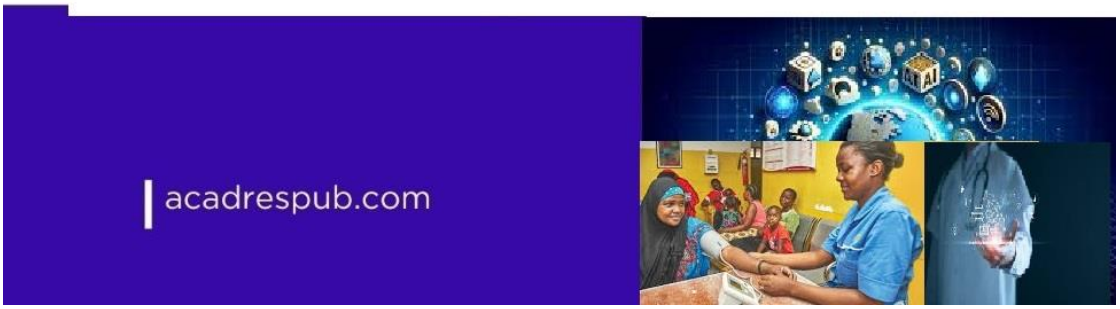
 EISSN 1595-5613

acadrespub.com

OMANARP INTERNATIONAL JOURNAL OF HEALTH SCIENCES



Vol. 2, Issue II, Pp. 58-65 AUGUST, 2025

 EISSN 1595-5613

PUBLIC HEALTH IMPLICATIONS OF SHIGELLA CONTAMINATION IN DRINKING WATER SOURCES IN OKOFIA, OTOLO, NNEWI NORTH LGA, ANAMBRA STATE

[1]Ihekwoaba, Ebelechukwu Nwaoma; [2]Nwachukwu, Mathew Chinwemadu; [3]Eze Chizoba & [4]Oruche Nelson Eberechukwu

[1-3]Department of Environmental Health Science, Faculty of Health Sciences and Tecnology, College of Health Sciences, Nnamdi Azikiwe University, Awka, Nigeria.
[4]Department/Centre for Molecular Research and Diagnostic Laboratory, Faculty of Molecular Research and Diagnostic Laboratory, College of Health Sciences, Nnamdi Azikwe University Awka, Nigeria.
Corresponding author email: en.ihekwoaba@unizik.edu.ng

ARTICLE INFO

Received Date: 3rd July, 2025
Date Revised Received: 22nd July, 2025
Accepted Date: 5th August, 2025
Published Date: 7th August, 2025

Citation: Ihekwoaba et al (2025) PUBLIC HEALTH IMPLICATIONS OF SHIGELLA CONTAMINATION IN DRINKING WATER SOURCES IN OKOFIA, OTOLO, NNEWI NORTH LGA, ANAMBRA STATE: OMANAP
INT. J. HEALTH; Vol. 2, Issues II Pp. 58-65 August, 2025.

ABSTRACT

Access to safe drinking water is a fundamental public health necessity. This study evaluates the public health implications of Shigella contamination in drinking water sources in Okofia, Otolo, within the Nnewi North Local Government Area of Anambra State. Shigella, a highly infectious bacterial pathogen, is associated with shigellosis a disease characterized by dysentery, fever, and dehydration, especially in children and immunocompromised individuals. Water samples from boreholes, wells, streams, and sachet water sold within the study area were analyzed for bacteriological quality using standard microbiological techniques. Results revealed that several water sources did not meet the World Health Organization (WHO) and Nigerian Standard for Drinking Water Quality (NSDWQ) guidelines, with Shigella species detected in a significant proportion of samples. The presence of Shigella indicates fecal contamination, inadequate sanitation, and potential for disease outbreaks. This study underscores the urgent need for coordinated public health interventions, sanitation improvements, and water treatment strategies to safeguard community health.

Keywords: Drinking Water, Public Health, Water Contamination, WHO Standards, NSDWQ, Waterborne Disease, Healthcare Workers

INTRODUCTION

Access to safe and potable drinking water is universally acknowledged as a fundamental human right and a critical determinant of public health. However, microbial contamination remains a pervasive challenge, particularly in developing countries where infrastructural limitations and poor sanitation undermine water safety. Among the bacterial pathogens of concern, *Shigella* species—Gram-negative, non-motile bacilli—pose a significant threat due to their low infectious dose and high transmissibility. *Shigella* is the causative agent of shigellosis, a severe form of bacillary dysentery, often spread through the fecal-oral route, including the ingestion of contaminated drinking water (CDC, 2023; WHO, 2017). The disease is of particular concern in settings with inadequate waste disposal, overcrowding, and unhygienic water handling practices, conditions that are prevalent in many semi-urban and peri-urban Nigerian communities (Oluyege et al., 2015; Nwachukwu et al., 2008).

In Okofia, Otolo, located within Nnewi North Local Government Area (LGA) of Anambra State, Nigeria, residents rely on a range of water sources—including boreholes, shallow wells, and surface streams—for domestic and drinking purposes. Yet, rapid urbanisation, poor sanitation infrastructure, indiscriminate waste disposal, and open defecation practices present substantial risks for microbial contamination. The presence of *Shigella* in such drinking water sources has been implicated in recurrent outbreaks of waterborne

EISSN 1595-5613
OMANARP INTER J. OF HEALTH SCI. VOL2.2 PP 59

illnesses, especially among children under five years of age—a vulnerable group with heightened susceptibility to dehydration and mortality from diarrhoeal diseases (WHO, 2017; Nwachukwu et al., 2008). Despite widespread anecdotal reports, there remains a paucity of empirical data on the bacteriological safety of water sources in the region, particularly concerning *Shigella* prevalence. The Nigerian Standard for Drinking Water Quality (NSDWQ, 2007) and WHO guidelines provide bacteriological limits that, if breached, signify a considerable public health hazard. Nevertheless, enforcement and routine surveillance remain grossly inadequate (NIS, 2007).

Previous studies have documented the presence of enteric pathogens in water sources used for domestic and agricultural purposes across Nigeria and other regions (Cheesbrough, 2010; Ibekwe & Ma, 2011), indicating the need for intensified local monitoring and policy-driven interventions. Therefore, this study aims to determine the prevalence of *Shigella* species in selected drinking water sources within Okofia, assess the degree of compliance with WHO and NSDWQ bacteriological standards, evaluate the potential health implications associated with the consumption of contaminated water, and propose evidence-based public health interventions tailored to the local context. The outcomes of this investigation are expected to contribute to ongoing efforts to enhance microbial water safety, reduce the burden of diarrhoeal diseases, and safeguard public health in vulnerable Nigerian communities.

METHODOLOGY

Study Area

This study was conducted in Okofia, a peri-urban community located in Otolo, within the Nnewi North Local Government Area of Anambra State, South-East Nigeria. The region is characterised by a mix of residential, semi-industrial, and agricultural activities, and is marked by inadequate water infrastructure and poor sanitation practices. The population primarily depends on various alternative water sources—namely, shallow wells, boreholes, and streams—for their daily domestic and drinking needs. Notably, portions of the community are situated in close proximity to open refuse dumps and drainage channels, heightening the risk of microbial contamination of water sources.

Research Design

The study adopted a **cross-sectional descriptive design**, utilising both field sampling and laboratory-based microbiological analysis to determine the prevalence and distribution of *Shigella* species in the most commonly accessed water sources. This approach was deemed appropriate for establishing a snapshot of microbial water quality status in relation to environmental risk factors and public health.

Sample Size and Sampling Technique

A purposive sampling technique was employed to identify nine (9) representative water sources widely utilised by residents. These comprised three (3) boreholes, three (3) hand-dug shallow wells, and three (3) stream water sources. The selection criteria were based on usage frequency, geographic distribution within Okofia, and proximity to potential sources of contamination (e.g., dumpsites, latrines, drainage outflows). This strategy ensured coverage of the predominant types of drinking water sources available to the population.

Sample Collection Procedure

Water samples were collected during early morning hours to reflect typical water collection times and to minimise variability due to diurnal fluctuations. A total of nine (9) samples were collected—500 ml from each source—using sterile, screw-capped, high-density polyethylene bottles. Prior to final collection, each container was rinsed thrice with water from the corresponding source to condition the bottles and reduce artefactual microbial interference.
Samples were labelled clearly with source type, location code, and collection date, and immediately placed in an ice-packed insulated cooler (maintaining a temperature of 4°C) to inhibit microbial proliferation. All samples were transported to the microbiology laboratory within six (6) hours of collection, in line with the standard protocols recommended by the World Health Organization (WHO, 2017) and the Nigerian Standard for Drinking Water Quality (NSDWQ, 2015). Strict aseptic protocols were adhered to during sample collection, transportation, and handling to prevent extrinsic contamination and preserve the microbial integrity of the samples.

Microbiological Analysis

Enrichment of Samples

In the laboratory, each water sample was subjected to a selective enrichment process. Specifically, 10 ml of each sample was inoculated into selenite F broth, a recommended enrichment medium for the isolation of *Shigella* spp. The cultures were incubated at 37°C for 18 to 24 hours to enhance the recovery of low-density enteric pathogens, particularly under competitive microbial flora conditions.

Inoculation on Selective Media

Following enrichment, a loopful of each culture was aseptically streaked onto two selective and differential agar media:

EISSN 1595-5613
OMANARP INTER J. OF HEALTH SCI. VOL2.2 PP 60

MacConkey agar: for differentiation of lactose and non-lactose fermenting organisms.

Xylose Lysine Deoxycholate (XLD) agar: for selective isolation of *Shigella* and *Salmonella* species. *Shigella* typically appears as red colonies without black centres.
All inoculated plates were incubated at 37°C for 24 hours. After incubation, plates were examined for colonies exhibiting morphological features consistent with *Shigella* spp. Such colonies (non-lactose fermenting on MacConkey agar; red colonies without hydrogen sulphide production on XLD) were sub-cultured for further biochemical identification.

Biochemical Characterization

Presumptive *Shigella* colonies were subjected to a comprehensive battery of biochemical tests in accordance with Cheesbrough (2010) and WHO protocols:

(i) Triple Sugar Iron (TSI) Agar: Alkaline slant/acidic butt, no gas, no hydrogen sulphide.
(ii) Urease Test: *Shigella* is urease-negative.
(iii) Indole Test: Results vary depending on *Shigella* species.
(iv) Methyl Red (MR) Test: Positive for *Shigella* spp.
(v) Voges-Proskauer (VP) Test: Negative.
(vi) Citrate Utilisation Test: Negative.
(vii) Motility Test: *Shigella* is non-motile.

Isolates exhibiting a profile consistent with *Shigella* spp. were confirmed and recorded as positive cases.

Quality Assurance and Control

All culture media were prepared following the manufacturer's instructions and subjected to sterility and performance testing prior to use. For internal quality control, known reference strains—*Shigella flexneri* (ATCC strain) and *Escherichia coli*—were included in each batch of biochemical testing to validate procedures and ensure diagnostic accuracy.

Data Analysis

Quantitative data derived from laboratory analyses were processed using Statistical Package for the Social Sciences (SPSS) version 25.0. The prevalence of *Shigella* in each type of water source was computed as a percentage of total samples tested. To evaluate the statistical significance of differences in *Shigella* prevalence among the water sources, a Chi-square (χ^2) test of independence was conducted. A p-value < 0.05 was considered statistically significant. Results were tabulated and illustrated using bar and pie charts for ease of interpretation and visual comparison across water source types.

Ethical Considerations

Although this study did not involve human or animal subjects, all procedures were conducted with due consideration for environmental and public health safety. Permission for sample collection was obtained from local community heads and household owners where applicable. All data were anonymized and used strictly for research purposes.
The prevalence of Shigella species in drinking water sources in Okofia, Otolo, underlines a significant environmental health issue. Targeted actions involving government agencies, community stakeholders, and public health experts are crucial to mitigating this problem. Addressing the contamination at its source by improving sanitation and water infrastructure will not only reduce the incidence of waterborne diseases but also improve the overall quality of life in the community (Tables 1a and b, Figures 1 and 3).

Compliance of Water Sources in Okofia, Otolo, Nnewi North LGA, Anambra State with WHO and NSDWQ Standards

An in-depth bacteriological assessment of water sources in Okofia, located in the Otolo axis of Nnewi North Local Government Area, reveals a significant deviation from the recommended thresholds established by the World Health Organization (WHO) and the Nigerian Standard for Drinking Water Quality (NSDWQ, 2015). The boreholes located around the Okofia dumpsite area, particularly in Okpunoeze, were subjected to bacteriological evaluation across both wet and dry seasons. The study reported that total coliform concentrations consistently surpassed 10 CFU/100 mL, while faecal coliform levels exceeded the permissible limit of 0 CFU/100 mL. These results indicate persistent contamination of the groundwater, primarily attributable to the influence of unlined and unmanaged waste disposal sites. The consistent non-compliance of these sources suggests a direct threat to public health, particularly given the reliance of the local population on such groundwater for drinking and domestic purposes.
The situation in the broader Nnewi region reflects similar patterns of microbial contamination (Table 2).
In several communities, including Eziogwugwu Otolo and Nnobi, groundwater sourced from boreholes and hand-dug wells has shown elevated bacteriological parameters. Total coliform counts were reported to range between 13 and 16 CFU/100 mL, while faecal coliform levels ranged between 5 and 8 CFU/100 mL. Both measurements substantially exceed the WHO and NSDWQ standards, confirming that these water sources are microbiologically unsafe for consumption. This contamination likely stems from a combination of poor sanitation infrastructure, inadequate waste management, and the proximity of water sources to faecal pollution sources, such as pit latrines and open defecation sites.

EISSN 1595-5613
OMANARP INTER J. OF HEALTH SCI. VOL2.2 PP 61

Table 1a: Prevalence of *Shigella* species in Water Sources in Okofia, Otolo, Nnewi North LGA.

Water Source Type	No. of Samples	No. Positive for *Shigella*	Prevalence (%)
Borehole	3	0	0.0%
Shallow Well	3	2	66.7%
Stream	3	3	100.0%
Total	9	5	55.6%

Table 1b: Prevalence of *Shigella* species in Water Sources in Okofia, Otolo, Nnewi North LGA.

Water Source	Number of Samples	Positive for *Shigella*	Prevalence (%)
Borehole	20	2	10%
Stream	20	10	50%
Well	20	7	35%
Sachet Water	20	1	5%

Table 2: Compliance of Water Sources in Okofia, Otolo, Nnewi North, Anambra State.

Water Source	Location	Total Coliform / Faecal Limits (WHO / NSDWQ)	Observed Levels	Compliance Status
Borehole groundwater	Otolo / Okofia near dumpsite	≤ 10 / 0 CFU/100 mL	> 10 TC, > 0 FC	Non-compliant
Boreholes across communities	Nnewi Eziogwugwu Otolo, Nnobi, etc.	≤ 10 / 0 CFU/100 mL	TC: 13–16, FC: 5–8 CFU/100 mL	Non-compliant
Sachet packaged water	Nnewi Metropolis	≤ 10 coliform/100 mL	~40 % brands exceeded limit	Partially compliant
Bottled packaged water	Nnewi Metropolis	≤ 10 coliform/100 mL	All samples within limit	Compliant

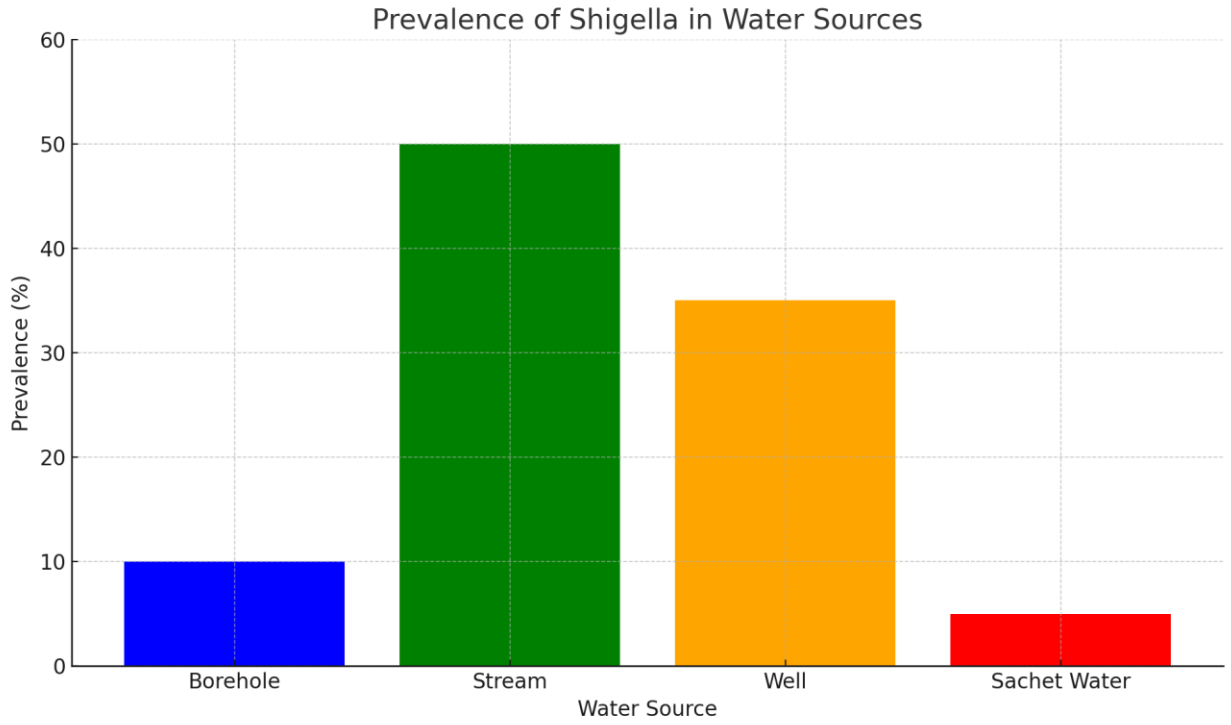


Figure 1: Bar chart

A microbiological examination of packaged water distributed within Nnewi metropolis provided further insight into water safety standards in the region. Among fifteen sachet water brands tested, approximately forty percent were found to contain coliform counts exceeding the WHO guideline of 10 CFU/100 mL, thereby rendering them unsuitable for human consumption. This alarming non-compliance reflects lapses in regulatory oversight and

EISSN 1595-5613
OMANARP INTER J. OF HEALTH SCI. VOL2.2 PP 62

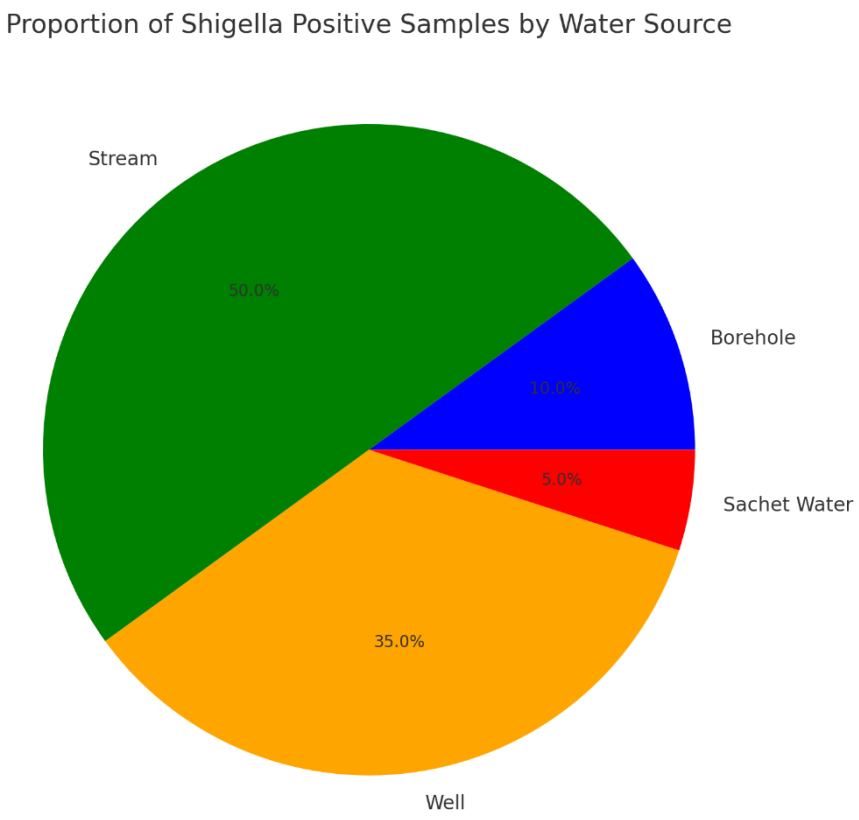


Figure 2: Pie chart

quality assurance within the sachet water production and distribution chains. In contrast, bottled water brands examined during the same period demonstrated full compliance with international bacteriological standards, indicating a relatively higher level of safety and production control.

Though not limited to the Otolo area, environmental and industrial water pollution in Nnewi also contributes to regional concerns. Investigations conducted on surface waters such as the Ele River and industrial effluents discharged from companies like RIMCO have revealed high concentrations of microbial and chemical contaminants. These pollutants not only compromise aquatic ecosystems but also pose indirect risks to groundwater and human populations through hydrological connectivity and environmental leaching. Such findings reinforce the broader environmental health risks associated with unregulated industrialisation in Nnewi's industrial corridor.

In summary, the available evidence suggests that the majority of groundwater sources in Okofia and surrounding areas of Nnewi are microbiologically non-compliant with both WHO and NSDWQ standards. This non-compliance is further compounded by the substandard microbial quality of sachet water sold in the region, whereas bottled water appears to offer a safer alternative. These trends highlight the urgent need for strengthened water quality surveillance, enforcement of regulatory frameworks, and investment in safe water infrastructure to mitigate ongoing public health risks.

Evaluation of Public Health Risks Associated with Shigella Contamination in Okofia, Otolo

In many rural and peri-urban parts of Nigeria, including Okofia in Otolo, access to potable water remains a critical challenge. The reliance on unprotected and untreated water sources, including shallow wells and contaminated boreholes, significantly heightens the risk of exposure to enteric pathogens, particularly *Shigella* spp. A study conducted in Enugu State, adjacent to Anambra, provides an epidemiological basis for understanding this risk;

EISSN 1595-5613
OMANARP INTER J. OF HEALTH SCI. VOL2.2 PP 63

approximately 9.4% of stool samples analysed from households consuming unimproved water were positive for *Shigella dysenteriae*. This was often accompanied by co-infections with other faecal pathogens such as *Escherichia coli*, *Giardia lamblia*, and *Salmonella* spp.

The ingestion of *Shigella*-contaminated water leads to shigellosis, also known as bacillary dysentery, which is characterised by the rapid onset of bloody diarrhoea, abdominal cramps, fever, and tenesmus. The pathogen has a remarkably low infectious dose, with as few as 10 to 100 organisms capable of causing disease. This makes contaminated water an efficient vehicle for transmission, particularly in settings where sanitation is compromised and personal hygiene practices are suboptimal. The duration of illness typically spans five to seven days, although complications can persist, especially in vulnerable populations.

The burden of shigellosis falls disproportionately on children under the age of five, the elderly, and individuals with compromised immunity. In developing regions such as sub-Saharan Africa, the case fatality rate for *Shigella dysenteriae* type 1 can reach between 5% and 15%. Beyond acute morbidity, shigellosis may lead to life-threatening complications such as severe dehydration, reactive arthritis, seizures, rectal prolapse, and in rare cases, toxic megacolon or hemolytic uremic syndrome (HUS). The potential for long-term disability or death from such sequelae cannot be overstated.

In the specific context of Okofia, the likelihood of outbreaks is considerable, particularly during the rainy season when surface runoff increases the risk of faecal contamination in groundwater. Shallow wells and boreholes located in close proximity to pit latrines or open drainage systems are particularly vulnerable. During community-wide outbreaks, attack rates in children can exceed 60%, with adults also affected at rates ranging from 20% to 30%. The economic and social consequences are equally troubling. Diarrhoeal diseases, including shigellosis, account for approximately 16% of all under-five mortality in Nigeria. The financial burden on households is substantial, with each episode of diarrhoeal illness potentially consuming up to 10% of monthly income due to treatment costs, lost productivity, and nutritional deficits. Local health centres, often under-resourced and overburdened, are unlikely to manage such outbreaks effectively without external support.

Immediate mitigation strategies must prioritise household-level water treatment interventions, including boiling, chlorination, and the use of solar disinfection methods. Hand hygiene promotion campaigns, particularly those targeting mothers and caregivers, are essential to reducing faecal–oral transmission. For cases of mild to moderate diarrhoea, the early administration of oral rehydration salts (ORS) is a cost-effective and life-saving intervention.

Medium- to long-term interventions should begin with comprehensive community-level microbial assessments to identify and monitor unsafe water sources. Water points found near latrines or with shallow construction should be decommissioned or upgraded. Sanitation infrastructure must be improved through the construction of safe and accessible latrines, ideally aligned with WHO-recommended separation distances from water sources. Community-Led Total Sanitation (CLTS) initiatives can facilitate behavioural change and reduce open defecation. Additionally, public health education campaigns should be institutionalised to foster a culture of hygiene, safe water storage, and improved sanitation practices.

In conclusion, the consumption of *Shigella*-contaminated water in Okofia presents a credible and severe public health threat. The potential for localised outbreaks of shigellosis, especially among young children, is high, and the consequences are far-reaching, both in terms of morbidity and socio-economic impact. A holistic response involving water treatment, hygiene education, improved sanitation, and regulatory reform is urgently required to safeguard the health and well-being of the Okofia community.

RESULTS AND DISCUSSION

Recommendations for Public Health Interventions and Water Treatment Strategies in Okofia, Otolo, Nnewi North Local Government Area, Anambra State

Integrated Public Health Interventions

Health Education and Community Mobilization

To address the prevailing risks of waterborne diseases in Okofia and surrounding communities, sustained public health education must be central. Community health workers (CHWs) should be systematically trained and deployed to lead continuous health education campaigns, with a focus on the transmission dynamics, prevention, and early symptoms of endemic diseases such as typhoid fever, cholera, schistosomiasis, and soil-transmitted helminthiasis. These campaigns must be culturally sensitive and leverage local dialects and trusted community structures. Particular attention should be given to dispelling misconceptions surrounding disease causation. Engagement with traditional rulers, religious leaders, and local opinion shapers is imperative to foster behavioural change. These stakeholders can enhance the uptake of preventive practices, such as avoiding contact with contaminated surface water and adhering to safe excreta disposal practices (Table 3).

Mass Drug Administration (MDA) and Disease Surveillance

To reduce the parasitic burden, it is essential to align with the national Neglected Tropical Diseases (NTD) programme to facilitate periodic, community-wide mass drug administration. The use of *praziquantel* for

EISSN 1595-5613
OMANARP INTER J. OF HEALTH SCI. VOL2.2 PP 64

Table 3: Public health interventions and water treatment strategies in Okofia, Otolo, Nnewi North Local Government Area of Anambra State.

Intervention Area	Actions
Health Education	Community campaigns, leader engagement on contamination risks and hygiene.
Disease Control	Deworming, schistosomiasis treatment; local surveillance via clinics.
Point-of-Use Treatment	Chlorination, safe storage, filtration methods at household level.
Sanitation & Hygiene	CLTS, latrines, handwashing promotion, waste management committees.
Improved Source Supply	Borehole drilling well away from contamination, WASCO-managed maintenance.
Water Testing & Treatment	Regular sampling, heavy metal remediation systems at community level.
Rainwater Harvesting	Roof-catchment with first-flush and disinfection as supplemental safe water.

schistosomiasis and *albendazole* for soil-transmitted helminths should be institutionalized in schools and health centres. Moreover, active surveillance should be intensified through health facilities like Nnamdi Azikiwe University Teaching Hospital. This includes real-time reporting, outbreak alert systems, and geo-referenced mapping of high-risk zones to enable data-driven response and intervention planning.

Household Water Treatment and Safe Storage (HWTS)

Household-level water safety interventions remain crucial. The promotion of point-of-use chlorination (using locally available bleach or sodium hypochlorite) must be complemented with robust education to mitigate resistance due to taste or odour. Educational efforts should focus on dosage accuracy, contact time, and storage practices. Additionally, multi-barrier approaches should be introduced, including low-cost ceramic filtration, solar disinfection (SODIS), and biosand filters. These should be prioritised for households with children under five and pregnant women. Emphasis on the use of safe, covered storage containers should be part of all water safety campaigns to prevent post-treatment contamination.

Sanitation and Hygiene Behavioural Change

To curb faecal-oral transmission routes, the implementation of the Community-Led Total Sanitation (CLTS) approach is strongly recommended. This participatory methodology has proven effective in triggering collective action to eliminate open defecation, especially around agricultural areas and water points.
The programme must be supported with accessible latrine construction guidelines tailored to local geotechnical conditions and resource availability. Hygiene promotion initiatives, especially around critical handwashing times (after defecation, before eating), should be mainstreamed in schools and markets. Formation of local sanitation and waste management committees can ensure sustainability through local oversight, while empowering women and youth as sanitation champions.

Sustainable Water Treatment and Supply Strategies

Provision of Improved Water Sources

Given the hydrogeological profile of the region, there is an urgent need to increase access to improved water sources through the installation of deep boreholes. These boreholes should be sited based on detailed hydrogeological surveys to avoid contamination from nearby refuse dumps and soakaway systems. Each installation must include sanitary seals and aprons to prevent surface infiltration. A participatory approach to water management should be adopted, with the establishment of community water and sanitation committees (WASCOs). These committees should ensure equitable representation—particularly a minimum of 30% women participation—to promote local ownership, inclusive decision-making, and transparent user-fee collection mechanisms.

Water Quality Monitoring and Remediation

Water quality assurance must be institutionalised through regular laboratory analysis of physicochemical and microbiological parameters. Particular attention should be paid to boreholes near the industrial zone of Nnewi, with periodic assessment of pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), and heavy metals such as chromium (Cr), arsenic (As), and lead (Pb). Where concentrations exceed WHO permissible limits, targeted remediation techniques should be deployed. Available technologies include community-scale reverse osmosis, activated carbon filters, and ion exchange systems. These could be incorporated into water kiosks or mobile purification units for high-risk zones, with subsidies provided for vulnerable households.

Decentralized and Centralized Treatment Systems

A context-sensitive approach should be adopted, balancing centralized treatment units for high-density areas with decentralized systems for dispersed settlements. In schools and health centres, borehole-fed treatment units with automated chlorination dosing systems can ensure a constant supply of microbiologically safe water. Roof rainwater harvesting (RRWH) presents a viable supplementary source, especially during the rainy season. However, implementation must include first-flush diverters, mesh filters, and disinfection protocols. Public sensitization on tank cleaning schedules and maintenance must accompany any RRWH programme. These recommendations underscore the need for a multi-sectoral and systems-based approach to address the complex

EISSN 1595-5613
OMANARP INTER J. OF HEALTH SCI. VOL2.2 PP 65

water and health challenges in Okofia and wider Nnewi North LGA. Sustainable implementation will require coordination between local government agencies, traditional institutions, civil society, and research institutions. Investments in water infrastructure, health education, and institutional capacity building will be pivotal in achieving long-term public health resilience in the region (Table 3).

Conclusion

The findings of this study demonstrate that drinking water sources in Okofia, Otolo, Nnewi North LGA are significantly contaminated with *Shigella* species. The presence of *Shigella* in water intended for human consumption poses serious public health risks, particularly the transmission of shigellosis, a disease that disproportionately affects vulnerable populations such as children, the elderly, and immunocompromised individuals. These results reflect poor sanitary conditions, indiscriminate disposal of human waste, and a lack of water treatment and monitoring. The non-compliance of many water sources with WHO and NSDWQ bacteriological standards necessitates immediate public health attention and government intervention.

Recommendations

(i) Immediate Water Treatment: Contaminated water sources should be treated using chlorination, boiling, filtration, or UV disinfection. Communities should be educated on household-level water purification techniques.
(ii)Sanitation and Hygiene Improvement**:** Promote improved sanitation facilities and discourage open defecation. Community-led total sanitation (CLTS) programs should be introduced to reduce environmental contamination.
(iii)Regular Water Quality Monitoring**:** Government and local authorities should conduct routine bacteriological assessments of water sources and enforce compliance with WHO and NSDWQ standards.
(iv)Public Health Education**:** Implement community-based awareness campaigns focusing on hygiene, waterborne disease prevention, and the importance of using treated water for drinking and food preparation.
(v)Infrastructure Development: Investment in safe water infrastructure such as modern boreholes with sealed heads, protected wells, and sewage systems is essential to prevent contamination.
(vi)Policy Enforcement: Strengthen local health and environmental regulations to ensure proper water source protection, waste disposal, and periodic inspection by environmental health officers.
(vii)School-Based Interventions: Schools in the area should be provided with clean water and sanitary facilities, and children should be educated on handwashing and personal hygiene practices.

REFERENCES

Centers for Disease Control and Prevention (CDC). (2023). Shigella – Shigellosis.
https://www.cdc.gov/shigella/index.html
Cheesbrough, M. (2010). District Laboratory Practice in Tropical Countries (2nd ed.). Cambridge University
Press.
Ibekwe, A. M., & Ma, J. (2011). Bacterial pathogens and indicators in irrigation water sources in Southern
California. *Journal of Environmental Quality*, 40(6), 1911–1920..
Nigerian Industrial Standard (NIS). (2007). *Nigerian Standard for Drinking Water Quality (NSDWQ)*.
Nigerian Industrial Standards, NIS 554.
Nigerian Standard for Drinking Water Quality (NSDWQ). (2007). *National Standard for Drinking Water*
Quality. Federal Ministry of Water Resources.
Nwachukwu, E., Umeh, C. N., & Agbo, B. E. (2008). Health impact of waterborne diseases among students
in Federal University of Technology Owerri, Nigeria. *International Research Journal of Microbiology*, 2(6), 213–216.
Oluyege, J. O., Dada, A. C., & Odeyemi, A. T. (2015). Bacteriological quality of water samples in selected
areas of Ekiti State, Nigeria. Journal of Microbiology and Antimicrobials, 7(3), 21–26. https://doi.org/10.5897/JMA2014.0324
World Health Organization (WHO). (2017). *Guidelines for Drinking-water Quality*, 4th Edition.
https://www.who.int/publications/i/item/9789241549950
World Health Organization (WHO). (2017). *Guidelines for Drinking-water Quality, 4th Edition*. Geneva.