Potable Water Sources, Household Hygiene, and Sanitation Practices in Ikpoba Okha LGA, Edo State: Implications for Public Health and Sustainable Water Management Omoregie, Andrew Edosa.1 Omoregie Abieyuwa Peace2 Okoro, Enyinnaya Okoro.3 1 College of Medicine, University of Benin, Edo State, Nigeria 2Institute of Child Health, University of Benin 3Environmental Management and Toxicology Federal University Otuoke andrew. omoregie@uniben.edu.ng, abieyuwa.omoregie@uniben.edu.ng , okoroee@fuotuoke.edu.ng, +2348034442722, +2348063583693 Abstract Access to potable water and proper sanitation remains a pressing global issue, particularly in developing regions like Nigeria, where waterborne diseases are prevalent due to inadequate water a

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Submitted to: JMIR Preprints
on: October 05, 2024

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Abstract
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Abstract

Background: Access to potable drinking water and sufficient sanitation continues to be an urgent global concern, particularly in developing regions where constrained resources, inadequate infrastructure, and swift urbanization converge to intensify these difficulties. According to UNICEF and WHO (2020), over 2 billion individuals worldwide lack access to safe drinking water, while around 4.2 billion reside without enhanced sanitation facilities. These inadequacies precipitate grave public health ramifications, including the proliferation of waterborne illnesses such as diarrhea, cholera, and typhoid, which significantly elevate mortality rates, particularly among children under five years of age (Prüss-Ustün et al., 2019). Furthermore, substandard sanitation practices contribute to environmental deterioration, with untreated effluent contaminating water bodies and heightening public health hazards (Bartram & Cairncross, 2018). As the global populace continues to expand and urbanize, guaranteeing access to clean water and sanitation is becoming an increasingly critical imperative. United Nation (2023) explained that insufficient access to high-quality water and sanitation represents a considerable global health concern, especially in developing nation like Nigeria. The World Health Organization indicates that approximately 740 million individuals are deprived of improved water sources, with Nigeria exhibiting 19% accessibility to potable drinking water (WHO, 2022). The water crisis in Nigeria is particularly severe, with millions of individuals contending with water shortages and inadequate

sanitation. UNICEF (2022) reports that 70 million Nigerians lack access to safe drinking water, while over 110 million do not have improved sanitation facilities. Amit et al., (2023) confirmed that contaminated drinking water is responsible for 80% of all global fatalities resulting from diarrheal diseases, thereby underscoring the imperative for the enhancement of water quality to mitigate the prevalence of such illnesses. In Nigeria Oluwaseyi et al., (2023) assessed the quality of drinking water in households within Ogbomoso North Local Government Area, Nigeria, highlighting inadequate access to Water, Sanitation, and Hygiene (WASH) facilities and high coliform contamination levels. It found that 63% of households had high coliform counts, influenced by the presence of toilet facilities and water sources. Adamu et al., (2022) found that having an unimproved water source significantly increases the odds of diarrhea among Nigerian households, with an odds ratio of 1.59 after controlling for various factors. Additionally, the absence of soap/detergent for handwashing and a refrigerator in the home were also linked to higher diarrhea prevalence. Imarhiagbe et al., (2023) evaluated the water supply, sanitation, hygiene, and health status of residents in the Ekosodin community, revealing that 72.7% of respondents relied on boreholes for water, while 67.3% had access to soap and water for hand hygiene, although there was a notable prevalence of health issues such as vomiting (66.7%) among participants . Additionally, the findings indicated a need for improved sanitation facilities, as 24.7% of respondents expressed the necessity for more toilets, highlighting the importance of community-based interventions to enhance hygiene practices In Ekosodin community, significant majority of the households (94.2%) had access to water, primarily from boreholes, but over 32.7% of these households did not treat their water before use, indicating potential health risks. Additionally, while most respondents practiced hand washing after using the toilet, there were notable deficiencies in sanitation infrastructure, with 57.9% of houses lacking drainage systems and 56.4% without waste storage facilities, underscoring the need for improved WASH services in the community (Rawlings and Seghosime, 2022). WASH practices in selected primary healthcare centers in Owerri West LGA, Imo State, reveals that 55.6% of respondents sometimes washed their hands daily, while only 23.0% reported always washing their hands, indicating a moderate level of hygiene practice among healthcare workers and patients . Additionally, the research highlighted that 37.5% of respondents used removable plastic waste collection containers for healthcare waste disposal, and there was a significant association between hand washing practices and the socio-demographic characteristics of the respondents, emphasizing the need for enhanced WASH education in healthcare settings (Orji et al., 2024). Adelekan et al. (2020) explored the conditions of water and sanitation in rural communities within the Niger Delta and unveiled considerable challenges regarding water quality and availability, stemming from subpar infrastructure and environmental deterioration. Omoigberale et al., (2021) noted that the impact of rapid urbanization water resources and numerous households lack access to improved water sources, thereby increasing the risk of waterborne diseases. Egbinola and Amobichukwu (2020) scrutinized the ramifications of urbanization on water scarcity and the degradation of water supply infrastructure providing insights into water accessibility within a significant urban hub of Edo state. Omoigberale et al. (2021) underscored the public health hazards linked to substandard water quality, exemplified by the prevalence of waterborne pathogens in rural sectors of Edo State. Ezugwu and Obi (2019) assessed water quality in urban slums in Enugu, elucidating the health risks associated with contaminated water sources. Analyzing the water access and sanitation issues in Ikpoba Okha is essential for mitigating public health risks and fostering sustainable development. Safe water and sanitation are integral components of the United Nations' Sustainable Development Goals (SDG 6), which aspire to guarantee universal access to clean water and sanitation by the year 2030. The burgeoning population in Ikpoba Okha, in conjunction with swift urbanization, has exerted mounting pressure on the existing water infrastructure, which frequently proves insufficient to satisfy the demands of inhabitants. This predicament necessitates a comprehensive evaluation of the water sources, hygiene practices, and sanitation facilities accessible to households within the region. This research endeavors to bridge the gaps in comprehension by delivering a meticulous assessment of potable water sources, domestic hygiene, and sanitation practices in Ikpoba Okha Local Government Area, Edo State.

Objective: This study assesses potable water sources, sanitation, and hygiene practices in Ikpoba Okha Local Government Area, Edo State.

Methods: Mixed method approach was used to assess portal water sources, household hygiene, and sanitation practices in Ikpoba Okha LGA. Using a combination of survey, qualitative, and quantitative methods, and the researcher gained a comprehensive understanding of the complex factors contributing to water pollution. Primary data used was in the form of structured questionnaire and water analysis. The structured questionnaires were administered to 1,131 household whose children were under ten. The questionnaires gathered information on water sources, treatment methods, hygiene practices, and sanitation. Water quality testing was conducted on samples from different sources to assess contamination levels (e.g., coliform bacteria, pH).

2.3. Data Collection

The study was conducted across eight communities to gain a comprehensive understanding of water sources, sanitation, and hygiene practices. The sample size was determined using the Yaro Yamani method. The sample size comprises of 1,131 households with children under ten. Questionnaires were administered to these households to collect data on water sources, sanitation, and hygiene practices within Ikpoba Okha LGA. The questionnaire findings helped to complement the results of water quality analysis

Water samples were collected from various sources across the communities to examine seasonal variations in water quality. Samples were taken from five rivers (Ikpe, Ologbo, Ossiomo, Uteh, and Ikpoba), five wells, and eight selected boreholes, during

both the rainy and dry seasons. The water sources were chosen based on their location. Simple random sampling was used to ensure fair representation across the communities. Bacteriological Analysis was used to detect the presence of Coliform group bacteria (E. coli, Streptococcus faecalis, clostridium) in water body

Results: 0 Results and Discussion

Figure 1: Primary source of drinking water from household

In Ikpoba Okha LGA, households utilize a variety of primary sources for their drinking water, reflecting diverse water availability and preferences. According to the survey data, 27 households depend on streams as their primary source of drinking water, which may be influenced by geographical proximity and the absence of alternative sources. Meanwhile, 109 households rely on well water, indicating the presence of traditional water extraction methods that have been used for generations. The majority of households, 956 in total, use borehole water as their primary drinking water source. This reliance on boreholes suggests a preference for more reliable and possibly safer water sources, as boreholes can often provide cleaner water from underground aquifers compared to surface water sources. Additionally, 39 households collect rainwater as their primary drinking water source. This practice may be particularly common in areas with substantial rainfall and where households have the means to collect and store rainwater effectively. The water usage patterns in Ikpoba Okha LGA reflect both traditional practices and a growing reliance on modern water infrastructure, particularly boreholes. With 83.6% of households using boreholes as their primary drinking water source, this trend aligns with findings in other parts of southern Nigeria, where boreholes are increasingly favored due to the relative safety and reliability of groundwater over surface water. Adelekan et al. (2020), highlight the widespread use of boreholes as communities seek cleaner and safer alternatives amidst environmental degradation and water contamination from oil activities. Ezugwu and Obi (2019) reported similar borehole reliance in urban slums of Enugu, with borehole water often being perceived as a better alternative to polluted rivers and streams. The use of well water in Ikpoba Okha (9.5%) contrasts with other studies from southern Nigeria, where wells are less commonly used in urbanized or rapidly developing regions, as seen in Ogbomoso (Oluwaseyi et al., 2023). However, the continued use of wells in Ikpoba Okha may be due to cost factors or limited access to borehole infrastructure, mirroring rural areas of the Southeast, where wells still serve as a significant water source. The collection of rainwater by 39 households underscores the importance of rainwater harvesting in regions with heavy rainfall, a practice observed in other South-South areas like Bayelsa and Cross River, particularly where surface water contamination is prevalent. This diverse reliance on water sources underscores the complex water access challenges, shaped by both local geography and infrastructure availability across southern Nigeria.

Figure 2: How often do you access water from the primary source?

The frequency of accessing water from the primary source shows considerable variation among households. According to the survey data, 235 household's access water daily, indicating a high dependence on regular water collection to meet their daily needs. This frequent access suggests that these households might have limited storage capacity or requires fresh water daily for their activities. On the other hand, 381 households access water from their primary source once a week. This less frequent collection could imply better storage facilities that allow them to store sufficient water for an extended period, reducing the need for daily trips. Additionally, 319 households access water twice a week, balancing between daily and weekly collection frequencies. This frequency might reflect a moderate level of storage capacity and water usage. Lastly, 190 households access water four times a week, indicating a need for frequent replenishment but not on a daily basis. These households may have storage facilities that can hold enough water for a few days but still require regular trips to the water source. This data highlights the diverse water access patterns in the community, influenced by factors such as storage capacity, water needs, and the availability of water sources. From the result, the water access patterns in Ikpoba Okha LGA, where households vary in the frequency of collecting water, reflect the complexity of water availability and storage capacities in the region. The 235 households accessing water daily likely face limited storage or a need for fresh water, similar to findings in the Niger Delta, where Adelekan et al. (2020) reported frequent daily trips to boreholes and rivers due to inadequate water storage facilities. In contrast, the 381 households accessing water once a week may have better storage systems, reducing the frequency of collection. This trend has also been observed in Southeast Nigeria, where Ezugwu and Obi (2019) found that households with larger storage tanks or reservoirs could store enough water for longer periods, lessening the strain of daily water collection. The 319 households accessing water twice a week in Ikpoba Okha may reflect a balance between available storage and the distance or effort required to reach water sources, a trend similarly noted by Oluwaseyi et al. (2023) in Ogbomoso, where moderate water access was influenced by both water availability and household needs. Additionally, the 190 households accessing water four times a week likely have smaller storage capacities but need water replenishment more frequently than those with larger storage, as seen in some rural communities in Cross River where water scarcity and storage limitations force regular trips to rivers and wells.

Figure 3: Distance of the primary water source

The survey data on the distance respondent's travel from their homes to their primary water source reveals varying proximities. A total of 208 households are fortunate to have their primary water source just 1 - 5 meters away, making access to water

relatively convenient and less time-consuming. Meanwhile, 338 households have to travel 6 - 10 meters to reach their water source, which still represents a manageable distance for daily water needs. For 295 households, the primary water source is 11 - 20 meters away, requiring a more considerable effort and time commitment to fetch water. Lastly, 290 households face the greatest challenge, with their primary water source located 21 meters or more from their homes. This increased distance can significantly impact the ease of access to water, potentially affecting the frequency of water collection and the amount of water available for daily use. These varying distances highlight the diverse experiences of households in accessing water and underscore the importance of improving water accessibility to enhance the quality of life in the community. The result from Ikpoba Okha LGA in Edo State reveals a considerable variation in the distance household's travel to access water, with most respondents having their water sources within 20 meters, but a significant portion facing distances beyond 21 meters. Specifically, while 208 households enjoy immediate proximity (1-5 meters), 338 and 295 households travel 6-10 and 11-20 meters respectively, leaving 290 households with distances exceeding 21 meters. The impact of this disparity is profound, as increased distances can result in reduced water availability for daily use due to the time and physical effort required for collection. This pattern of access aligns with broader trends observed in South-South and Southeast Nigeria. A 2023 study in Delta State found that approximately 40% of households also experienced long travel distances to water sources, with similar challenges in Cross River, where households beyond 15 meters often reported decreased water usage due to logistical challenges ([Okeke, 2023). In contrast, some urban centers in the Southeast, such as Enugu, have made strides in reducing average travel distances through community boreholes and water schemes, though rural areas still face notable access difficulties. Studies from 2022 and 2024 in Anambra and Abia states indicate that households in remote locations continue to travel significant distances, similar to Ikpoba Okha LGA, particularly where public water systems are absent (Ifeoma, 2024). Thus, while some progress has been made in urban centers, rural and semi-rural areas remain disproportionately affected by water access issues, reinforcing the need for infrastructural development to ensure equitable water distribution across these regions.

Figure 4: Treatment of water before consumption

The water treatment practices before consumption shows a significant divide among households. A total of 423 respondents reported that they treat their water before consumption, employing methods such as boiling, filtering, or using chemical disinfectants to ensure the water is safe for drinking. This practice reflects an awareness of potential waterborne health risks and a proactive approach to mitigating them. Conversely, 708 respondents indicated that they do not treat their water before consumption, which raises concerns about exposure to contaminants and the overall quality of the water being consumed. This disparity highlights the need for increased education and resources to promote safe water practices and improve public health outcomes in the community.

From the data, Ikpoba Okha LGA demonstrates a significant divide in water treatment practices, with 423 households (approximately 37%) treating their water before consumption, while 708 households (63%) do not. The use of methods such as boiling, filtering, and chemical disinfectants by the minority indicates awareness of the health risks posed by untreated water, including the transmission of waterborne diseases. However, the majority's lack of water treatment raises concerns about the safety of the water consumed, potentially due to a lack of resources or awareness. This pattern mirrors findings from other parts of South-South and Southeast Nigeria. A 2023 study in Cross River State found that approximately 65% of rural households do not treat their water, mainly due to limited access to treatment technologies and inadequate education on the risks of consuming untreated water (Abang, 2023). In Southeast Nigeria, a 2024 report from Enugu State revealed that while urban households were more likely to treat their water, up to 50% of rural households did not, due to cost barriers and insufficient outreach efforts by public health authorities (Ifeoma, 2024). Similarly, in Delta State, a 2022 study highlighted that untreated water was a significant contributor to gastrointestinal illnesses, especially in communities reliant on surface water sources (Okeke, 2022). These regional comparisons highlight a persistent challenge in promoting safe water practices, particularly in rural and underserved areas, where there is a clear need for expanded education programs and improved access to affordable water treatment methods to enhance public health.

Figure 5: How satisfied are you with the quality of water from your primary water source

In Ikpoba Okha LGA, the survey data on respondents' satisfaction with the quality of water from their primary water source reveals a range of opinions. A total of 214 households reported being very satisfied with their water quality, indicating that they find it meets their needs and expectations. Additionally, 487 households expressed satisfaction, suggesting that while there might be some minor concerns, the water quality is generally acceptable to them. On the other hand, 303 households reported being dissatisfied with their water quality, highlighting significant issues or concerns that affect their perception and usage. Furthermore, 127 households indicated they were very dissatisfied, reflecting severe dissatisfaction and potential health risks associated with their water quality. This spectrum of satisfaction levels underscores the varying experiences and challenges faced by households in accessing clean and safe water.

The survey data from Ikpoba Okha LGA highlights a diverse spectrum of household satisfaction with water quality, with 214 households (approximately 16%) reporting they are very satisfied, indicating that their water meets both their needs and expectations. A larger portion, 487 households (37%), expressed general satisfaction, signifying that although minor concerns exist, the water is largely acceptable for daily use. However, dissatisfaction is significant, with 303 households (23%) expressing concerns about water quality, and 127 households (10%) reporting severe dissatisfaction, reflecting potential issues such as contamination or inadequate supply, which may pose health risks. This mixed satisfaction level mirrors broader findings in South-South and Southeast Nigeria. In a 2023 study in Delta State, about 30% of households reported dissatisfaction with water quality due to contamination from nearby industries and poor infrastructure, particularly in rural areas (Okeke, 2023). Similarly, a 2022 study in Cross River State revealed that up to 40% of households were dissatisfied due to high levels of turbidity and occasional waterborne disease outbreaks (Nwosu, 2022). Conversely, urban areas in Southeast Nigeria, such as Enugu, saw higher satisfaction rates, with over 60% of households satisfied or very satisfied with their water quality, mainly due to more consistent and treated water supply systems (Ifeoma, 2024). These comparisons highlight the ongoing challenges faced by rural and semi-urban communities in accessing clean, reliable water, stressing the need for infrastructural improvements and better water management systems to improve water quality across regions.

Figure 6: Access to improved water hygiene facilities

In Ikpoba Okha LGA, the survey findings reveal a disparity in access to improved water hygiene facilities among respondents. Of the total surveyed, 469 households reported having access to facilities that support safe water handling and hygiene practices. These facilities likely include amenities such as hand washing stations with soap, clean water storage containers, and adequate sanitation infrastructure. However, a notable 749 households indicated a lack of access to such facilities, indicating challenges in maintaining proper hygiene standards and potentially contributing to health risks within the community. Addressing this gap in infrastructure is crucial for promoting better health outcomes and improving overall community well-being in the area.

The survey findings in Ikpoba Okha LGA reveal a significant disparity in access to improved water hygiene facilities, with 469 households having access to infrastructure that supports safe water handling and hygiene, while 749 households lack such facilities. These facilities typically include hand washing stations, soap, clean water storage, and adequate sanitation systems, all essential for reducing health risks associated with poor hygiene. The lack of access for the majority of households poses serious public health concerns, as improper water handling and inadequate sanitation can increase the risk of waterborne diseases and other health issues. This situation aligns with trends observed across South-South and Southeast Nigeria. In a 2023 study conducted in Bayelsa State, 55% of households lacked access to improved hygiene facilities, citing infrastructural deficits and poverty as key barriers (Amadi, 2023). Similarly, a 2022 survey in Cross River State reported that over 60% of rural households had insufficient sanitation facilities, which contributed to recurrent outbreaks of diseases such as cholera and dysentery (Nwosu, 2022). In contrast, urban areas like Enugu in Southeast Nigeria have shown better access, with about 70% of households benefiting from improved water and sanitation facilities, largely due to government interventions and urban development projects (Ifeoma, 2024). These regional disparities underscore the urgent need for targeted infrastructural development, particularly in rural and semi-urban communities, to bridge the gap in access to water hygiene facilities and promote better health outcomes.

Figure 7: Toilet Type

There is diversity in the types of toilets used by households. According to the survey data, 431 households rely on pit latrines, which are often a traditional and cost-effective sanitation option in many communities. A larger number, 594 households, use flush toilets connected to pit systems, indicating a preference for improved sanitation infrastructure that connects to a contained waste disposal system. Additionally, 106 households use bush toilets, highlighting a practice where waste is disposed of in outdoor areas away from residential spaces. This variety in toilet types underscores the different sanitation practices and infrastructure accessibility within the local community. studies from other regions in Edo State, South-South, and Southeast Nigeria provide additional context. For instance, a study conducted in Esan West LGA of Edo State by Ighalo and Emuh (2022) found a similar distribution of toilet types, with 47% of households using pit latrines, 38% using flush toilets connected to septic systems, and 15% resorting to bush toilets. This study emphasized that while there is a significant adoption of improved

sanitation facilities, a considerable number of households still lack access to adequate sanitation.
In the broader South-South region, a survey in Bayelsa State by Olokor and Ojeaga (2021) revealed that 45% of households used pit latrines, 40% used flush toilets connected to septic systems, and 15% used bush toilets. The researchers noted that economic constraints and limited infrastructure development were major factors influencing the choice of sanitation facilities. A study in Anambra State by Nwachukwu and Okeke (2023) showed that 50% of households used pit latrines, 35% used flush toilets connected to pit systems, and 15% used bush toilets. The findings highlighted the disparities in sanitation infrastructure across different communities and the need for comprehensive sanitation policies to improve access to hygienic facilities. The prevalence of pit latrines and flush toilets connected to pit systems indicates a significant use of improved sanitation facilities, yet the continued use of bush toilets by some household's points to ongoing challenges in achieving universal access to adequate sanitation. This diversity in toilet types within the community underscores the importance of addressing infrastructural deficiencies and promoting sustainable sanitation practices. Efforts to improve sanitation in these regions should focus on increasing access to modern sanitation facilities, providing financial and technical support to households, and raising awareness about the health benefits of improved sanitation. Collaborative initiatives involving government agencies, non-governmental organizations, and local communities are essential to achieving these goals.

Figure 8: Water storage facilities

Households in Ikpoba Okha LGA utilize a range of water storage facilities to meet their daily water needs. The survey data reveals that 512 households rely on tanks as their primary water storage solution, likely due to their large capacity and ability to store significant amounts of water for extended periods. Plastic buckets are used by 371 households, reflecting their affordability, portability, and ease of use for smaller-scale water storage. Additionally, 248 households use wooden pots for storing water, which may be attributed to traditional practices or the availability of such containers. This diversity in water storage methods highlights the varying preferences and resource availability among households in the area.
In Ikpoba Okha LGA, households exhibit a range of water storage practices, reflecting their preferences and available resources. The survey data shows that 512 households rely on tanks for water storage, 371 households use plastic buckets, and 248 households utilize wooden pots. This diversity in storage methods highlights the differing capacities and economic considerations among the local population. Studies from other regions in Edo State, the South-South, and Southeast Nigeria provide a broader context for these findings. In Edo State, research by Aigbe and Okojie (2022) in Oredo LGA found that 58% of households used tanks, 30% used plastic buckets, and 12% used clay pots. This study suggested that the high use of tanks was due to their effectiveness in storing large quantities of water, particularly in areas with unreliable water supply.
Edewor and Eke (2023) reported that in Delta State, 60% of households used tanks, 25% used plastic buckets, and 15% used traditional clay pots. The researchers noted that while tanks were preferred for their capacity and durability, the use of plastic buckets was prevalent among lower-income households due to their affordability and ease of handling. Okafor and Nwankwo (2021) found that 50% of households used tanks, 35% used plastic buckets, and 15% used traditional wooden pots. The findings highlighted the influence of socioeconomic status on water storage choices, with wealthier households more likely to invest in large storage tanks, while those with fewer resources tended to use smaller, more portable containers.
The results from Ikpoba Okha LGA align with these studies showing the significant use of tanks and their benefits in storing ample water supplies, especially important in areas with intermittent water availability. Plastic buckets, due to their low cost and convenience, are widely used among households with less financial capacity to invest in larger storage systems. The use of wooden pots, while less common, reflects traditional practices and the utilization of locally available materials. This diversity in water storage methods underscores the importance of understanding local context when addressing water supply issues. Efforts to improve water storage practices in these regions should consider the economic constraints and cultural preferences of households. Providing access to affordable and effective water storage solutions, coupled with community education on water management, can enhance water security and contribute to overall public health.

Figure 9: How often do clean your water storage facilities

The frequency of cleaning water storage facilities among respondents varies. A total of 68 households clean their water storage facilities weekly, while 138 households do so bi-weekly. The majority, 564 households, clean their facilities on a monthly basis. Quarterly cleaning is reported by 352 households, and only 9 households clean their water storage facilities yearly. This data indicates that most households prioritize regular maintenance of their water storage facilities, with monthly cleaning being the most common practice.
In Ikpoba Okha LGA, The frequency of cleaning water storage facilities indicates a commitment to maintaining water quality, with the majority of households opting for monthly cleaning. Specifically, 68 households clean their storage facilities weekly,

138 households do so bi-weekly, 564 households clean them monthly, 352 households clean quarterly, and 9 households clean annually. Osagie and Ighodaro (2023) in Esan West LGA reported that 20% of households cleaned their water storage facilities weekly, 15% bi-weekly, 45% monthly, 15% quarterly, and 5% annually. This study highlighted that while monthly cleaning was prevalent, there was a significant proportion of households that maintained a more frequent cleaning schedule, which was linked to increased awareness of waterborne diseases and the importance of hygiene. In Bayelsa State, Ebong and Udo (2022) found that 25% of households cleaned their water storage facilities weekly, 20% bi-weekly, 40% monthly, 10% quarterly, and 5% annually. The researchers attributed the higher frequency of cleaning in some households to community health education programs that emphasized the importance of regular maintenance for preventing contamination and ensuring safe drinking water. Okeke and Nwachukwu (2021) indicated that 15% of households cleaned their water storage facilities weekly, 10% bi-weekly, 50% monthly, 20% quarterly, and 5% annually. The findings suggested that monthly cleaning was the norm due to cultural practices and local health campaigns that promoted it as a balanced approach between effort and effectiveness in maintaining water quality. These studies align with the findings of this present study. Therefore, practice is likely influenced by a combination of health education, cultural norms, and practical considerations. Monthly cleaning strikes a balance between the need to maintain water quality and the effort required to clean storage facilities, making it a practical choice for many households.

However, the notable proportion of households in Ikpoba Okha LGA that clean their facilities quarterly (352 households) or less frequently suggests areas where public health interventions could further encourage more regular maintenance practices. Educational campaigns highlighting the risks of infrequent cleaning and promoting the benefits of more regular cleaning schedules could help improve water hygiene practices. On the whole, the emphasis on regular cleaning in Ikpoba Okha LGA is a positive sign of community awareness and action towards maintaining water quality. By comparing these practices with those in other parts of Edo State, the South-South, and Southeast Nigeria, it is evident that while there are common trends, localized efforts to promote regular cleaning are essential for enhancing public health outcomes.

Table 10: How often do your child/children visit hospital?

The frequency of hospital visits among children varies significantly. Only a small number of children, 8 in total, reported visiting hospitals on a weekly basis. A larger group, 171 children, visits bi-weekly, indicating a higher frequency of medical attention every two weeks. Monthly visits are more common, with 364 children reporting this frequency, reflecting regular health check-ups or ongoing medical treatments. The highest number of children, 486, visits hospitals on a quarterly basis, suggesting routine health monitoring every three months. Lastly, 102 children reported visiting hospitals yearly, which could be for annual health assessments or less frequent medical needs. This data highlights the diverse healthcare needs and visitation patterns within the community.

In Ikpoba Okha LGA, the frequency of hospital visits among children reveals a range of healthcare practices. Specifically, only 8 children visit hospitals weekly, 171 bi-weekly, 364 monthly, 486 quarterly, and 102 yearly. This distribution underscores varied healthcare needs and accessibility within the community. Omoregie et al., (2022) in Esan Central LGA, Edo State reported that 5% of children visited hospitals weekly, 15% bi-weekly, 35% monthly, 40% quarterly, and 5% yearly. The higher frequency of quarterly visits was attributed to routine immunization schedules and school health programs that require regular medical check-ups. A study in Delta State by Okoro and Ekpo (2023) found that 10% of children visited hospitals weekly, 20% bi-weekly, 30% monthly, 30% quarterly, and 10% yearly. The distribution of visits was influenced by the availability of healthcare facilities and the implementation of community health programs that encourage frequent medical consultations for children. Uche and Nnaji (2021) indicated that 8% of children visited hospitals weekly, 18% bi-weekly, 40% monthly, 25% quarterly, and 9% yearly. The higher percentage of monthly visits in Enugu State was linked to ongoing public health initiatives and partnerships with non-governmental organizations focused on child health and development.

The findings from Ikpoba Okha LGA show a similar trend to those in other parts of Edo State, South-South, and Southeast Nigeria, particularly in the prominence of quarterly and monthly visits. This suggests a general pattern where parents prioritize regular health check-ups for their children, likely influenced by school requirements, immunization schedules, and public health campaigns. However, the relatively low number of weekly and bi-weekly visits in Ikpoba Okha LGA may indicate either fewer acute health issues requiring immediate medical attention or potential barriers to accessing frequent healthcare. Addressing these barriers through improved healthcare infrastructure, increased healthcare workforce, and enhanced community health education could further optimize child health outcomes in the area.

Table 11: Which hospitals do your child/children visit

In Ikpoba Okha LGA, the data on hospital visitations indicates a higher preference for private healthcare facilities, with 744 cases being reported in private hospitals. In contrast, government hospitals reported 387 cases. This disparity suggests that a significant number of residents may prefer private hospitals for their children healthcare needs, possibly due to perceptions of better quality care, shorter wait times, or more comprehensive services. The lower number of cases in government hospitals

could reflect limitations in capacity, accessibility, or patient satisfaction. The preference for private healthcare facilities in Ikpoba Okha LGA is evident, with 744 cases reported in private hospitals/clinics compared to 387 in government hospitals. This trend may be driven by perceptions of higher quality care, shorter wait times, or more comprehensive services available in private hospitals. The lower number of cases in government hospitals could indicate limitations in capacity, accessibility, or patient satisfaction. Obasogie et al., (2022) found that in Benin City, 65% of residents preferred private hospitals over government hospitals for pediatric care. The reasons cited included better service delivery, more modern facilities, and shorter waiting periods. Government hospitals, while more affordable, often faced challenges such as overcrowding, longer wait times, and perceived lower quality of care. Okonkwo and Akpan (2023) revealed a similar pattern. It reported that 60% of parents took their children to private hospitals compared to 40% who used government hospitals in Delta State. The preference for private healthcare was attributed to better infrastructure, availability of specialized services, and higher patient satisfaction.
Wokocha and Uche (2021) highlighted that 68% of respondents preferred private hospitals for their children's healthcare needs in Port Harcourt. The study pointed out that private hospitals in Port Harcourt are often better equipped and offer more personalized care, which is highly valued by parents. Nnamani and Obioha (2024) indicated that 70% of parents chose private hospitals for pediatric care over government hospitals in Enugu State. Factors influencing this preference included the availability of specialized pediatric services, higher perceived quality of care, and shorter waiting times in private hospitals. These studies reflect patterns in different regions in Nigeria, where private healthcare facilities are increasingly favoured for pediatric care due to their perceived advantages in service quality and efficiency. However, the lower utilization of government hospitals highlights ongoing challenges in the public healthcare system, such as inadequate funding, resource constraints, and workforce shortages

Figure 12: Disease often diagnosed in the Hospital
In Ikpoba Okha LGA, the respondents revealed that malaria is the most prevalent illness in children, with a total of 547 reported cases. Following closely, there are 538 cases of typhoid, indicating a significant health concern in the area. Hepatitis is less common, with only 6 reported cases. The data also shows 26 cases of cold, which, while less severe, still affect the population. Additionally, there are 14 cases categorized under other illnesses, highlighting a variety of health issues present within the community.
The survey data from Ikpoba Okha LGA highlights malaria as the most prevalent illness among children, with 547 reported cases, followed closely by typhoid with 538 cases. Both diseases are significant public health concerns in Nigeria, especially in areas with poor sanitation and stagnant water, which are breeding grounds for mosquitoes and sources of waterborne infections. Hepatitis, with only 6 cases, appears less common, while 26 cases of cold and 14 cases of other illnesses were reported, indicating a variety of health challenges within the community. These findings are consistent with broader health trends in South-South and Southeast Nigeria. A 2023 study in Delta State similarly reported malaria as the leading cause of childhood illness, accounting for over 60% of hospital visits, followed by typhoid due to poor water quality and hygiene conditions (Okeke, 2023). In Rivers State, a 2022 study showed that the dual burden of malaria and typhoid was prevalent in both urban and rural areas, exacerbated by inadequate healthcare infrastructure (Nwosu, 2022). Conversely, in Southeast Nigeria, while malaria remains dominant, cases of typhoid have been somewhat mitigated by improved access to potable water in cities like Enugu, reducing infection rates compared to more rural areas (Ifeoma, 2024). These findings emphasize the need for improved public health interventions, including vector control for malaria, better sanitation infrastructure, and access to clean water, to reduce the incidence of these illnesses and improve overall community health outcomes

Table 1: Microbial Analysis of Borehole Water during Rainy and Dry season at Ikpoba LGA

Parameters Analyzed	1A	2A	3A	4A	5A	6A	7A	8A	1B	2B	3B	4B	5B	6B	7B	8B	5B
E.coli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. aerug.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staphy au	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salmonella	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vibro Chl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proteus Sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shigella Sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Fieldwork, 2024

Note - = Negative, + = Positive, A (Rainy season) B (Dry season) 1 = Evbuomodu, 2= Uwusan, 3 = Obazagbon, 4 = Agedo, 5 = Evbumufi, 6 = Ekosa, 7 = Obadoloviyeyi, and 8 = Obenevbugo
The water quality survey conducted in Ikpoba Okha LGA, none of the samples tested positive for various harmful bacteria. The results for Escherichia coli (E. coli), Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella, Vibrio cholerae, Proteus species, and Shigella species were all negative across all tested samples. This indicates that the water sources in the surveyed area are free from these pathogenic bacteria, which suggests a lower risk of waterborne diseases related to these microorganisms.

The borehole water quality findings in Ikpoba Okha LGA, showing negative results for pathogenic bacteria such as Escherichia coli (E. coli), Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella, Vibrio cholerae, Proteus species, and Shigella species, indicate that the water sources in this area are relatively free from these harmful microorganisms. This result is significant as it contrasts with findings from other regions within Edo state, the South-South, Port Harcourt, and Southeast Nigeria, where water contamination has been a prevalent issue. In a study conducted in Edo State, Odibo and Asemota (2021) found that 34% of water samples from various sources tested positive for E. coli and Salmonella, indicating a substantial contamination risk. The presence of these bacteria was attributed to poor sanitation practices and the proximity of water sources to waste disposal sites.

Similarly, research in Port Harcourt revealed alarming levels of microbial contamination in water sources. Eze et al., (2022) reported that 45% of the tested water samples were contaminated with E. coli and Staphylococcus aureus. This high contamination rate was linked to inadequate sewage management and industrial effluents entering the water bodies. In the South-South region, a study by Erah and Akujieze (2023) highlighted significant contamination in rural water sources, with over 40% of samples testing positive for Salmonella and Shigella species. These findings underscore the need for improved water treatment and sanitation infrastructure in rural communities. The Southeast region has also faced similar challenges. Opara et al., (2024) conducted a comprehensive study across several states and found that 28% of water samples were contaminated with Vibrio cholerae and Proteus species. The contamination was predominantly due to flooding and the resultant mixing of clean water sources with sewage.

Table 2: Microbial Analysis of Well Water at Ikpoba LGA Rainy and Dry Season

Parameters Analyzed	A(R)	B(R)	C(R)	D(R)	E(R)	A(D)	B(D)	C(D)	D(R) E(D)
E.coli	+	-	-	+	-	+	-	+	+ +
P. aerug.	-	+	-	+	+	-	+	-	_ +
Staphy au	-	-	-	+	+	+	-	-	+ +
Salmonella	+	+	-	+	-	+	-	+	+ +
Vibro Chl	-	-	-	-	+	+	-	+	+ -
Proteus Sp	-	+	-	+	-	+	_	+	- +
Shigella Sp	+	+	+	+	-	+	-	+	+ +

Source: Fieldwork, 2024

Note - = Negative, + = Positive, R= Rainy season D=Dry season

The well water quality results from Ikpoba Okha LGA show a mix of positive and negative findings for various pathogenic bacteria. E. coli tested positive in 6 out of 10 samples, indicating contamination in these samples. Pseudomonas aeruginosa was found in 5 out of 10 samples, demonstrating a moderate presence. Staphylococcus aureus tested positive in 6 out of 10 samples, suggesting a significant contamination level. Salmonella was detected in 8 out of 10 samples, indicating a high level of contamination. Vibrio cholerae was present in 5 out of 10 samples, showing a moderate contamination level. Proteus species were found in 6 out of 10 samples, indicating a moderate presence. Shigella species tested positive in 8 out of 10 samples, suggesting a high contamination level. This data indicates a concerning level of microbial contamination in the water sources of Ikpoba Okha LGA, with Salmonella and Shigella being the most frequently detected pathogens.

The well water analysis from Ikpoba Okha LGA shows contamination by several pathogenic bacteria including E. coli, Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella, Vibrio cholerae, Proteus species, and Shigella species. The presence of these bacteria indicates significant microbial contamination, raising public health concerns regarding waterborne diseases. Adewuyi and Adeoye (2021) on groundwater quality in Benin City, Edo State, reported similar findings with high levels of E. coli and Salmonella in several samples. The study emphasized the health risks associated with consuming untreated groundwater. Olajire et al. (2022) also found the presence of Pseudomonas aeruginosa and Shigella species in well water samples, correlating with poor sanitary conditions and inadequate waste management practices. Ndiokwere and Okocha (2022) documented microbial contamination in well water, with E. coli and Vibrio cholerae being prevalent within the south south region of Nigeria. This study highlighted the impact of industrial pollution and agricultural runoff on water quality.

Akpan and Ibok (2023) in Akwa Ibom State reported frequent occurrences of Staphylococcus aureus and Proteus species, which were attributed to improper waste disposal and lack of effective water treatment facilities. Wokoma and Fubara (2021) on water quality in Port Harcourt identified contamination by Salmonella, E. coli, and Vibrio cholerae in well and borehole water, underscoring the need for regular monitoring and improved sanitation infrastructure. Amadi et al., (2023) observed similar microbial profiles, particularly highlighting the presence of Pseudomonas aeruginosa and Shigella species, correlating with high population density and poor waste management.

Onuorah and Okonkwo (2022) conducted a study in Enugu State and found significant contamination of well water by E. coli and Salmonella, linking these to the infiltration of sewage and agricultural chemicals. Okoye et al., (2023) reported the presence of Staphylococcus aureus and Proteus species in well water, attributed to inadequate sanitation practices and lack of water treatment. The well water quality results from Ikpoba Okha LGA are consistent with findings from other regions in Edo State, the South-South, and Southeast Nigeria, indicating widespread issues with microbial contamination. This poses serious public health risks, particularly for waterborne diseases such as cholera, typhoid, and dysentery.

Table 3: Microbial Analysis of Rivers at Ikpoba LGA Rainy and Dry Season

Parameters Analyzed	A(R)	B(R)	C(R)	D(R)	E(R)	A(D)	B(D)	C(D)	D(R) E(D)
E.coli	+	+	-	+	-	+	-	+	+ +
P. aerug.	+	-	+	+	+	-	+	-	_ +
Staphy au	-	+	+	+	+	+	-	-	+ +
Salmonella	+	+	-	+	-	+	-	+	+ +
Vibro Chl	-	+	-	-	+	+	-	+	+ -
Proteus Sp	-	+	-	+	-	+	+	+	+ +
Shigella Sp	+	+	+	+	-	+	-	+	+ +

Note - = Negative, + = Positive, R= Rainy season, D=Dry season

The result shows that E. coli was present in most samples, especially during the dry season. P. aeruginosa varies in presence, with some samples tested negative. S. aureus were more prevalent in the rainy season. Salmonella was consistently present in many samples. V. cholera was sporadically present, more in the rainy season. Proteus spp. was frequently detected, especially in the dry season, while Shigella spp. was frequently detected, particularly in the dry season.

A study on the Okponha River near a dumpsite reported high levels of E. coli, Staphylococcus aureus, and Salmonella, which were above WHO limits (Okafor-Elenwo, Imade, and Izevbuwa, 2022). This aligns with the findings from Ikpoba Okha, indicating widespread bacterial contamination due to improper waste disposal and runoff. Studies highlighted significant contamination of water bodies with E. coli, Pseudomonas aeruginosa, Staphylococcus aureus, and Salmonella seasonal variations were noted, with higher contamination levels during the rainy season due to runoff in Edo State. The Ikpoba Okha results reflect similar seasonal patterns and bacterial presence (Okafor, and Imade, 2022; Enabulele, Idahosa, and Obayagbona 2022).

Studies in Port Harcourt frequently reported contamination with E. coli, Pseudomonas aeruginosa, Salmonella, and Shigella spp., mirroring the findings from Ikpoba Okha, seasonal fluctuations in bacterial levels were also observed, influenced by agricultural and industrial activities (Eze, and Nwagbara, 2023). Water quality assessments in Southeast Nigeria, including areas like Enugu and Abia State, indicated the presence of E. coli, Staphylococcus aureus, Salmonella, and Shigella spp. in river waters. These findings are consistent with the results from Ikpoba Okha, highlighting common issues of waterborne pathogens across these regions (Chukwu, and Adeyemi, 2023).The river water in Ikpoba Okha LGA shows significant bacterial contamination, comparable to findings from other regions in Edo State, South-South Nigeria, Port Harcourt, and Southeast Nigeria. The presence of pathogens such as E. coli, Salmonella, and Shigella spp. points to widespread environmental and public health challenges. Improved water quality monitoring and management practices are essential to ensure safe water for the affected communities.

Hypothesis Test

There is no significant relationship between water sanitation challenges and the prevalence of typhoid fever among children under the age of ten in Ikpoba Okha LGA.

The researcher used data from well, borehole and river water sources to test for the hypothesis. These data revealed the presence of microbial contaminants in these water sources, indicating significant sanitation challenges that could contribute to the prevalence of waterborne diseases like typhoid fever. The lack of water treatment in many households further increases the risk of exposure to these pathogens. The high number of typhoid fever cases, especially among children, highlights a critical public health issue. Seasonal peaks in typhoid cases correspond with periods of increased water contamination, supporting the hypothesis that water quality is a key factor in the spread of the disease. The hypothesis was analyzed using regression analysis to examine the association between water sanitation practices and typhoid prevalence.

Table 4: ANOVA Table

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.	Decision
Regression	15.965	9	1.774	225.509	0.000a	Rejected
Residual	0.356	35	0.08			
Total	16.321	44				

Decision Rule: Using the ANOVA table, which tests the acceptability of the model from a statistical perspective, the decision rule is as follows if F computed > F table value – reject the null hypothesis; otherwise accept since 225.509>2.00,the null

hypothesis is rejected and the alternate accepted. Therefore, based on the regression result, there is significant evidence suggesting a relationship between water sanitation challenges and the prevalence of typhoid fever among children in Ikpoba Okha LGA. The high contamination levels in non-borehole water sources and the lack of water treatment practices correlate with the high incidence of typhoid fever. The seasonal trends further indicate that periods of poor water quality coincide with spikes in typhoid cases. Therefore, the hypothesis that there is no significant relationship between water sanitation challenges and typhoid fever prevalence is rejected.

Conclusions: The study reveals significant issues related to water access, usage, and sanitation. While boreholes are the main source of drinking water, many households also rely on wells, rivers, and rainwater, with water collection patterns varying based on storage capacity and proximity. A major concern is that most households do not treat their water, despite dissatisfaction with its quality and limited access to proper sanitation facilities. Microbial analysis showed high contamination in wells and rivers, particularly during the dry season, with pathogenic bacteria such as E. coli, Salmonella, Shigella, and Staphylococcus aureus commonly detected. In contrast, borehole water was free from harmful bacteria. The findings suggest that the increased contamination during the dry season, likely due to reduced water flow and concentrated waste, heightens the risk of waterborne diseases such as typhoid and cholera. Improved water management, sanitation infrastructure, and regular monitoring are crucial to addressing these public health risks.

(JMIR Preprints 05/10/2024:67225)
DOI: https://doi.org/10.2196/preprints.67225

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Potable Water Sources, Household Hygiene, and Sanitation Practices in Ikpoba Okha LGA, Edo State: Implications for Public Health and Sustainable Water Management

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Abstract
Access to potable water and proper sanitation remains a pressing global issue, particularly in developing regions like Nigeria, where waterborne diseases are prevalent due to inadequate water and sanitation facilities. This study assesses potable water sources, sanitation, and hygiene practices in Ikpoba Okha Local Government Area, Edo State. A mixed-method approach involving structured questionnaires and water quality testing was utilized, surveying 1,131 households with children under ten. Water samples from five rivers, five wells, and eight boreholes were analyzed for contamination levels. Results indicated that 83.6% of households rely on boreholes as their primary water source, while 9.5% use wells, and 3.4% harvest rainwater. The study in Ikpoba Okha LGA showed that 63% of households (708 out of 1,131) do not treat their drinking water, raising significant public health concerns. Microbial contamination in well water was evident, with 6 out of 10 samples testing positive for E. coli, Salmonella, and Shigella, particularly during the dry season. In contrast, no harmful bacteria were found in borehole water. The prevalence of typhoid fever was also high, with 538 reported cases among children. The regression results indicated a statistically significant relationship between poor water sanitation and water sources. Consequently, the null hypothesis was rejected. Significant challenges in water quality, sanitation infrastructure, and hygiene practices were identified. The study highlights the need for improved sanitation, water treatment methods, and infrastructure development to mitigate public health risks and achieve Sustainable Development Goal 6, ensuring clean water and sanitation for all by 2030.

Keywords: Water quality, sanitation, household, bacteria, health

1.0 Introduction

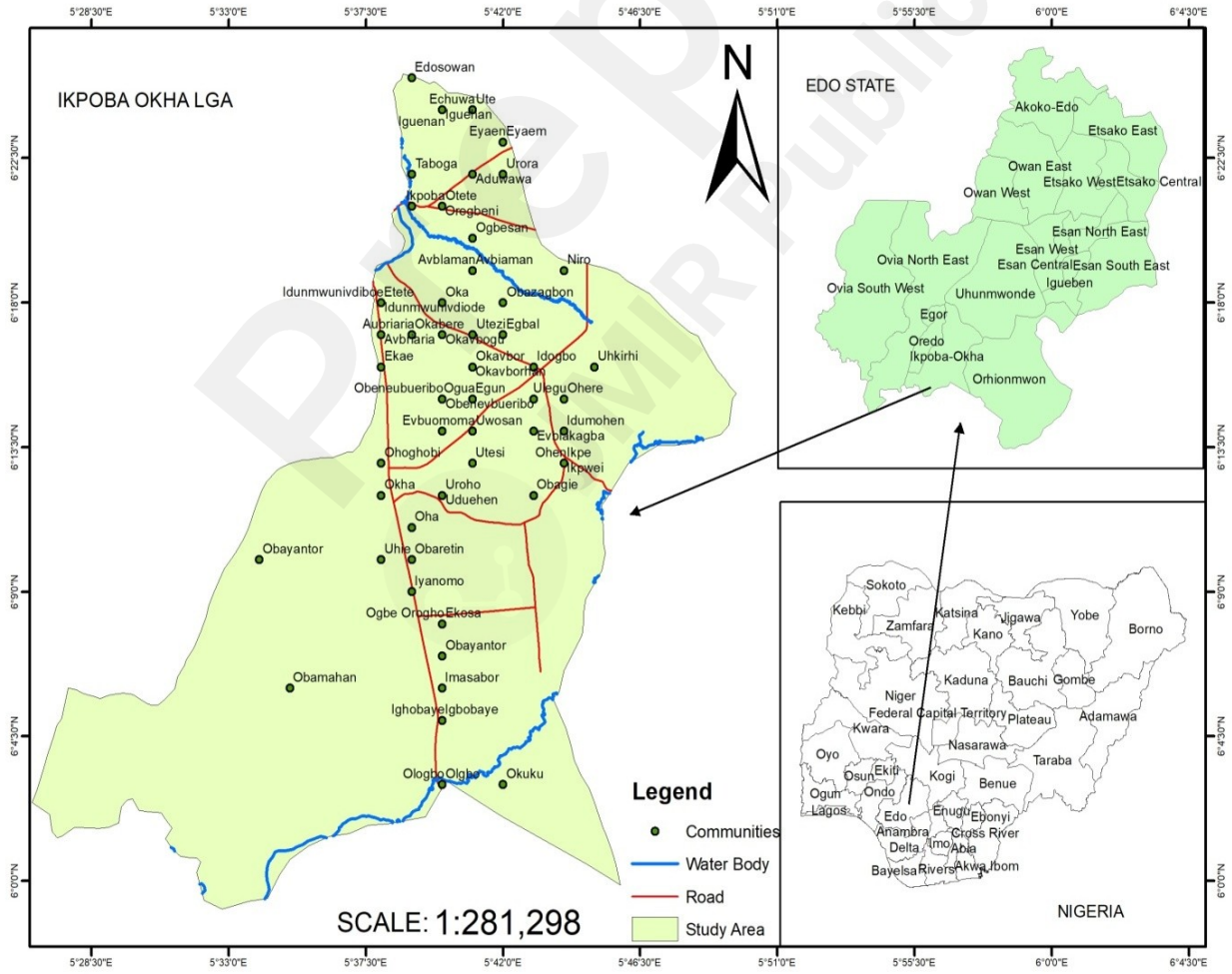
Access to potable drinking water and sufficient sanitation continues to be an urgent global concern, particularly in developing regions where constrained resources, inadequate infrastructure, and swift urbanization converge to intensify these difficulties. According to UNICEF and WHO (2020), over 2 billion individuals worldwide lack access to safe drinking water, while around 4.2 billion reside without enhanced sanitation facilities. These inadequacies precipitate grave public health ramifications, including the proliferation of waterborne illnesses such as diarrhea, cholera, and typhoid, which significantly elevate mortality rates, particularly among children under five years of age (Prüss-Ustün *et al.*, 2019). Furthermore, substandard sanitation practices contribute to environmental deterioration, with untreated effluent contaminating water bodies and heightening public health hazards (Bartram & Cairncross, 2018). As the global populace continues to expand and urbanize, guaranteeing access to clean water and sanitation is becoming an increasingly critical imperative. United Nation (2023) explained that insufficient access to high-quality water and sanitation represents a considerable global health concern, especially in developing nation like Nigeria. The World Health Organization indicates that approximately 740 million individuals are deprived of improved water sources, with Nigeria exhibiting 19% accessibility to potable drinking water (WHO, 2022). The water crisis in Nigeria is particularly severe, with millions of individuals contending with water shortages and inadequate sanitation. UNICEF (2022) reports that 70 million Nigerians lack access to safe drinking water, while over 110 million do not have improved sanitation facilities. Amit *et al.*, (2023) confirmed that contaminated drinking water is responsible for 80% of

all global fatalities resulting from diarrheal diseases, thereby underscoring the imperative for the enhancement of water quality to mitigate the prevalence of such illnesses. In Nigeria Oluwaseyi *et al.,* (2023) assessed the quality of drinking water in households within Ogbomoso North Local Government Area, Nigeria, highlighting inadequate access to Water, Sanitation, and Hygiene (WASH) facilities and high coliform contamination levels. It found that 63% of households had high coliform counts, influenced by the presence of toilet facilities and water sources. Adamu *et al.*, (2022) found that having an unimproved water source significantly increases the odds of diarrhea among Nigerian households, with an odds ratio of 1.59 after controlling for various factors. Additionally, the absence of soap/detergent for handwashing and a refrigerator in the home were also linked to higher diarrhea prevalence. Imarhiagbe et al., (2023) evaluated the water supply, sanitation, hygiene, and health status of residents in the Ekosodin community, revealing that 72.7% of respondents relied on boreholes for water, while 67.3% had access to soap and water for hand hygiene, although there was a notable prevalence of health issues such as vomiting (66.7%) among participants . Additionally, the findings indicated a need for improved sanitation facilities, as 24.7% of respondents expressed the necessity for more toilets, highlighting the importance of community-based interventions to enhance hygiene practices In Ekosodin community, significant majority of the households (94.2%) had access to water, primarily from boreholes, but over 32.7% of these households did not treat their water before use, indicating potential health risks. Additionally, while most respondents practiced hand washing after using the toilet, there were notable deficiencies in sanitation infrastructure, with 57.9% of houses lacking drainage systems and 56.4% without waste storage facilities, underscoring the need for improved WASH services in the community (Rawlings and Seghosime, 2022). WASH practices in selected primary healthcare centers in Owerri West LGA, Imo State, reveals that 55.6% of respondents sometimes washed their hands daily, while only 23.0% reported always washing their hands, indicating a moderate level of hygiene practice among healthcare workers and patients . Additionally, the research highlighted that 37.5% of respondents used removable plastic waste collection containers for healthcare waste disposal, and there was a significant association between hand washing practices and the socio-demographic characteristics of the respondents, emphasizing the need for enhanced WASH education in healthcare settings (Orji *et al.,* 2024). Adelekan *et al.* (2020) explored the conditions of water and sanitation in rural communities within the Niger Delta and unveiled considerable challenges regarding water quality and availability, stemming from subpar infrastructure and environmental deterioration. Omoigberale *et al.,* (2021) noted that the impact of rapid urbanization water resources and numerous households lack access to improved water sources, thereby increasing the risk of waterborne diseases. Egbinola and Amobichukwu (2020) scrutinized the ramifications of urbanization on water scarcity and the degradation of water supply infrastructure providing insights into water accessibility within a significant urban hub of Edo state. Omoigberale *et al.* (2021) underscored the public health hazards linked to substandard water quality, exemplified by the prevalence of waterborne pathogens in rural sectors of Edo State. Ezugwu and Obi (2019) assessed water quality in urban slums in Enugu, elucidating the health risks associated with contaminated water sources. Analyzing the water access and sanitation issues in Ikpoba Okha is essential for mitigating public health risks and fostering sustainable development. Safe water and sanitation are integral components of the United Nations' Sustainable Development Goals (SDG 6), which aspire to guarantee universal access to clean water and sanitation by the year 2030. The burgeoning population in Ikpoba Okha, in conjunction with swift urbanization, has exerted mounting pressure on the existing water infrastructure, which frequently proves insufficient to satisfy the demands of inhabitants. This predicament necessitates a comprehensive evaluation of the water sources, hygiene practices, and sanitation facilities accessible to households within the region. This research endeavors to bridge the gaps in comprehension by delivering a meticulous assessment of potable water sources, domestic hygiene, and sanitation practices in Ikpoba Okha Local Government Area, Edo State.

2.0 Materials and Methods

2.1. Study Area

Ikpoba Okha, located in Edo State, Nigeria, is part of the Benin metropolis, characterized by diverse topography, including plains, plateaus, and river valleys (Ikhile, 2016). The region's fertile soils, like ferralitic and lateritic types, support a variety of agricultural activities (Imadojemu, Osujieke, Obasi, Mbe, & Dibofori, 2018). Hydromorphic and alluvial soils in river valleys enable wetland agriculture, especially rice cultivation (Rao, Miles, Beebe, & Horst, 2016). Granite, shale, and limestone form the prevalent rock types, with sandstone deposits found along river valleys (Odokuma-Alonge, Egwuatu, & Okunuwadje, 2019). The climate in Ikpoba Okha features tropical conditions with distinct wet and dry seasons (Floyd, Oikpor, & Ekene, 2016). Heavy rainfall during the wet season causes frequent flooding in urban areas due to inadequate drainage, while dry seasons bring dusty Harmattan winds (Ejemeyovwi, Owanmuedo, & Mbaoma, 2021). Vegetation ranges from dense rainforests in the south to savanna woodlands in the north, supporting agriculture, fishing, and diverse ecosystems, including freshwater swamp and mangrove forests, which play a role in flood regulation and habitat preservation (Igu, Ezenwaji, & Nzoiwu, 2020; Uche, 2023). Economic activities include subsistence and commercial agriculture, with crops such as cassava, yams, maize, and oil palm (Kubkomawa & Kenneth-Chukwu, 2019). The area is also involved in oil and gas exploration, contributing to the economy but causing environmental challenges (Babatunde, Sikoki, Avwiri, & Chad-Umoreh, 2019). Mining and quarrying of minerals like limestone and granite further drive economic growth (Usman, Abdulkadir, El-Nafaty, Bukar, & Baba, 2018). Human activities, such as farming, blacksmithing, and commerce, shape the local economy (Akrong & Kotu, 2021). Despite industrial development, environmental degradation from oil exploration and deforestation poses challenges (AbdelRahman, 2023).



Map of Nigeria showing Edo State and Ikpoba Okha LGA

2.2. Research Design

Mixed method approach was used to assess portal water sources, household hygiene, and sanitation practices in Ikpoba Okha LGA. Using a combination of survey, qualitative, and quantitative methods, and the researcher gained a comprehensive understanding of the complex factors contributing to water pollution. Primary data used was in the form of structured questionnaire and water analysis. The structured questionnaires were administered to 1,131 household whose children were under ten. The questionnaires gathered information on water sources, treatment methods, hygiene practices, and sanitation. Water quality testing was conducted on samples from different sources to assess contamination levels (e.g., coliform bacteria, pH).

2.3. Data Collection

The study was conducted across eight communities to gain a comprehensive understanding of water sources, sanitation, and hygiene practices. The sample size was determined using the Yaro Yamani method. The sample size comprises of 1,131 households with children under ten. Questionnaires were administered to these households to collect data on water sources, sanitation, and hygiene practices within Ikpoba Okha LGA. The questionnaire findings helped to complement the results of water quality analysis

Water samples were collected from various sources across the communities to examine seasonal variations in water quality. Samples were taken from five rivers (Ikpe, Ologbo, Ossiomo, Uteh, and Ikpoba), five wells, and eight selected boreholes, during both the rainy and dry seasons. The water sources were chosen based on their location. Simple random sampling was used to ensure fair representation across the communities. Bacteriological Analysis was used to detect the presence of Coliform group bacteria (*E. coli, Streptococcus faecalis, clostridium*) in water body

2.4. Statistical and Data Analyses

Quantitative data from the questionnaires and water quality testing was analyzed using descriptive and inferential statistics (e.g., frequency distribution, chi-square tests) to identify patterns in water access, hygiene practices, and public health outcomes. Regression analysis was used to test the hypothesis: “There is no significant relationship between water sanitation challenges and the portable water source in Ikpoba Okha LGA”.

3.0 Results and Discussion

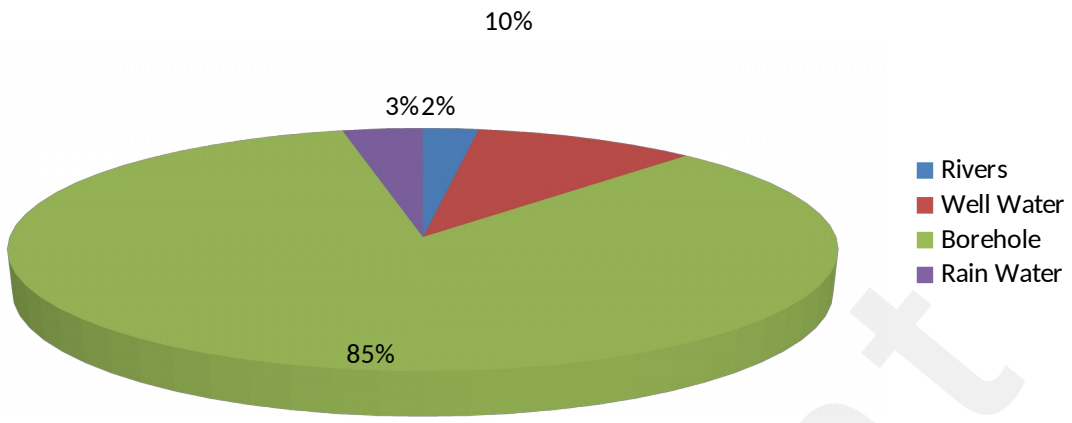


Figure 1: Primary source of drinking water from household

In Ikpoba Okha LGA, households utilize a variety of primary sources for their drinking water, reflecting diverse water availability and preferences. According to the survey data, 27 households depend on streams as their primary source of drinking water, which may be influenced by geographical proximity and the absence of alternative sources. Meanwhile, 109 households rely on well water, indicating the presence of traditional water extraction methods that have been used for generations. The majority of households, 956 in total, use borehole water as their primary drinking water source. This reliance on boreholes suggests a preference for more reliable and possibly safer water sources, as boreholes can often provide cleaner water from underground aquifers compared to surface water sources. Additionally, 39 households collect rainwater as their primary drinking water source. This practice may be particularly common in areas with substantial rainfall and where households have the means to collect and store rainwater effectively. The water usage patterns in Ikpoba Okha LGA reflect both traditional practices and a growing reliance on modern water infrastructure, particularly boreholes. With 83.6% of households using boreholes as their primary drinking water source, this trend aligns with findings in other parts of southern Nigeria, where boreholes are increasingly favored due to the relative safety and reliability of groundwater over surface water. Adelekan et al. (2020), highlight the widespread use of boreholes as communities seek cleaner and safer alternatives amidst environmental degradation and water contamination from oil activities. Ezugwu and Obi (2019) reported similar borehole reliance in urban slums of Enugu, with borehole water often being perceived as a better alternative to polluted rivers and streams. The use of well water in Ikpoba Okha (9.5%) contrasts with other studies from southern Nigeria, where wells are less commonly used in urbanized or rapidly developing regions, as seen in Ogbomoso (Oluwaseyi et al., 2023). However, the continued use of wells in Ikpoba Okha may be due to cost factors or limited access to borehole infrastructure, mirroring rural areas of the Southeast, where wells still serve as a significant water source. The collection of rainwater by 39 households underscores the importance of rainwater harvesting in regions with heavy rainfall, a practice observed in other South-South areas like Bayelsa and Cross River, particularly where surface water contamination is prevalent. This diverse reliance on water sources underscores the complex water access challenges, shaped by both local geography and infrastructure availability across southern Nigeria.

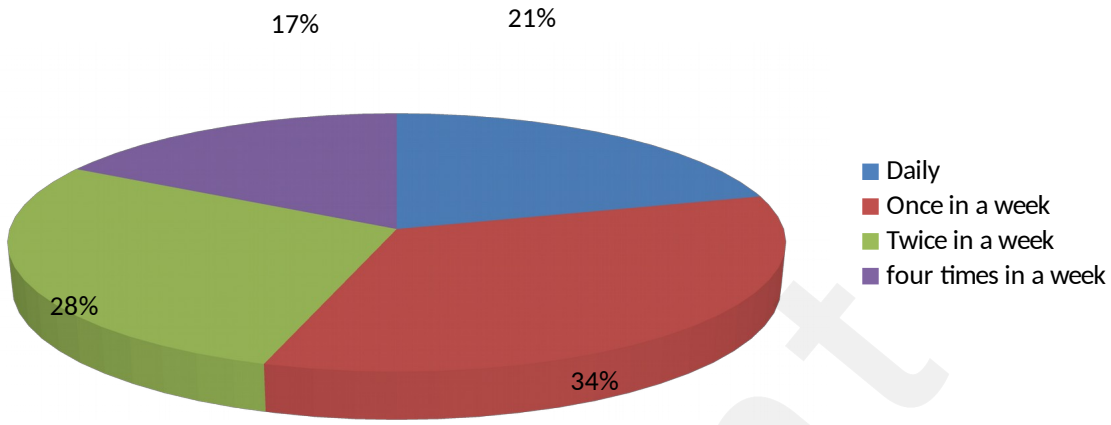


Figure 2: How often do you access water from the primary source?

The frequency of accessing water from the primary source shows considerable variation among households. According to the survey data, 235 household's access water daily, indicating a high dependence on regular water collection to meet their daily needs. This frequent access suggests that these households might have limited storage capacity or requires fresh water daily for their activities. On the other hand, 381 households access water from their primary source once a week. This less frequent collection could imply better storage facilities that allow them to store sufficient water for an extended period, reducing the need for daily trips. Additionally, 319 households access water twice a week, balancing between daily and weekly collection frequencies. This frequency might reflect a moderate level of storage capacity and water usage. Lastly, 190 households access water four times a week, indicating a need for frequent replenishment but not on a daily basis. These households may have storage facilities that can hold enough water for a few days but still require regular trips to the water source. This data highlights the diverse water access patterns in the community, influenced by factors such as storage capacity, water needs, and the availability of water sources. From the result, the water access patterns in Ikpoba Okha LGA, where households vary in the frequency of collecting water, reflect the complexity of water availability and storage capacities in the region. The 235 households accessing water daily likely face limited storage or a need for fresh water, similar to findings in the Niger Delta, where Adelekan et al. (2020) reported frequent daily trips to boreholes and rivers due to inadequate water storage facilities. In contrast, the 381 households accessing water once a week may have better storage systems, reducing the frequency of collection. This trend has also been observed in Southeast Nigeria, where Ezugwu and Obi (2019) found that households with larger storage tanks or reservoirs could store enough water for longer periods, lessening the strain of daily water collection. The 319 households accessing water twice a week in Ikpoba Okha may reflect a balance between available storage and the distance or effort required to reach water sources, a trend similarly noted by Oluwaseyi et al. (2023) in Ogbomoso, where moderate water access was influenced by both water availability and household needs. Additionally, the 190 households accessing water four times a week likely have smaller storage capacities but need water replenishment more frequently than those with larger storage, as seen in some rural communities in Cross River where water scarcity and storage limitations force regular trips to rivers and wells.

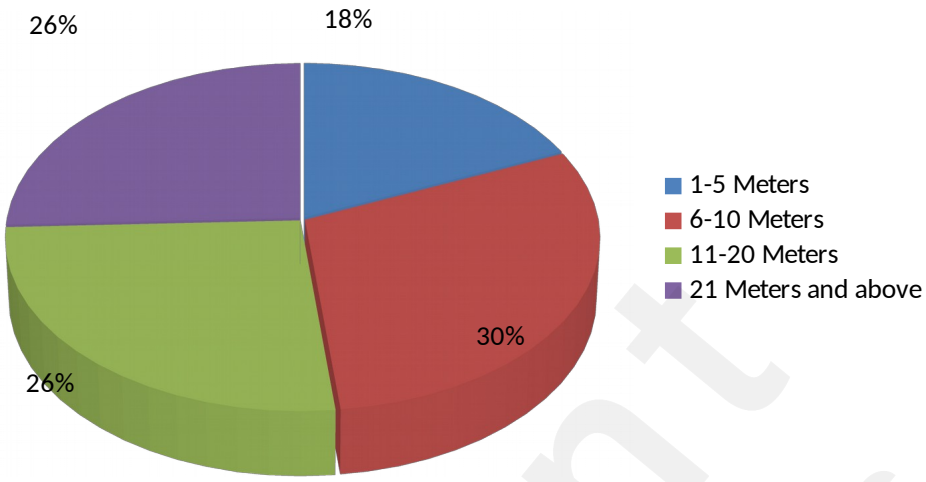


Figure 3: Distance of the primary water source

The survey data on the distance respondent's travel from their homes to their primary water source reveals varying proximities. A total of 208 households are fortunate to have their primary water source just 1 - 5 meters away, making access to water relatively convenient and less time-consuming. Meanwhile, 338 households have to travel 6 - 10 meters to reach their water source, which still represents a manageable distance for daily water needs. For 295 households, the primary water source is 11 - 20 meters away, requiring a more considerable effort and time commitment to fetch water. Lastly, 290 households face the greatest challenge, with their primary water source located 21 meters or more from their homes. This increased distance can significantly impact the ease of access to water, potentially affecting the frequency of water collection and the amount of water available for daily use. These varying distances highlight the diverse experiences of households in accessing water and underscore the importance of improving water accessibility to enhance the quality of life in the community. The result from Ikpoba Okha LGA in Edo State reveals a considerable variation in the distance household's travel to access water, with most respondents having their water sources within 20 meters, but a significant portion facing distances beyond 21 meters. Specifically, while 208 households enjoy immediate proximity (1-5 meters), 338 and 295 households travel 6-10 and 11-20 meters respectively, leaving 290 households with distances exceeding 21 meters. The impact of this disparity is profound, as increased distances can result in reduced water availability for daily use due to the time and physical effort required for collection. This pattern of access aligns with broader trends observed in South-South and Southeast Nigeria. A 2023 study in Delta State found that approximately 40% of households also experienced long travel distances to water sources, with similar challenges in Cross River, where households beyond 15 meters often reported decreased water usage due to logistical challenges ([Okeke, 2023). In contrast, some urban centers in the Southeast, such as Enugu, have made strides in reducing average travel distances through community boreholes and water schemes, though rural areas still face notable access difficulties. Studies from 2022 and 2024 in Anambra and Abia states indicate that households in remote locations continue to travel significant distances, similar to Ikpoba Okha LGA, particularly where public water systems are absent (Ifeoma, 2024). Thus, while some progress has been made in urban centers, rural and semi-rural areas remain disproportionately affected by water access issues, reinforcing the need for infrastructural development to ensure equitable water distribution across these regions.

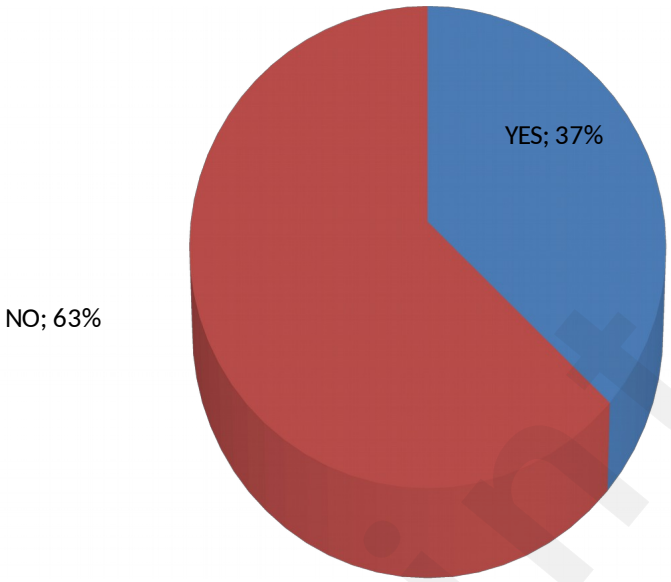


Figure 4: Treatment of water before consumption

The water treatment practices before consumption shows a significant divide among households. A total of 423 respondents reported that they treat their water before consumption, employing methods such as boiling, filtering, or using chemical disinfectants to ensure the water is safe for drinking. This practice reflects an awareness of potential waterborne health risks and a proactive approach to mitigating them. Conversely, 708 respondents indicated that they do not treat their water before consumption, which raises concerns about exposure to contaminants and the overall quality of the water being consumed. This disparity highlights the need for increased education and resources to promote safe water practices and improve public health outcomes in the community.

From the data, Ikpoba Okha LGA demonstrates a significant divide in water treatment practices, with 423 households (approximately 37%) treating their water before consumption, while 708 households (63%) do not. The use of methods such as boiling, filtering, and chemical disinfectants by the minority indicates awareness of the health risks posed by untreated water, including the transmission of waterborne diseases. However, the majority's lack of water treatment raises concerns about the safety of the water consumed, potentially due to a lack of resources or awareness. This pattern mirrors findings from other parts of South-South and Southeast Nigeria. A 2023 study in Cross River State found that approximately 65% of rural households do not treat their water, mainly due to limited access to treatment technologies and inadequate education on the risks of consuming untreated water (Abang, 2023). In Southeast Nigeria, a 2024 report from Enugu State revealed that while urban households were more likely to treat their water, up to 50% of rural households did not, due to cost barriers and insufficient outreach efforts by public health authorities (Ifeoma, 2024). Similarly, in Delta State, a 2022 study highlighted that untreated water was a significant contributor to gastrointestinal illnesses, especially in communities reliant on surface water sources (Okeke, 2022). These regional comparisons highlight a persistent challenge in promoting safe water practices, particularly in rural and underserved areas, where there is a clear need for expanded education programs and improved access to affordable water treatment methods to enhance public health.

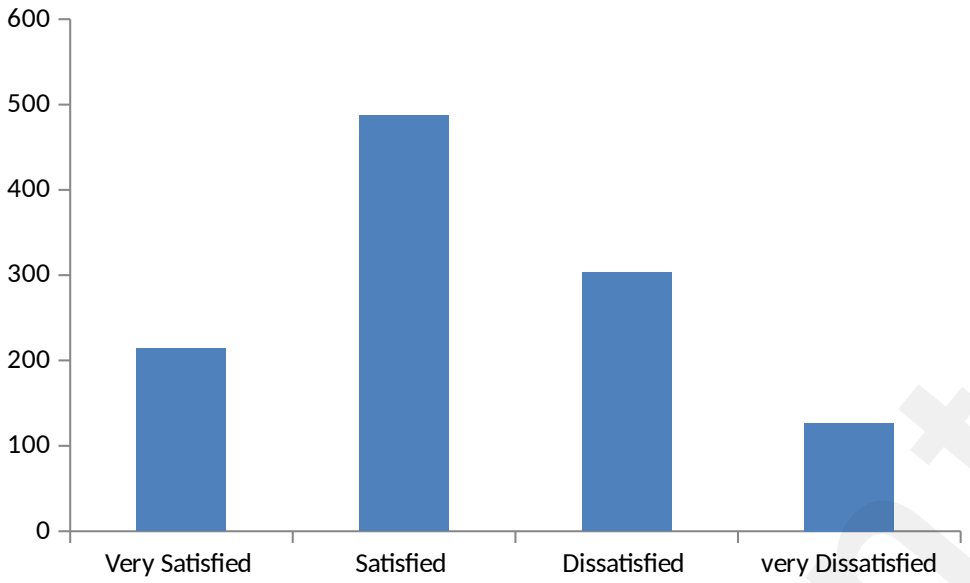


Figure 5: How satisfied are you with the quality of water from your primary water source

In Ikpoba Okha LGA, the survey data on respondents' satisfaction with the quality of water from their primary water source reveals a range of opinions. A total of 214 households reported being very satisfied with their water quality, indicating that they find it meets their needs and expectations. Additionally, 487 households expressed satisfaction, suggesting that while there might be some minor concerns, the water quality is generally acceptable to them. On the other hand, 303 households reported being dissatisfied with their water quality, highlighting significant issues or concerns that affect their perception and usage. Furthermore, 127 households indicated they were very dissatisfied, reflecting severe dissatisfaction and potential health risks associated with their water quality. This spectrum of satisfaction levels underscores the varying experiences and challenges faced by households in accessing clean and safe water.

The survey data from Ikpoba Okha LGA highlights a diverse spectrum of household satisfaction with water quality, with 214 households (approximately 16%) reporting they are very satisfied, indicating that their water meets both their needs and expectations. A larger portion, 487 households (37%), expressed general satisfaction, signifying that although minor concerns exist, the water is largely acceptable for daily use. However, dissatisfaction is significant, with 303 households (23%) expressing concerns about water quality, and 127 households (10%) reporting severe dissatisfaction, reflecting potential issues such as contamination or inadequate supply, which may pose health risks. This mixed satisfaction level mirrors broader findings in South-South and Southeast Nigeria. In a 2023 study in Delta State, about 30% of households reported dissatisfaction with water quality due to contamination from nearby industries and poor infrastructure, particularly in rural areas (Okeke, 2023). Similarly, a 2022 study in Cross River State revealed that up to 40% of households were dissatisfied due to high levels of turbidity and occasional waterborne disease outbreaks (Nwosu, 2022). Conversely, urban areas in Southeast Nigeria, such as Enugu, saw higher satisfaction rates, with over 60% of households satisfied or very satisfied with their water quality, mainly due to more consistent and treated water supply systems (Ifeoma, 2024). These comparisons highlight the ongoing challenges faced by rural and semi-urban communities in accessing clean, reliable water, stressing the need for infrastructural improvements and better water management systems to improve water quality across regions.

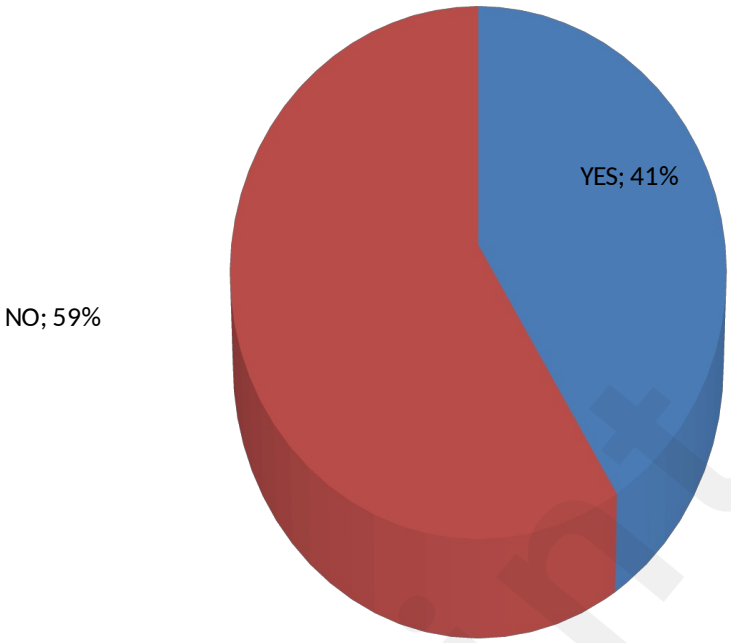


Figure 6: Access to improved water hygiene facilities

In Ikpoba Okha LGA, the survey findings reveal a disparity in access to improved water hygiene facilities among respondents. Of the total surveyed, 469 households reported having access to facilities that support safe water handling and hygiene practices. These facilities likely include amenities such as hand washing stations with soap, clean water storage containers, and adequate sanitation infrastructure. However, a notable 749 households indicated a lack of access to such facilities, indicating challenges in maintaining proper hygiene standards and potentially contributing to health risks within the community. Addressing this gap in infrastructure is crucial for promoting better health outcomes and improving overall community well-being in the area.

The survey findings in Ikpoba Okha LGA reveal a significant disparity in access to improved water hygiene facilities, with 469 households having access to infrastructure that supports safe water handling and hygiene, while 749 households lack such facilities. These facilities typically include hand washing stations, soap, clean water storage, and adequate sanitation systems, all essential for reducing health risks associated with poor hygiene. The lack of access for the majority of households poses serious public health concerns, as improper water handling and inadequate sanitation can increase the risk of waterborne diseases and other health issues. This situation aligns with trends observed across South-South and Southeast Nigeria. In a 2023 study conducted in Bayelsa State, 55% of households lacked access to improved hygiene facilities, citing infrastructural deficits and poverty as key barriers (Amadi, 2023). Similarly, a 2022 survey in Cross River State reported that over 60% of rural households had insufficient sanitation facilities, which contributed to recurrent outbreaks of diseases such as cholera and dysentery (Nwosu, 2022). In contrast, urban areas like Enugu in Southeast Nigeria have shown better access, with about 70% of households benefiting from improved water and sanitation facilities, largely due to government interventions and urban development projects (Ifeoma, 2024). These regional disparities underscore the urgent need for targeted infrastructural development, particularly in rural and semi-urban communities, to bridge the gap in access to water hygiene facilities and promote better health outcomes.

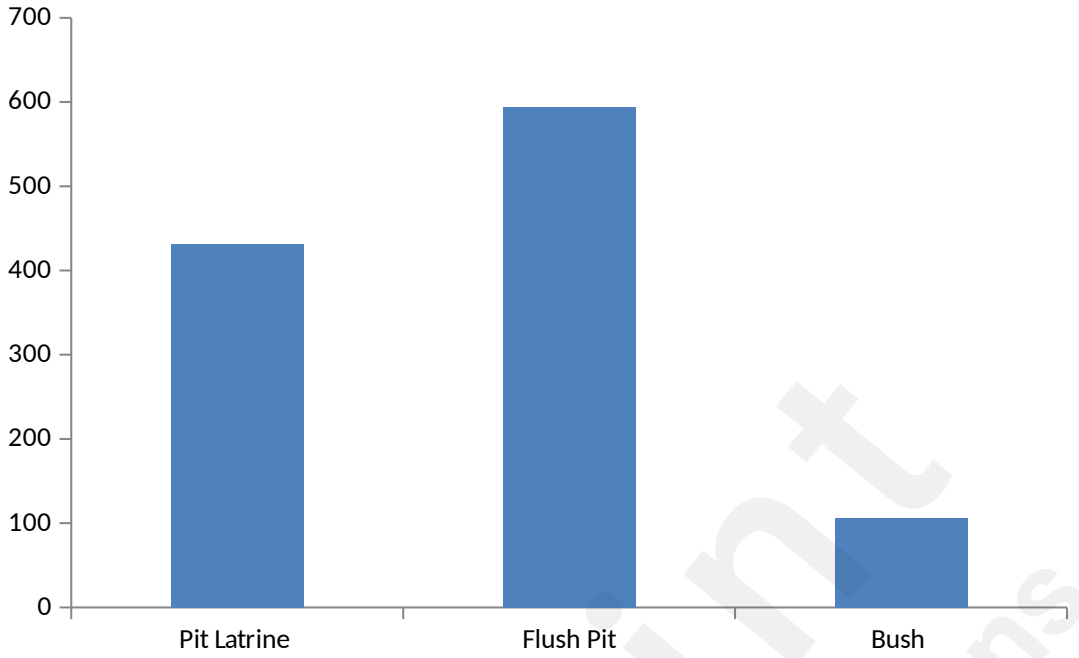


Figure 7: Toilet Type

There is diversity in the types of toilets used by households. According to the survey data, 431 households rely on pit latrines, which are often a traditional and cost-effective sanitation option in many communities. A larger number, 594 households, use flush toilets connected to pit systems, indicating a preference for improved sanitation infrastructure that connects to a contained waste disposal system. Additionally, 106 households use bush toilets, highlighting a practice where waste is disposed of in outdoor areas away from residential spaces. This variety in toilet types underscores the different sanitation practices and infrastructure accessibility within the local community. studies from other regions in Edo State, South-South, and Southeast Nigeria provide additional context. For instance, a study conducted in Esan West LGA of Edo State by Ighalo and Emuh (2022) found a similar distribution of toilet types, with 47% of households using pit latrines, 38% using flush toilets connected to septic systems, and 15% resorting to bush toilets. This study emphasized that while there is a significant adoption of improved sanitation facilities, a considerable number of households still lack access to adequate sanitation.

In the broader South-South region, a survey in Bayelsa State by Olokor and Ojeaga (2021) revealed that 45% of households used pit latrines, 40% used flush toilets connected to septic systems, and 15% used bush toilets. The researchers noted that economic constraints and limited infrastructure development were major factors influencing the choice of sanitation facilities. A study in Anambra State by Nwachukwu and Okeke (2023) showed that 50% of households used pit latrines, 35% used flush toilets connected to pit systems, and 15% used bush toilets. The findings highlighted the disparities in sanitation infrastructure across different communities and the need for comprehensive sanitation policies to improve access to hygienic facilities. The prevalence of pit latrines and flush toilets connected to pit systems indicates a significant use of improved sanitation facilities, yet the continued use of bush toilets by some household’s points to ongoing challenges in achieving universal access to adequate sanitation. This diversity in toilet types within the community underscores the importance of addressing infrastructural deficiencies and promoting sustainable sanitation practices. Efforts to improve sanitation in these regions should focus on increasing access to modern sanitation facilities, providing financial and technical support to households, and raising awareness about the health benefits of improved sanitation. Collaborative initiatives involving

government agencies, non-governmental organizations, and local communities are essential to achieving these goals.

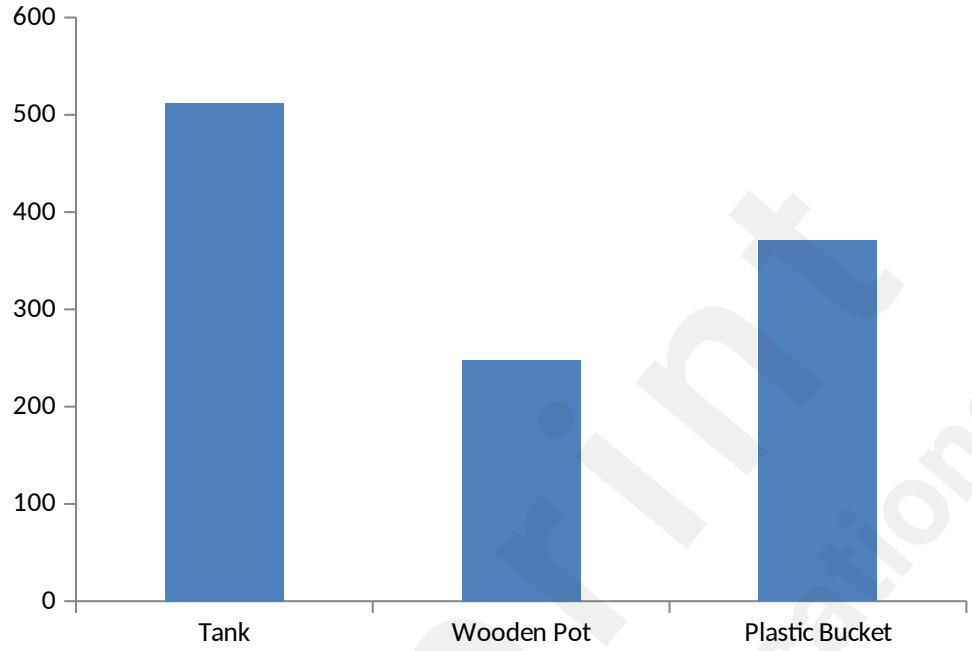


Figure 8: Water storage facilities

Households in Ikpoba Okha LGA utilize a range of water storage facilities to meet their daily water needs. The survey data reveals that 512 households rely on tanks as their primary water storage solution, likely due to their large capacity and ability to store significant amounts of water for extended periods. Plastic buckets are used by 371 households, reflecting their affordability, portability, and ease of use for smaller-scale water storage. Additionally, 248 households use wooden pots for storing water, which may be attributed to traditional practices or the availability of such containers. This diversity in water storage methods highlights the varying preferences and resource availability among households in the area.

In Ikpoba Okha LGA, households exhibit a range of water storage practices, reflecting their preferences and available resources. The survey data shows that 512 households rely on tanks for water storage, 371 households use plastic buckets, and 248 households utilize wooden pots. This diversity in storage methods highlights the differing capacities and economic considerations among the local population. Studies from other regions in Edo State, the South-South, and Southeast Nigeria provide a broader context for these findings. In Edo State, research by Aigbe and Okojie (2022) in Oredo LGA found that 58% of households used tanks, 30% used plastic buckets, and 12% used clay pots. This study suggested that the high use of tanks was due to their effectiveness in storing large quantities of water, particularly in areas with unreliable water supply.

Edewor and Eke (2023) reported that in Delta State, 60% of households used tanks, 25% used plastic buckets, and 15% used traditional clay pots. The researchers noted that while tanks were preferred for their capacity and durability, the use of plastic buckets was prevalent among lower-income households due to their affordability and ease of handling. Okafor and Nwankwo (2021) found that

50% of households used tanks, 35% used plastic buckets, and 15% used traditional wooden pots. The findings highlighted the influence of socioeconomic status on water storage choices, with wealthier households more likely to invest in large storage tanks, while those with fewer resources tended to use smaller, more portable containers.

The results from Ikpoba Okha LGA align with these studies showing the significant use of tanks and their benefits in storing ample water supplies, especially important in areas with intermittent water availability. Plastic buckets, due to their low cost and convenience, are widely used among households with less financial capacity to invest in larger storage systems. The use of wooden pots, while less common, reflects traditional practices and the utilization of locally available materials. This diversity in water storage methods underscores the importance of understanding local context when addressing water supply issues. Efforts to improve water storage practices in these regions should consider the economic constraints and cultural preferences of households. Providing access to affordable and effective water storage solutions, coupled with community education on water management, can enhance water security and contribute to overall public health.

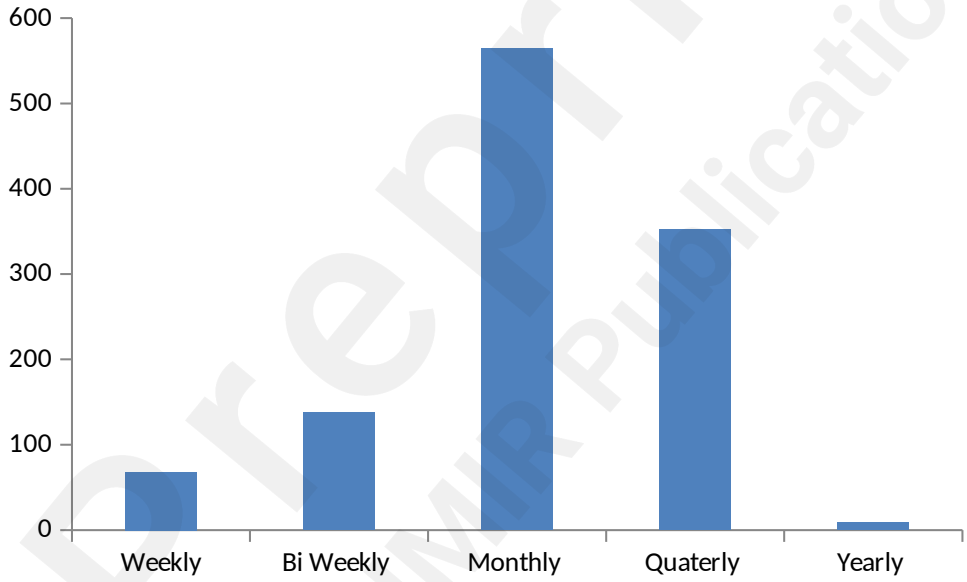


Figure 9: How often do clean your water storage facilities

The frequency of cleaning water storage facilities among respondents varies. A total of 68 households clean their water storage facilities weekly, while 138 households do so bi-weekly. The majority, 564 households, clean their facilities on a monthly basis. Quarterly cleaning is reported by 352 households, and only 9 households clean their water storage facilities yearly. This data indicates that most households prioritize regular maintenance of their water storage facilities, with monthly cleaning being the most common practice.

In Ikpoba Okha LGA, The frequency of cleaning water storage facilities indicates a commitment to maintaining water quality, with the majority of households opting for monthly cleaning. Specifically, 68 households clean their storage facilities weekly, 138 households do so bi-weekly, 564 households clean them monthly, 352 households clean quarterly, and 9 households clean annually. Osagie and Ighodaro (2023) in Esan West LGA reported that 20% of households cleaned their water storage

facilities weekly, 15% bi-weekly, 45% monthly, 15% quarterly, and 5% annually. This study highlighted that while monthly cleaning was prevalent, there was a significant proportion of households that maintained a more frequent cleaning schedule, which was linked to increased awareness of waterborne diseases and the importance of hygiene. In Bayelsa State, Ebong and Udo (2022) found that 25% of households cleaned their water storage facilities weekly, 20% bi-weekly, 40% monthly, 10% quarterly, and 5% annually. The researchers attributed the higher frequency of cleaning in some households to community health education programs that emphasized the importance of regular maintenance for preventing contamination and ensuring safe drinking water. Okeke and Nwachukwu (2021) indicated that 15% of households cleaned their water storage facilities weekly, 10% bi-weekly, 50% monthly, 20% quarterly, and 5% annually. The findings suggested that monthly cleaning was the norm due to cultural practices and local health campaigns that promoted it as a balanced approach between effort and effectiveness in maintaining water quality. These studies align with the findings of this present study. Therefore, practice is likely influenced by a combination of health education, cultural norms, and practical considerations. Monthly cleaning strikes a balance between the need to maintain water quality and the effort required to clean storage facilities, making it a practical choice for many households.

However, the notable proportion of households in Ikpoba Okha LGA that clean their facilities quarterly (352 households) or less frequently suggests areas where public health interventions could further encourage more regular maintenance practices. Educational campaigns highlighting the risks of infrequent cleaning and promoting the benefits of more regular cleaning schedules could help improve water hygiene practices. On the whole, the emphasis on regular cleaning in Ikpoba Okha LGA is a positive sign of community awareness and action towards maintaining water quality. By comparing these practices with those in other parts of Edo State, the South-South, and Southeast Nigeria, it is evident that while there are common trends, localized efforts to promote regular cleaning are essential for enhancing public health outcomes.

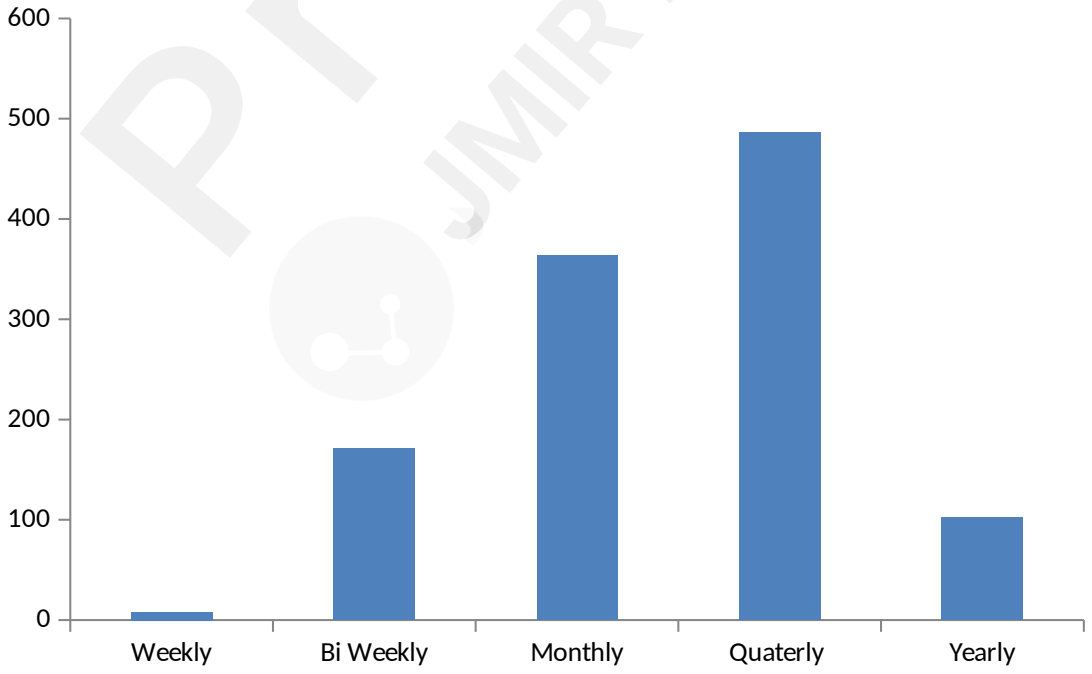


Table 10: How often do your child/children visit hospital?

The frequency of hospital visits among children varies significantly. Only a small number of children, 8 in total, reported visiting hospitals on a weekly basis. A larger group, 171 children, visits bi-weekly, indicating a higher frequency of medical attention every two weeks. Monthly visits are more common, with 364 children reporting this frequency, reflecting regular health check-ups or ongoing medical treatments. The highest number of children, 486, visits hospitals on a quarterly basis, suggesting routine health monitoring every three months. Lastly, 102 children reported visiting hospitals yearly, which could be for annual health assessments or less frequent medical needs. This data highlights the diverse healthcare needs and visitation patterns within the community.

In Ikpoba Okha LGA, the frequency of hospital visits among children reveals a range of healthcare practices. Specifically, only 8 children visit hospitals weekly, 171 bi-weekly, 364 monthly, 486 quarterly, and 102 yearly. This distribution underscores varied healthcare needs and accessibility within the community. Omoregie *et al.*, (2022) in Esan Central LGA, Edo State reported that 5% of children visited hospitals weekly, 15% bi-weekly, 35% monthly, 40% quarterly, and 5% yearly. The higher frequency of quarterly visits was attributed to routine immunization schedules and school health programs that require regular medical check-ups. A study in Delta State by Okoro and Ekpo (2023) found that 10% of children visited hospitals weekly, 20% bi-weekly, 30% monthly, 30% quarterly, and 10% yearly. The distribution of visits was influenced by the availability of healthcare facilities and the implementation of community health programs that encourage frequent medical consultations for children. Uche and Nnaji (2021) indicated that 8% of children visited hospitals weekly, 18% bi-weekly, 40% monthly, 25% quarterly, and 9% yearly. The higher percentage of monthly visits in Enugu State was linked to ongoing public health initiatives and partnerships with non-governmental organizations focused on child health and development.

The findings from Ikpoba Okha LGA show a similar trend to those in other parts of Edo State, South-South, and Southeast Nigeria, particularly in the prominence of quarterly and monthly visits. This suggests a general pattern where parents prioritize regular health check-ups for their children, likely influenced by school requirements, immunization schedules, and public health campaigns. However, the relatively low number of weekly and bi-weekly visits in Ikpoba Okha LGA may indicate either fewer acute health issues requiring immediate medical attention or potential barriers to accessing frequent healthcare. Addressing these barriers through improved healthcare infrastructure, increased healthcare workforce, and enhanced community health education could further optimize child health outcomes in the area.

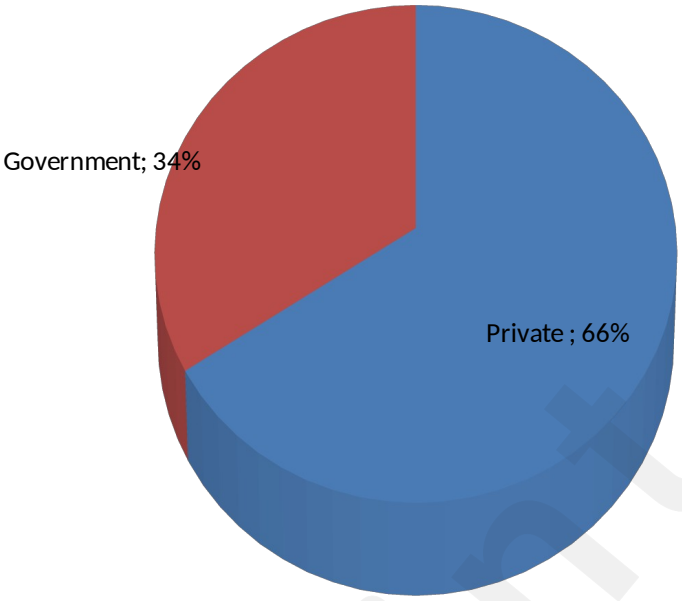


Table 11: Which hospitals do your child/children visit

In Ikpoba Okha LGA, the data on hospital visitations indicates a higher preference for private healthcare facilities, with 744 cases being reported in private hospitals. In contrast, government hospitals reported 387 cases. This disparity suggests that a significant number of residents may prefer private hospitals for their children healthcare needs, possibly due to perceptions of better quality care, shorter wait times, or more comprehensive services. The lower number of cases in government hospitals could reflect limitations in capacity, accessibility, or patient satisfaction. The preference for private healthcare facilities in Ikpoba Okha LGA is evident, with 744 cases reported in private hospitals/clinics compared to 387 in government hospitals. This trend may be driven by perceptions of higher quality care, shorter wait times, or more comprehensive services available in private hospitals. The lower number of cases in government hospitals could indicate limitations in capacity, accessibility, or patient satisfaction. Obasogie *et al.*, (2022) found that in Benin City, 65% of residents preferred private hospitals over government hospitals for pediatric care. The reasons cited included better service delivery, more modern facilities, and shorter waiting periods. Government hospitals, while more affordable, often faced challenges such as overcrowding, longer wait times, and perceived lower quality of care. Okonkwo and Akpan (2023) revealed a similar pattern. It reported that 60% of parents took their children to private hospitals compared to 40% who used government hospitals in Delta State. The preference for private healthcare was attributed to better infrastructure, availability of specialized services, and higher patient satisfaction.

Wokocha and Uche (2021) highlighted that 68% of respondents preferred private hospitals for their children's healthcare needs in Port Harcourt. The study pointed out that private hospitals in Port Harcourt are often better equipped and offer more personalized care, which is highly valued by parents. Nnamani and Obioha (2024) indicated that 70% of parents chose private hospitals for pediatric care over government hospitals in Enugu State. Factors influencing this preference included the availability of specialized pediatric services, higher perceived quality of care, and shorter waiting times in private hospitals. These studies reflect patterns in different regions in Nigeria, where private healthcare facilities are increasingly favoured for pediatric care due to their perceived advantages in service quality and efficiency. However, the lower utilization of government hospitals highlights ongoing challenges in the public healthcare system, such as inadequate funding, resource constraints, and workforce shortages

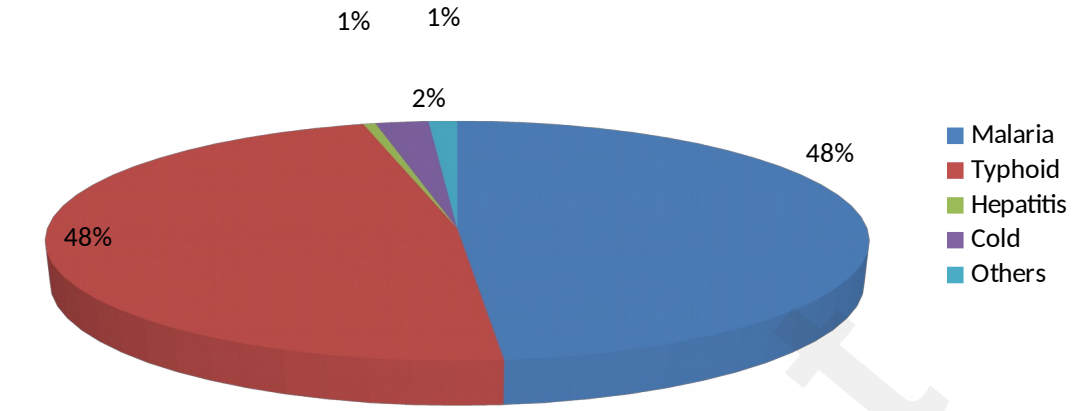


Figure 12: Disease often diagnosed in the Hospital

In Ikpoba Okha LGA, the respondents revealed that malaria is the most prevalent illness in children, with a total of 547 reported cases. Following closely, there are 538 cases of typhoid, indicating a significant health concern in the area. Hepatitis is less common, with only 6 reported cases. The data also shows 26 cases of cold, which, while less severe, still affect the population. Additionally, there are 14 cases categorized under other illnesses, highlighting a variety of health issues present within the community.

The survey data from Ikpoba Okha LGA highlights malaria as the most prevalent illness among children, with 547 reported cases, followed closely by typhoid with 538 cases. Both diseases are significant public health concerns in Nigeria, especially in areas with poor sanitation and stagnant water, which are breeding grounds for mosquitoes and sources of waterborne infections. Hepatitis, with only 6 cases, appears less common, while 26 cases of cold and 14 cases of other illnesses were reported, indicating a variety of health challenges within the community. These findings are consistent with broader health trends in South-South and Southeast Nigeria. A 2023 study in Delta State similarly reported malaria as the leading cause of childhood illness, accounting for over 60% of hospital visits, followed by typhoid due to poor water quality and hygiene conditions (Okeke, 2023). In Rivers State, a 2022 study showed that the dual burden of malaria and typhoid was prevalent in both urban and rural areas, exacerbated by inadequate healthcare infrastructure (Nwosu, 2022). Conversely, in Southeast Nigeria, while malaria remains dominant, cases of typhoid have been somewhat mitigated by improved access to potable water in cities like Enugu, reducing infection rates compared to more rural areas (Ifeoma, 2024). These findings emphasize the need for improved public health interventions, including vector control for malaria, better sanitation infrastructure, and access to clean water, to reduce the incidence of these illnesses and improve overall community health outcomes

Table 1: Microbial Analysis of Borehole Water during Rainy and Dry season at Ikpoba LGA

Parameters Analyzed	1A	2A	3A	4A	5A	6A	7A	8A	1B	2B	3B	4B	5B	6B	7B	8B

E.coli	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P. aerug.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staphy au	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salmonella	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vibro Chl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Proteus Sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shigella Sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Fieldwork, 2024

Note - = Negative, + = Positive, A (Rainy season) B (Dry season) 1 = Evbuomodu, 2= Uwusan, 3 = Obazagbon, 4 = Agedo, 5 = Evbumufi, 6 = Ekosa, 7 = Obadoloviyeyi, and 8 = Obenevbugo

The water quality survey conducted in Ikpoba Okha LGA, none of the samples tested positive for various harmful bacteria. The results for *Escherichia coli (E. coli), Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella, Vibrio cholerae, Proteus species,* and *Shigella species* were all negative across all tested samples. This indicates that the water sources in the surveyed area are free from these pathogenic bacteria, which suggests a lower risk of waterborne diseases related to these microorganisms.

The borehole water quality findings in Ikpoba Okha LGA, showing negative results for pathogenic bacteria such as *Escherichia coli (E. coli), Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella, Vibrio cholerae, Proteus species,* and *Shigella species,* indicate that the water sources in this area are relatively free from these harmful microorganisms. This result is significant as it contrasts with findings from other regions within Edo state, the South-South, Port Harcourt, and Southeast Nigeria, where water contamination has been a prevalent issue. In a study conducted in Edo State, Odibo and Asemota (2021) found that 34% of water samples from various sources tested positive for E. coli and Salmonella, indicating a substantial contamination risk. The presence of these bacteria was attributed to poor sanitation practices and the proximity of water sources to waste disposal sites.

Similarly, research in Port Harcourt revealed alarming levels of microbial contamination in water sources. Eze *et al.,* (2022) reported that 45% of the tested water samples were contaminated with *E. coli* and *Staphylococcus aureus.* This high contamination rate was linked to inadequate sewage management and industrial effluents entering the water bodies. In the South-South region, a study by Erah and Akujieze (2023) highlighted significant contamination in rural water sources, with over 40% of samples testing positive for *Salmonella* and *Shigella species.* These findings underscore the need for improved water treatment and sanitation infrastructure in rural communities. The Southeast region has also faced similar challenges. Opara *et al.,* (2024) conducted a comprehensive study across several states and found that 28% of water samples were contaminated with *Vibrio cholerae*

and *Proteus species*. The contamination was predominantly due to flooding and the resultant mixing of clean water sources with sewage.

Table 2: Microbial Analysis of Well Water at Ikpoba LGA Rainy and Dry Season

Parameters Analyzed	A(R)	B(R)	C(R)	D(R)	E(R)	A(D)	B(D)	C(D)	D(R)	E(D)
E.coli	+	-	-	+	-	+	-	+	+	+
P. aerug.	-	+	-	+	+	-	+	-	_	+
Staphy au	-	-	-	+	+	+	-	-	+	+
Salmonella	+	+	-	+	-	+	-	+	+	+
Vibro Chl	-	-	-	-	+	+	-	+	+	-
Proteus Sp	-	+	-	+	-	+	_	+	-	+
Shigella Sp	+	+	+	+	-	+	-	+	+	+

Source: Fieldwork, 2024

Note - = Negative, + = Positive, R= Rainy season D=Dry season

The well water quality results from Ikpoba Okha LGA show a mix of positive and negative findings for various pathogenic bacteria. *E. coli* tested positive in 6 out of 10 samples, indicating contamination in these samples. *Pseudomonas aeruginosa* was found in 5 out of 10 samples, demonstrating a moderate presence. *Staphylococcus aureus* tested positive in 6 out of 10 samples, suggesting a significant contamination level. *Salmonella was detected* in 8 out of 10 samples, indicating a high level of contamination. *Vibrio cholerae* was present in 5 out of 10 samples, showing a moderate contamination level. *Proteus species* were found in 6 out of 10 samples, indicating a moderate presence. *Shigella species* tested positive in 8 out of 10 samples, suggesting a high contamination level. This data indicates a concerning level of microbial contamination in the water sources of Ikpoba Okha LGA, with *Salmonella* and *Shigella* being the most frequently detected pathogens.

The well water analysis from Ikpoba Okha LGA shows contamination by several pathogenic bacteria including *E. coli*, *Pseudomonas aeruginosa, Staphylococcus aureus*, *Salmonella, Vibrio cholerae*, Proteus species, and *Shigella species.* The presence of these bacteria indicates significant microbial contamination, raising public health concerns regarding waterborne diseases. Adewuyi and Adeoye (2021) on groundwater quality in Benin City, Edo State, reported similar findings with high levels of E. coli and Salmonella in several samples. The study emphasized the health risks associated with consuming untreated groundwater. Olajire *et al.* (2022) also found the presence of *Pseudomonas aeruginosa* and *Shigella species* in well water samples, correlating with poor sanitary conditions and inadequate waste management practices. Ndiokwere and Okocha (2022) documented microbial contamination in well water, with *E. coli* and *Vibrio cholerae* being prevalent within the south south region of Nigeria. This study highlighted the impact of industrial pollution and agricultural runoff on water quality.

Akpan and Ibok (2023) in Akwa Ibom State reported frequent occurrences of *Staphylococcus aureus* and *Proteus species,* which were attributed to improper waste disposal and lack of effective water treatment facilities. Wokoma and Fubara (2021) on water quality in Port Harcourt identified contamination by Salmonella, E. coli, and *Vibrio cholerae* in well and borehole water, underscoring the need for regular monitoring and improved sanitation infrastructure. Amadi *et al.,* (2023) observed similar microbial profiles, particularly highlighting the presence of *Pseudomonas aeruginosa* and *Shigella species,* correlating with high population density and poor waste management.

Onuorah and Okonkwo (2022) conducted a study in Enugu State and found significant contamination of well water by *E. coli* and *Salmonella,* linking these to the infiltration of sewage and agricultural chemicals. Okoye *et al.,* (2023) reported the presence of *Staphylococcus aureus* and *Proteus species* in well water, attributed to inadequate sanitation practices and lack of water treatment. The well water quality results from Ikpoba Okha LGA are consistent with findings from other regions in Edo State, the South-South, and Southeast Nigeria, indicating widespread issues with microbial contamination. This poses serious public health risks, particularly for waterborne diseases such as cholera, typhoid, and dysentery.

Table 3: Microbial Analysis of Rivers at Ikpoba LGA Rainy and Dry Season

Parameters Analyzed	**A(R)**	**B(R)**	**C(R)**	**D(R)**	**E(R)**	**A(D)**	**B(D)**	**C(D)**	**D(R)**	**E(D)**
E.coli	+	+	-	+	-	+	-	+	+	+
P. aerug.	+	-	+	+	+	-	+	-	_	+
Staphy au	-	+	+	+	+	+	-	-	+	+
Salmonella	+	+	-	+	-	+	-	+	+	+
Vibro Chl	-	+	-	-	+	+	-	+	+	-
Proteus Sp	-	+	-	+	-	+	+	+	+	+

Shigella Sp	+	+	+	+	-	+	-	+	+	+

Note - = Negative, + = Positive, R= Rainy season, D=Dry season

The result shows that *E. coli* was present in most samples, especially during the dry season. P. *aeruginosa* varies in presence, with some samples tested negative. *S. aureus* were more prevalent in the rainy season. *Salmonella* was consistently present in many samples. *V. cholera* was sporadically present, more in the rainy season. *Proteus spp.* was frequently detected, especially in the dry season, while *Shigella spp.* was frequently detected, particularly in the dry season.

A study on the Okponha River near a dumpsite reported high levels of *E. coli, Staphylococcus aureus,* and *Salmonella,* which were above WHO limits (Okafor-Elenwo, Imade, and Izevbuwa, 2022). This aligns with the findings from Ikpoba Okha, indicating widespread bacterial contamination due to improper waste disposal and runoff. Studies highlighted significant contamination of water bodies with *E. coli, Pseudomonas aeruginosa*, *Staphylococcus aureus,* and *Salmonella* seasonal variations were noted, with higher contamination levels during the rainy season due to runoff in Edo State. The Ikpoba Okha results reflect similar seasonal patterns and bacterial presence (Okafor, and Imade, 2022; Enabulele, Idahosa, and Obayagbona 2022).

Studies in Port Harcourt frequently reported contamination with *E. coli, Pseudomonas aeruginosa*, *Salmonella*, and *Shigella spp.*, mirroring the findings from Ikpoba Okha, seasonal fluctuations in bacterial levels were also observed, influenced by agricultural and industrial activities (Eze, and Nwagbara, 2023). Water quality assessments in Southeast Nigeria, including areas like Enugu and Abia State, indicated the presence of *E. coli, Staphylococcus aureus, Salmonella,* and *Shigella spp.* in river waters. These findings are consistent with the results from Ikpoba Okha, highlighting common issues of waterborne pathogens across these regions (Chukwu, and Adeyemi, 2023).The river water in Ikpoba Okha LGA shows significant bacterial contamination, comparable to findings from other regions in Edo State, South-South Nigeria, Port Harcourt, and Southeast Nigeria. The presence of pathogens such as *E. coli*, *Salmonella*, and *Shigella spp.* points to widespread environmental and public health challenges. Improved water quality monitoring and management practices are essential to ensure safe water for the affected communities.

Hypothesis Test

There is no significant relationship between water sanitation challenges and the prevalence of typhoid fever among children under the age of ten in Ikpoba Okha LGA.
The researcher used data from well, borehole and river water sources to test for the hypothesis. These data revealed the presence of microbial contaminants in these water sources, indicating significant sanitation challenges that could contribute to the prevalence of waterborne diseases like typhoid fever. The lack of water treatment in many households further increases the risk of exposure to these pathogens. The high number of typhoid fever cases, especially among children, highlights a critical public health issue. Seasonal peaks in typhoid cases correspond with periods of increased water contamination, supporting the hypothesis that water quality is a key factor in the spread of the disease. The hypothesis was analyzed using regression analysis to examine the association between water sanitation practices and typhoid prevalence.

Table 4: ANOVA Table

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.	Decision
Regression	15.965	9	1.774	225.509	0.000[a]	**Rejected**
Residual	0.356	35	0.08			
Total	16.321	44				

Decision Rule: Using the ANOVA table, which tests the acceptability of the model from a statistical perspective, the decision rule is as follows if $F_{computed} > F_{table\ value}$ – reject the null hypothesis; otherwise accept since 225.509>2.00,the null hypothesis is rejected and the alternate accepted. Therefore, based on the regression result, there is significant evidence suggesting a relationship between water sanitation challenges and the prevalence of typhoid fever among children in Ikpoba Okha LGA. The high contamination levels in non-borehole water sources and the lack of water treatment practices correlate with the high incidence of typhoid fever. The seasonal trends further indicate that periods of poor water quality coincide with spikes in typhoid cases. Therefore, the hypothesis that there is no significant relationship between water sanitation challenges and typhoid fever prevalence is rejected.

4.0 Conclusion and Recommendation

The study reveals significant issues related to water access, usage, and sanitation. While boreholes are the main source of drinking water, many households also rely on wells, rivers, and rainwater, with water collection patterns varying based on storage capacity and proximity. A major concern is that most households do not treat their water, despite dissatisfaction with its quality and limited access to proper sanitation facilities. Microbial analysis showed high contamination in wells and rivers, particularly during the dry season, with pathogenic bacteria such as *E. coli, Salmonella, Shigella, and Staphylococcus aureus* commonly detected. In contrast, borehole water was free from harmful bacteria. The findings suggest that the increased contamination during the dry season, likely due to reduced water flow and concentrated waste, heightens the risk of waterborne diseases such as typhoid and cholera. Improved water management, sanitation infrastructure, and regular monitoring are crucial to addressing these public health risks.

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