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Water Quality Assessment and Burden of Waterborne Diseases in Gyel and Du Communities of Jos South LGA

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Abstract

Background: Safe water is important for health, yet many people still rely on sources of water that are not adequately protected from contamination. Drinking unsafe water provides conditions that enhance the chances of contacting such waterborne illnesses as diarrhea and typhoid, especially in communities with poor sanitation measures. The study was conducted to assess water sources, handling practices, and waterborne diseases in Gyel and Du communities in Jos South Local Government Area.

Methods: A total of 807 respondents participated in this community-based cross-sectional survey. The structured questionnaire focused on household drinking water sources, storage methods, hygiene behaviors, and episodes of illness in the past six months. Water samples were collected from common sources like wells, streams, and stored household water. The water samples were

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assayed for simple quality indicators, namely pH, turbidity, and bacterial contamination, using simple laboratory procedures.

The results indicated a high reliance by households on water sources that were unsafe, with the majority being wells without protection and surface waters. The majority of households did not treat the water before drinking. Laboratory analysis indicated many samples contained unsafe levels for bacteria such as coliforms and Escherichia coli, indicative of fecal contamination. A large number of respondents reported diarrhea and typhoid within the last six months; this points to a strong association between water quality and health complaints.

Conclusion: Drinking water in Gyel and Du communities is not always safe, leading to a high burden of waterborne diseases. Improvements in water supply systems are urgently needed along with the promotion of household water treatment and improved sanitation and hygiene practices in order to safeguard public health.

Keywords: water quality, waterborne diseases, sanitation, bacterial contamination, public health

Introduction

Good health and daily life require access to safe and clean drinking water. Safe drinking water improves health and helps to promote healthy growth in children, whereas contaminated drinking water can cause illness and promote unhealthy growth. Unfortunately, many developing countries rely on untreated or unprotected sources of drinking water, which create a population at risk for serious health consequences. Contaminated drinking water commonly contains disease-causing bacterium and viruses that can cause the spread of diseases including typhoid fever, cholera, and diarrhea. These diseases are each easily transmitted and remain among the leading causes of illness and death among children under the age of five.

The availability of safe drinking water for all citizens throughout Nigeria is still an issue of concern today. Most individuals living in rural and semi-urban areas continue to rely on shallow wells, creeks or other non-protected sources as their source of drinking water. The issue of limited access to safe drinking water is compounded by inadequate sanitation,

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dumping human or animal waste near water sources, as well as open defecation, which increase the likelihood of exposure to germs and diseases.

The lack of access to sufficient amounts of water as the population of Gyel and the surrounding communities of Du and Jos South continues to grow rapidly raises serious concerns in Plateau State. Some members of these communities rely heavily on wells and boreholes; however, these water sources have the potential to be contaminated if not properly constructed or maintained. Improperly handled and stored water by households could also pose similar health risks, even though the original source of water was not contaminated.

For people to improve their health, it is vital to learn where individuals retrieve their water for drinking and sanitation, how they store/handle/consume it within the household and the types of illnesses that they have experienced. This study will assess the relationship between the sources of drinking water, water quality and the burden of waterborne illnesses for the residents of the communities of Gyel and Du in Plateau State (7). The research findings will contribute toward developing plans to increase access to safe drinking water, improving community hygiene practices and creating public health campaigns in these areas.

Methods

Study Design and Setting

Between June and August 2025, a cross-sectional study was carried out in the communities of Gyel and Du, located in Jos South Local Government Area, Plateau State, Nigeria (8). The Gyel and Du communities were chosen based on their history of experiencing high levels of waterborne illness and the diverse range of water supply sources that residents use to obtain drinking water (i.e., wells, boreholes, and surface water) for their households. The study focused on the assessment of household water supply sources, storage and treatment practices, hygiene habits, and the prevalence of waterborne illness in these communities.

Study Population and Sampling

The number of participants in this study was 807. To be eligible for participation in the study, participants must have been adults (e.g., 18 years or older) who primarily collected or handled drinking water in their respective homes. The households from which the adults were selected were selected through a stratified

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random sampling method; this allowed for the selection of households from different neighbourhoods across both communities. In order to prevent duplicating responses, only one adult from each household was interviewed.

Data Collection

- Research assistants, who have been trained, collected the data through a structured survey, which included collecting:
- Demographic data and household information
- Sources of drinking water (primarily and otherwise)
- Use of household methods for transporting and storing drinking water
- Ways that people treat drinking water before it reaches them (i.e. boiling, filtering and adding chlorine)
- How people wash their hands, as well as their level of hygiene
- Any water related illnesses (diarrhea, typhoid fever, cholera) someone in the surveyed household had experienced within the previous 12 months (9).

Water Testing

Household Water Samples Collected at Primary Household Sources: Wells; Boreholes; Streams and Water Received from Containers Inside the Home. The results of these analyses provide information on physical (e.g., Color; Turbidity; Total Coliforms and E. coli) and Microbial Quality Indicators (pH). All water sample analyses were conducted following standard laboratory methods (10).

Data Analysis

Information gathered from questionnaires and lab work was processed through Excel, then analyzed using descriptive statistical techniques. Water source summarizations, storage practices, water quality results, and reported rates of occurrence for diseases caused by contaminated water were presented using frequency counts, percentages, and basic cross-tabulation of variables.

The relationship between how water is handled, stored, and used by people in relation to disease occurrence was investigated through cross-tabulation, the relationship between water use and disease occurrence was expressed in graphical forms and tables for ease of viewing/accessing.

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Ethical Considerations

The Desh Bhagat University Institutional Review Board (Approval No. IRB/DBU/2024/017) and the Wesley University, Ondo, Research Ethics Committee provided ethical approval for this study. All participants provided written informed consent prior to their enrollment. We took extreme measures to ensure confidentiality; no names were recorded, and responses were expressed in unique identifiers. Participation in the study was voluntary and participants were not offered any monetary or material incentives for their involvement in the study. All procedures were carried out in accordance with the ethical standards established in the Helsinki Declaration

Results

Table 1. Main Sources of Drinking Water (n = 807)

Water Source	Frequency	Percentage (%)
Well water	345	42.8
Borehole water	220	27.3
Stream water	172	21.3
Stored water from vendors	70	8.6

The table below presents the primary sources of water utilized by the residents of the Gijl and Duj communities for drinking purposes. A total of 345 individuals (42.8%) noted that well water made up their main source of drinking water. Borehole water was the second most frequently stated primary source at 220 respondents (27.3%). Following these two options, an impressive number of households (172 respondents or 21.3%) utilize stream water, which is frequently exposed to

environmental factors, thus leading to significant risks of contamination. Lastly, a smaller number of individuals (70 respondents) used stored water obtained from vendors (8.6%), indicating an opportunity for improvement in providing reliable, accessible water through municipal services.

In sum, the majority of households are dependent upon sources of water that are not treated or susceptible to pollution during transit. The heavy reliance upon wells and streams indicates that these communities do not have the benefit of having access to properly operated boreholes or piped water distribution. The combination of the current water source pattern combined with the high level of exposure to microbial waterborne illness suggests a large potential for increased

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levels of illness caused by waterborne pathogens in these households. Improvements to the water supply systems coupled with education on proper drinking water safety will help to reduce the incidence of waterborne illness in these communities.

Table 2. Basic Water Quality Results

Parameter	WHO Standard	Community Mean	Interpretation
pH	6.5–8.5	5.9	Too acidic
Turbidity (NTU)	<5	14.2	Not clear
Total Coliform	0 CFU/100 ml	Present	Unsafe
E. coli	0 CFU/100 ml	Present	Unsafe

In Table 2, a summary of results of main water quality indicators for the household water sources from Gyel and Du communities is presented. Among the results from the study, it was found that the drinking water's pH (an average of 5.9), which is below the WHO's recommended value of 6.5 to 8.5, indicates the acidity of this water supply. A further indication of the corrosive quality of acidic water is that it can corrode storage containers and piping material introducing harmful metals that reduce the safety of the drinking water.

The average for Turbidity also was found to be greater than the WHO recommended value of less than 5 NTU with an average of 14.2 NTU for the water samples collected. The level of turbidity indicates that the clarity of the water is poor and that this turbidity is caused by the suspended materials within the water samples, including dirt, decaying plant and animal material, and microorganisms. As a result, the water samples with high turbidity could potentially contain pathogens and need to undergo treatment before consumption.

The detection of microbial contaminants poses significant health risks to individuals living in these communities. WHO establishes a maximum acceptable level of zero total coliforms and Escherichia coli per 100ml when testing drinking water. The presence of fecal matter (E. coli) from human and animal sources demonstrates inadequate hygiene and presents a serious threat to public health via waterborne diseases such as diarrhea, typhoid, and cholera.

To summarize, the overall results of the laboratory analysis indicate that almost all of the sources of drinking water within these communities are unfit for consumption without some form of treatment. Therefore, there is a pressing need for improved water treatment systems, improved hygiene behaviours, and improved protection of the

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community's water sources to mitigate the risk of illness associated with microbial contaminants.

Table 3. Reported Waterborne Diseases in the Last 6 Months

Disease	Frequency	Percentage (%)
Diarrhea	370	45.9
Typhoid fever	286	35.4
Cholera	42	5.2
Skin infections	109	13.5

Table 3 outlines the top reported water-related illnesses within the past six months among the residents who participated in this survey. The most frequent illness reported was diarrhea, which affected 370 of the respondents (45.9%). A relatively high percentage of respondents indicate that there is likely to have been repeated exposure by respondents to unsafe drinking water, particularly from using wells or streams for drinking water within their households. Typhoid fever was the second-most common illness with 286 cases (35.4%); this means that many individuals continued to have contact with water that came into contact with human waste.

Also noted as a result of using contaminated water for appropriate bathing or household cleaning, skin infections were reported in 109 respondents (13.5%). Cholera was the least commonly reported disease at 42 cases (5.2%), which shows that cholera can occur as an outbreak when sanitation conditions are considered to be very poor.

Based on the results of the current study, waterborne diseases are a significant public health issue in both Gyel and Du communities. A high prevalence of diarrhea and typhoid demonstrates that drinking water contains relatively low levels of microbial quality. The findings suggest that adequate treatment, improvement of access to safe drinking water, and proper hygiene education should focus on the prevention of waterborne diseases.

Discussion

According to our research done in 2020, significant health problems exist in the Gyel and Du communities. In fact, most families in these two communities rely on various water sources such as streams, boreholes, and wells, which they are all "natural" sources of water; however, despite being perceived as "natural" sources of safe water, the reality is that many of these water sources do not meet safety standards. Laboratory tests conducted in December 2020 confirmed that microbial

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contamination, particularly Coliform and E. coli, was detected in many of the water samples tested.

These findings support recent research from Nigeria; for example, a 2024 review highlighted a widely recognized "water crisis" caused by polluted groundwater, lack of infrastructure, and unsafe drinking water in an environment where there were abundant water resources available (12). In addition, another review published in 2025, revealed significant health risks and very poor groundwater quality in a semi-urban community as a result of pit latrines leaking into wells (13).

Additionally, studies regarding treatment of household water in Nigeria have shown that point-of-use (POU) chlorination is both effective at treating contaminated water and inexpensive to use; however, very few households use or are knowledgeable about using POU methods for treating their drinking water (14); this was also supported by our findings that very few households treated their water prior to drinking.

Water storage practices are important as they are a major contributor to contaminated water supply. Research has shown that open (or uncovered) containers will have a much higher chance of being contaminated than covered containers (15). Our survey results showed that a large percentage of households use open (or uncovered) containers and that very few households use tap/spouted containers.

Poor storage/handling practices will cause re-contamination of borehole/well water, thus making the initial conclusion of 'clean' water not a valid assumption. Those living in rural areas in Nigeria experience increased risks from re-contamination due to poor sanitation practices, such as open defecation and inadequate waste disposal, in close proximity to their water source.

The high incidence of water-related illnesses means that diarrhea is especially harmful to children under 5, corroborated by the fact that other studies within Nigeria have also shown that unimproved water sources are associated with an increased incidence of diarrhea (16). Due to lack of access to safe drinking water and lack of sanitation facilities, water-related diseases represent a significant public health burden.

To address the potential risk of disease transmission from unsafe water, there are several steps that need to be taken: improving

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the infrastructure of safe drinking water systems such as protected wells, well-maintained boreholes, and piped water supply, promoting safe storage practices (such as having covered containers with tap/spout) for drinking water, encouraging household treatments for drinking water (boiling, chlorination, and filtration), and improving the overall sanitation and hygiene of the area (toilets, hand washing, and waste disposal).

Conclusion

Clean and safe drinking water is still not available to many households in the Gyel and Du communities of Jos South LGA. Households rely on untreated or improperly treated sources of water, such as wells, streams, and rivers; these sources are often contaminated by dirt and animal waste, which allow germs to grow and multiply.

Unprotected and improperly treated water can easily become contaminated with bacteria, which can cause a number of diseases that can be easily transmitted, particularly to young children, who are at an increased risk of infection.

Furthermore, the lack of knowledge about effective methods for treating water(e.g., boiling, filtration, chemical treatments, and other methods) has resulted in many families using untreated water directly from the source..

The problems outlined above lead to significant health care concerns for the people that live in the Gyel and Du communities as a result of waterborne illnesses. Access to safe drinking water, proper hygiene education, and testing of water supplies is crucial to reducing the occurrence of illnesses. Developing educational programs within the community, providing appropriate storage containers and sanitation services would aid in improving health and preventing future occurrences.

In summary, providing safe water and developing better hygiene practices are key components of reducing preventable illnesses and improving the overall health of the residents of Gyel and Du.

Take-Home Message

Access to clean water helps to reduce illness and supports good health, particularly in the Gyel and Du communities where many families use unsafe drinking-water sources contaminated with pathogenic bacteria, resulting in a high number of people suffering from diarrhoea, typhoid and other waterborne diseases. Provision of safe drinking water;

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promotion of safe water storage and hygiene practices; and routine testing of community water sources will benefit local residents by reducing their illness burden from preventable diseases.

Authors' Contribution

SHU-ACHET Daniel Gimbason designed the study, methodology, and made data collection contributions. The data analysis, interpretation, and manuscript drafting was coordinated by Dr. Stephen Monday. Prof. (Dr.) Daniel Mairafi Gimbason gave general supervision, critical revisions, and approval of the research design. Amina Elisha Atikinpan assisted in data curation, literature review, and figure and table preparation. Ruby S. Gibson assisted with writing, editing, and final manuscript formatting for publication. All authors read and approved the final manuscript, and agreed to be held responsible for the work. `

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Conflict of Interest

The authors declare that they have no relationships that could be viewed as a potential conflict of interest in the research, the interpretation of data, authorship of the article, or the publication of the research. Specifically, the authors have not received financial support, materials or gifts from an organisation, government agency or business entity that might reasonably be judged to result in such a conflict of interest. All decisions about study design, data collection, data analysis, data interpretation, and the writing of the

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