrated a significant association between inadequate access to safe drinking water and the prevalence of waterborne diseases in the Melong Centre Health Area, Cameroon. Rivers, streams, and unprotected wells were identified as major sources of drinking water for many households, while microbiological analysis revealed contamination levels exceeding recommended safety standards. Typhoid fever emerged as the most commonly reported waterborne disease, highlighting the public health consequences of unsafe water consumption and inadequate sanitation practices. Long distances to water sources, prolonged collection times, seasonal water shortages, and limited household water treatment practices further contributed to poor water accessibility.

The findings underscore the urgent need for investment in potable water infrastructure, strengthening of water quality monitoring systems, promotion of household water treatment methods, and implementation of community-based hygiene education programs. Future water quality surveillance should also consider assessment of Gram-negative bacterial contamination and associated endotoxins to enhance understanding of emerging environmental health risks. Addressing these challenges will contribute significantly to reducing the burden of waterborne diseases and improving population health in Melong Centre and similar resource-limited settings.

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