Assessment of Water and Excreta Sanitation in Owerri Municipal and Owerri North Local Government Area, Imo State, Southeast, Nigeria

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ABSTRACT

Background: In many developing countries, access to water supply and sanitation remains low and the need to provide both improved water supply and safe means of excreta disposal is the concern of every developing country. This paper aimed at assessing the water and excreta sanitation status in Owerri zone, Imo state.

Methods: The study employed a descriptive technique that involves the assessment of the sanitary conditions of studied areas. The study focused on sample size of 400 respondents to get information on water and excreta sanitation. Microbial analysis of water supply was examined to identify the presence of bacteria. The total heterotrophic bacteria plate counts (HPC) in the water samples were obtained using the standard pour plate technique. The data was analyzed using descriptive statistical analysis and results were presented in frequency, percentage and charts.

Results: The results of the study showed that 125(62.5%) were males from Owerri North (ON) and 113(56.5%) from Owerri Municipal (OM). Source of water supply, 80(40%) in ON reported that water supply source was far from the individual houses; and 144(72%) in OM supported the idea. In hand washing after defecation, 180(90%) agreed from ON and 170(85%) agreed from OM. In Owerri North and Municipal, 120(60%) and 110(55%) had malaria which was the most common type of

sanitation related diseases from wastewater and excreta management. The laboratory result of drinking water from different villages indicated the presence of heavy growth of bacteria (*staphylococcus, streptococcus* and *salmonella)* as observed using Macconkey Agar media.

In conclusion, the findings of this study showed the presence of bacteria in water supply. Therefore, the community needs to be educated on the importance of maintaining clean and hygienic environment around the boreholes to ensure the safety of water from such borehole.

Key words: Bacteria, Excreta, MacConkey agar, Sanitation, and Water supply.

INTRODUCTION

Access to water supply and practice of excreta sanitation is a fundamental right to every individual. In domestic hygiene, proper excreta disposal and safe water supply are essential for protecting public health. National Water Sanitation Policy, [1] defined access to water as the percentage of the population that uses drinking water from improved sources while access to excreta is the percentage of population that uses safe excreta disposal facilities, whereas access to sanitation is the percentage of the population that uses improve water sanitation. Generally, access to water can be

stated as having a source of safe water within 1 kilometer of the dwelling. It is estimated that in 2015, 663 million people still lacked access to "improved" drinking water sources. Improved sources are those deemed to be relatively protected from contamination and, therefore, likely to provide water safe for human consumption and household use, such as piped water supplies into the house, yard, boreholes or protected wells or springs. [2]

An estimated 2.6 billion people or 39% of the world population lack access to improved facilities for the disposal of human excreta. [3] Also, WHO and UNICEF Joint monitoring programme for water supply and sanitation gave an estimate of 768 million people who are still use unsafe drinking water sources and the number of people practicing open defecation decreased a little by over one billion people that practice open defecation and this still represent 15% of the global population. [4]

Sanitation is important to human health and it generates economic benefits and contributes to social development of a country. [5] In this regards, sanitation can be seems as a process of creating barriers to prevent the transmission of disease agents through a sustained hygiene and healthy environment. In this study context, sanitation is regarded as the provision of facilities and services for the safe disposal of human urine and faeces. Rochester [6] viewed sanitation as the process capable of mitigating the number of microbial contaminants to a relatively safe level. Generally, sanitation refers to the principles and practices relating to the collection, removal or disposal of human excreta, household waste water and refuse as they impact upon health and the environment. [1]

Good sanitation can be viewed as appropriate health and hygiene awareness among people and its positive influence in behaviour which is capable to sustain sanitation services such as disposing of human excreta; house hold waste water and refuse in a manner that is acceptable and affordable to the users. And the above conditions must not have any unacceptable impact on the environment.

The consequences for children when they are denied the most basic rights to safe water, the dignity of using toilet and the simple practice of washing of hands with soap are diarrhea occurrence, skin disease, respiratory illness such as pneumonia, intestinal illness and other water borne and excreta-related disease.

Alexander, [7] stated that every year an estimate of one million Africans die from diseases related to unsafe drinking water, poor sanitation and poor hygiene. Thus, the inadequacy of safe water and improved excreta sanitation services is manifested in the increased rate of diseases due to water and sanitation. The health burden of diseases mostly falls disproportionately on young children where diarrheal illness accounts for 20% of death among children under age of five [8] and other illness due to chemical contamination of water placing people at risk of a host of diarrhoeal. [9,10] The health problems associated with water and sanitation was pivoted on poor education on the importance of sanitary behaviour in regard to hygiene practice (as washing of hands after defecation and anal cleaning) as a means of safe health. [11] Proper excreta disposal and safe water will minimized the levels of money spent on health because of illness from preventable diseases such as diarrhoea.

United Nations [5] opined that Nigeria is one of the top five countries in the world that practice open defecation. The statistics recorded that over 100 million Nigerians have no access to improved sanitation facilities such as latrines and toilets, while about 33 millions Nigerians defecate openly because there are no sanitation facilities in public places. [5] Therefore, this study has its aim as to assess the water and excreta sanitation status in Owerri North and Owerri Municipal in Imo state.

MATERIALS AND METHODS

The research design employed in this study was a descriptive study to assess the water and excreta sanitation status in Owerri North LGA and Owerri Municipal in Imo state. The study was carried out at randomly selected autonomous communities (Emekuku, Mbaoma, Hite Ogada, Naze, and Awaka) from Owerri North and communities (Ama Awomm, Uum Ochi, Umu Onyeche, Umu Ororonjo and Umu oyima) in Owerri Municipal. A sample of 400 questionnaires was administered in each of the five communities and 10 households were randomly selected for the collection of 40 water samples for analysis.

The laboratory procedures for water samples collection, the collection was obtained from different boreholes. To ensure the sterility of the samples, the borehole taps were sterilized by means of lighters, after which the taps were opened to flow for 1 to 2 min. Then the plastic bottle were filled with water up to 200ml leaving some space to allow shaking before analysis, the collected samples were delivered to the laboratory.

In the laboratory, the culture media used include Nutrient agar, Chocolate agar, and MacConkey agar. They were all prepared according to the manufacturer's specification and sterilized in an autoclave at 121°C at 15 psi for 15 minutes. Nutrient agar was used to determine the total viable plate count, Chocolate and MacConkey agar was used to enumerate coliforms.

The pure culture of each isolate was obtained by aseptically picking distinct colony and culturing them on newly prepared MacConkey agar which was subsequently incubated at 370^{c}C for 24hours. The pure cultures of the bacterial isolates obtained were subjected to morphological identification using Gram-staining procedure; microscopy of the isolates was under x100 objective of the light microscope. Analysis of data was done using the Statistical Package for Social Science (SPSS) version 20.0. Chi-square test statistics was used to determine the influence variables at the significant level of 0.05.

RESULTS

The results of the data collected were gathered and interpreted as shown in tables below (Tables 1,2,3,4 and 5) and figures (1 and 2). Table 1 presented the socio-demographic characteristics of the respondents assessed on excreta and wastewater management in Owerri North and Owerri Municipal in Imo State where each LGA contributed 200 respondents each, 125(62.5%) were males from Owerri North (ON) and 113(56.5%) were males from Owerri Municipal (OM). For females, 75(37.5%) were from ON while 87(43.5%) were from OM.

For age of the respondents, less than 30 years came from Owerri North and Municipal with 95(47.5%) and 83(41.5%) respectively. Ages between 31-40 years had 75(37.5%) in ON; 71(35.5%) in OM, between within 41-50 years and 51 -60 years had no difference of 12(6%) in ON but not the same in OM as 19(9.5%) and 14(7%) respectively. The highest educational attainment was secondary as 110(55%) in Owerri North (ON) and 106(53%). Owerri Municipal (OM). Also, in ON, 90(45.5%) were traders and 62(31%) in OM. Civil services were higher than any occupation in OM with 78(39%). Size of the household of the respondent as a determining factor of waste generation and management, in ON 129(64.5%) said they were 4-6 persons in household compared to 122(61.5%) in OM. The least was found among those that stay 10 persons and above in a household with 8(4%) in ON and 5(2.5%) in OM respectively. Monthly income of the respondent, Owerri Municipal has the highest earned monthly income between ₦31,000 - ₦ 60,000 with 84(42%) compared to Owerri North with 65(32.5%). Those that earned ₦100,000and above were 21(11.5%) in OM and 17(8.5%) in ON.

Table 1: Socio-Demographic data on excreta and water management

Variables	Owerri North	Owerri Municipal	Total
Gender of the respondent			
Male	125(62.5%)	113(56.5%)	238(59.5%)
Female	75(37.5%)	87(43.5%)	162(40.5%)
Total	200(100%)	200(100%)	400(100%)
Age of the respondent			
< 30 years	95(47.5%)	83(41.5%)	178(44.5%)
31- 40 years	75(37.5%)	71(35.5%)	146(36.5%)
41-50 years	12(6%)	19(9.5%)	31(7.8%)
51 -60 years	12(6%)	14(7%)	26(6.5%)
61 -70 years	9(4.5%)	10(5%)	19(4.8%)
Total	200(100%)	200(100%)	400(100%)
Educational level of the respondent			
No formal education	15(7.5%)	3(1.5%)	18(4.5%)
Primary education	30(15%)	4(2%)	34(8.5%)
Secondary education	110(55%)	106(53%)	216(54%)
Tertiary education	45(22.5%)	87(43.5%)	129(32.3%)
Total	200(100%)	200(100%)	400(100%)
Occupation of the respondent			
Civil service	20(10%)	78(39%)	98(24.5%)
Farming	13(6.5%)	20(10%)	23(5.8%)
Trading	90(45.5%)	62(31%)	152(38%)
Artisan	22(11%)	8(4%)	30(7.5%)
Others	55(22.5%)	32(16%)	87(21.8%)
Total	200(100%)	200(100%)	400(100%)
Size of the household of the respondent			
1- 3 persons	38(19.5%)	45(22.5%)	83(20.8%)
4-6 persons	129(64.5%)	122(61.5%)	251(62.8%)
7-9 persons	25(12.5%)	28(14%)	53(13.3%)
10 person and above	8(4%)	5(2.5%)	13(3.2%)
Total	200(100%)	200(100%)	400(100%)
Monthly income of the respondent			
< ₦10,000	31(15.5%)	12(6%)	43(10.8%)
₦21,000 - ₦30,000	58(29%)	62(31%)	120(30%)
₦31,000 - ₦ 60,000	65(32.5%	84(42%)	149(37.3%)
₦61,000- ₦100,000	25(12.5%)	25(12.5%)	50(12.5%)
₦100,000and above	17(8.5%)	21(11.5%)	38(9.5%)
Total	200(100%)	200(100%)	400(100%)

Field work of 2019 at Owerri North and Owerri Municipal

Table 2 showed the awareness of respondents on source of water supply and its health effects due to poor sanitation. From the results, 80(40%) reported that source of water was far from their house in Owerri North compared to 144(72%) in Owerri municipal. Storing water for future use, 145(72.2%) agreed in Owerri North compared to 180(90%) in Owerri municipal. Treatment of water before use was higher in Owerri North (45%) than Owerri municipal (10%). Also, 65% reported that water was connected to their household in Owerri municipal while 45% was reported in Owerri North. Washing hand after defecation, 180(90%) agreed in Owerri North while 170(85%) supported the idea in Owerri municipal. Use soap while washing hands; 152(76%) and 170(85%) said yes in both LGAs.

Aware of any health effects due to poor sanitation; 160(80%) said yes in Owerri North and 145(72.5%) reported the same in Owerri Municpal. Suffered any sanitation related diseases; 83.5% agreed in Owerri municipal and 57.5% reported the same in Owerri North.

Table 2: Awareness of respondents on source of water supply and its health effects due to poor sanitation

Variables	Owerri North		Owerri Municipal	
	Yes	No	Yes	No
Source of water far from the house	80(40%)	120(60%)	144(72%)	56(28%)
Store water	145(72.2%)	55(27.5%)	180(90%)	20(10%)
Treat water before use	90(45%)	110(55%)	75(37.5%)	125(62.5%)
Water connected to household	95(45%)	105(52.5%)	130(65%)	70(35%)
Wash hand after defecation	180(90%)	20(10%)	170(85%)	30(15%)
Use soap while washing hands	152(76%)	48(24%)	170(85%)	30(15%)
Aware of any health effects of poor sanitation	160(80%)	40(20%)	145(72.5%)	55(27.5%)
Suffered any sanitation related diseases	115(57.5%)	85(42.5%)	167(83.5%)	33(16.5%)

Fieldwork of 2019 at Owerri North and Owerri Municipal

Management of excreta and wastewater in Owerri North and Municipal as was table 3 depicted; different method of discharging excreta from family household 133(66.5%) from Owerri North said they do call sewage disposal tanker while 184(92%) from Owerri Municipal reported the same. Out of half of 400 respondents in each LGA, 5% reported they practice opening the soak away to drain out in Owerri Municipal while 4% was in Owerri North. Abandoning the filled pit to open another one was common in Owerri North 50(25%) than Owerri Municipal 1(0.5%). Drying the excreta for agricultural purposes, 5(2.5%) in Owerri North support the idea and 3(1.5%) was from Owerri Municipal. Using the excreta for biogas technology, only 2(1%) understand that in Owerri North while 1(0.5%) did so in Owerri Municipal.

Figure 1 showed the treatment method of water in Owerri North, 42.5% of reported using boiling water, 18% said chlorination and filter with cloth, 8.5% for bleaching, adding alum and sedimentation had 9% while those who use different other methods were 5%.
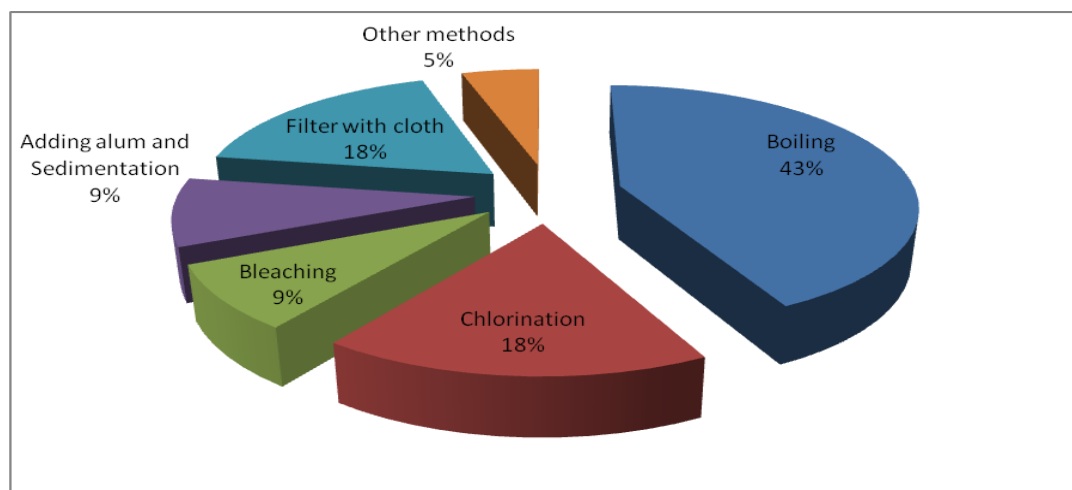

Figure 1: Treatment methods of drinking water employed in Owerri North.

Figure 2 showed the treatment method of water in Owerri Municipal, 54% of reported using boiling water, 19% said chlorination, 1% for bleaching, adding alum and sedimentation had 7.5%, filter with cloth has 6%, while those who use different other methods were 12.5%.
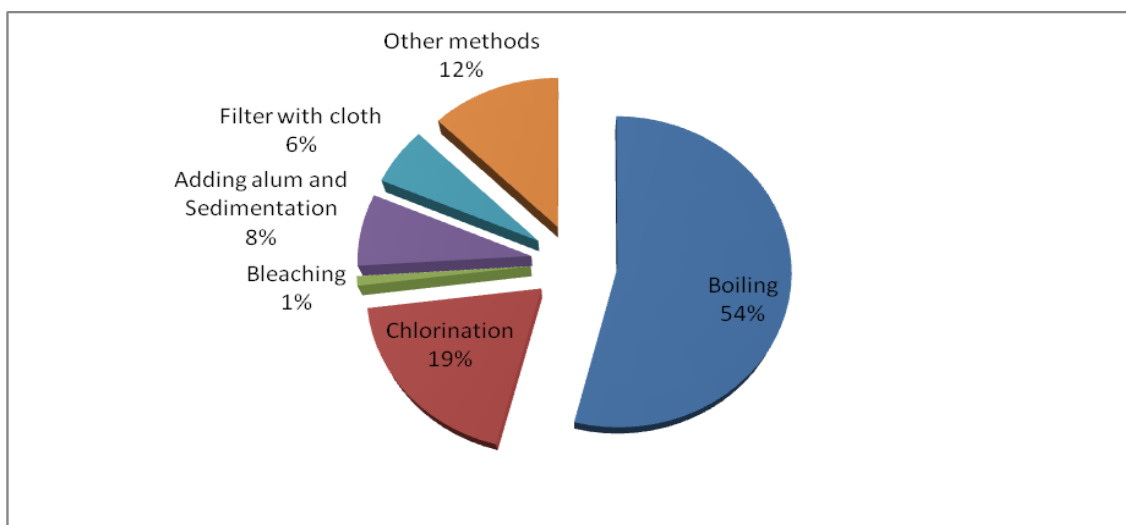

Figure 2: Treatment methods of drinking water employed in Owerri Municipal.

Table 3: Management of excreta and wastewater in Owerri North and Municipal

Variables	Owerri North	Owerri Municipal
Method of discharging excreta from family household		
Call sewage disposal tanker	133(66.5%)	184(92%)
Opening the soak away to drain out	8(4%)	10(5%)
Abandoning the filled pit to open another one	50(25%)	1(0.5%)
Drying the excreta for agricultural purposes	5(2.5%)	3(1.5%)
Using the excreta for biogas technology	2(1%)	1(0.5%)
Other methods	2(1%)	1(0.5%)
Total	200	200

Table 4 showed that 120(60%) of malaria is the most common type of sanitation related diseases from wastewater and excreta management in Owerri North and 110(55%) in Owerri Municipal. In Owerri North, 20(10%) said they have suffered diarrhoea 9(4.5%) from Owerri Municipal. In Owerri North, 5(2.5%) suffered cholera and 10(5%) suffered it from Owerri Municipal. Typhoid fever had 40(20%) in Owerri North and 52(26.5%) from Owerri Municipal.

Table 4: Sanitation related diseases from wastewater and excreta management

Study Area	Malaria		Diarrhoea		Cholera		Typhoid		Total
	Yes	No	Yes	No	Yes	No	Yes	No	
Owerri North	120(60%)	4(2%)	20(10%)	2(1%)	5(2.5%)	4(2%)	40(20%)	5(2%)	200
Owerri Municipal	110(55%)	0(0%)	9(4.5%)	1(0.5%)	10(5%)	15(7.5%)	52(27%)	3(1%)	200
Total	230	4	29	3	15	19	92	8	400

The laboratory result of water from different villages in Owerri North and Owerri Municipal showed the presence of bacteria. The highest distance of the boreholes to soakaway in a household was 10.7m in the study areas. The laboratory analysis of coliform count depicted the presence of bacteria such as staphylococcus and salmonella from different boreholes at different distance to soakaway pit from living houses. The average mean dilution of the sample was higher (4×10^{-8}) in borehole number 4 with identification of Salmonella and lowest average mean of 2×10^{-8} in borehole number 6 with identification of staphylococcus as seen in table 5.

Table 5: Bacteriological analysis of water

Water source	Distance of borehole to soakaway	Dilution Samples			Identified bacteria	Total coliform count			Mean
		1st	2nd	3rd		1st	2nd	3rd	
Borehole number 1	10.7m	01	02	03	Salmonella	1.2×10^1	5×10^{-6}	3.0×10^{-10}	4×10^{-7}
Borehole number 2	10.6m	01	02	03	Staphylococcus, Salmonella	6.5×10^{-1}	3.5×10^{-6}	2.0×10^{-10}	2.2×10^{-8}
Borehole number 3	7.7m	01	02	03	Salmonella	8.5×10^{-1}	3.3×10^{-6}	2.0×10^{-10}	2.8×10^{-8}
Borehole number 4	10.4m	01	02	03	staphylococcus	1.3×10^{-1}	4.3×10^{-6}	3.2×10^{-10}	4×10^{-8}
Borehole number 5	5.3m	01	02	03	Salmonella	9.5×10^{-1}	4.0×10^{-6}	2.5×10^{-10}	3.0×10^{-5}
Borehole number 6	10.5m	01	02	03	staphylococcus	6.0×10^{-1}	3.5×10^{-6}	2.7×10^{-10}	2×10^{-8}
Borehole number 7	10.4m	01	02	03	staphylococcus	1.0×10^{-1}	5.5×10^{-6}	3.5×10^{-10}	3.3×10^{-8}

DISCUSSION

This study discusses the assessment of water and excreta sanitation status in Owerri North and Owerri Municipal in Imo state. From the findings, the most common type of sanitation related diseases were malaria, diarrhea, cholera and typhoid fever which was not far from the identification of bacteria such as staphylococcus and salmonella from different boreholes at different distance to soakaway pit from living houses except malaria parasite.

Taking water as an essential for human existence and its importance for individual health, could lead to unintentional consumption of water contaminated by disease causing agent (pathogens) which can cause health problems such as diarrhoea, cholera, typhoid, dysentery. On this note, John-Dewole, [12] opined that inadequate amount of water for basic hygiene can contribute to poor hygiene practices and diseases occurrence.

The presence of coliform organisms identified in the study such as *Streptococcus spp, Staphylococcus spp,* and *Salmonella*, from the borehole water samples are unacceptable from the public health point of view. These bacteria have been implicated in water related diseases which have been reported to cause death rate among children especially in the under developed countries. [13]

The measurement of distance of the borehole to the soak away as the highest was 10.7m which was not up to WHO recommended standard of 15m distance from the borehole to the soak away.

This finding was not surprising considering the high population settlement of people and close proximity of the boreholes to the soak away. Shittu et al, [14] reported that generally underground water is often considered as the purest form of water, although it's vulnerability to contamination because of improper construction, animal waste, proximity to toilet facilities, sewage, refuse dumpsite and various human activities surrounding it. [15]

Onemano and Otun, [16] reported that long term usage of boreholes may lead to deterioration of the water quality because the pipeline may become corroded with random cracks and in most cases clogged with sediment. Following the findings of Ibe and Okplenye [17] on bacteriological analysis of borehole water in Uli Nigeria, which was similar to the findings of this study showed that the water from all boreholes did not meet the World Health Organization standards for drinking water and borehole

water should be treated or boiled and filtered before drinking.

Inadequate sanitation and unhygienic practices account for the major source of microbial contamination of any potable water. [12] Adequate treatment of borehole water before drinking will help to prevent health problems associated with pathogenic bacteria. From the study 43% of respondents in Owerri North boil their water before drinking while in Owerri Municpal 54% boil their water, this could be as a result of awareness level, educational programmes on the essence of treating water. Diarrhoea is the most important public health problems directly related to water and sanitation which kills an estimated 1.8 million people each year. [13]

However, assessment of respondents on source of water supply and its health effects due to poor sanitation, the findings showed that majority were males compared to females and age scenarios among respondents in this study, showed more within the age brackets of less than 30 years and followed by prime economic and active reproductive age bracket of 31-40year and matured socio-economic age group of 41-50 were the predominant age group engaged in the assessment in the State. Then, the analysis on sanitation related diseases shows that malaria is the most common type of sanitation related diseases with 62% reported cases in Owerri North and 55% in Owerri Municpal. At present 109 countries in the world are considered endemic for malaria and 45 other countries within the WHO African region. [13] Environmental sanitation constitutes the most effective and sustainable measures for controlling malaria, diarrhea, cholera and typhoid fever.

CONCLUSION/RECOMMENDATION

This study recorded high number of coliform count as well as coliform bacteria in water samples analysed, thus making it unsafe for drinking and require further treatment. Water is health and health is water, humans rely on water for everything and thus water is one of the essential

resources for human survival, consumption of contaminated water brings about ill health. From the analysis carried out it was observed that most individual in Owerri North/Municipal were not properly educated on the essence of treating their drinking water before use. Therefore there is urgent need for awareness to be extended to people in semi-urban about the present situation of some of the boreholes to enlighten the people on the necessity for further treatment.

ACKNOWLEDGMENTS

Conflict of interest

All authors of this article report no conflicts of interest throughout the work.

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