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Biologic quality of households' drinking-water in an urban local government area of Oyo State, Southwest, Nigeria.

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Abstract

Background: Inadequate access to Water, Sanitation, and Hygiene (WASH) facilities is a global public health issue with several associated illnesses, particularly in developing countries like Nigeria. It is imperative to understand the availabilities of these facilities, to provide baseline data for policy design and implementation. This study assessed access to WASH facilities. It also examined the factors associated with drinking-water contamination by coliform organisms in households within Ogbomoso North Local Government Area, Oyo-State, Nigeria.

Methods: Cross-sectional design was employed and a two-stage cluster-sampling method was used to recruit eligible respondents from 100 households. Interviewer-administer, semi-structured questionnaire was used to collect data. Chi-square test and binary logistic regression were used for inferential statistics.

Results: Mean age of respondents was 40.5±16.7years, 81.0% of the households practiced open defecation, and 78.9% of those with toilet facilities used pit latrines. The most common water source was borehole (71.6%); available within 5 minutes walking distance to residence of 68.0% of study participants. Sixty-three percent of the households had high drinking water coliform counts. High drinking-water coliform counts were influenced by the presence or absence of toilets facilities (OR=4.61, CI=1.22-1.68), types of toilets (OR=2.63, CI=3.22-5.34), and water sources (OR=0.12, CI=0.47-0.68).

Conclusion: Access to good quality water and basic sanitation facilities is sub-optimal in the study setting despite being an urban community. Authors advocate for more vibrant and intentional government efforts at ensuring equitable access to WASH facilities in the Nigerian communities. This is to fast-track the nation's journey towards the actualization of the sustainable development goal (SDG)-6.

Keywords: Coliform organism, water quality, Households, Hygiene, Nigeria.

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Qualité biologique de l'eau potable des ménages dans une zone de gouvernement local urbain de l'État d'Oyo, au sud-ouest du Nigéria.

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Résumé

Contexte général de l'étude : L'accès insuffisant aux installations d'eau, d'assainissement et d'hygiène (EAH) est un problème mondial de santé publique avec plusieurs maladies associées, en particulier dans les pays en développement comme le Nigéria. Il est impératif de comprendre les disponibilités de ces installations, afin de fournir des données de référence pour la conception et la mise en œuvre des politiques. Cette étude a évalué l'accès aux installations EAH. Il a également examiné les facteurs associés à la contamination de l'eau potable par des organismes coliformes dans les ménages de la zone de gouvernement local d'Ogbomoso North, dans l'État d'Oyo, au Nigéria.

Méthode de l'étude : Une conception transversale a été utilisée et une méthode d'échantillonnage en grappes à deux degrés a été utilisée pour recruter des répondants éligibles dans 100 ménages. L'intervieweur-administré, un questionnaire semi-structuré a été utilisé pour recueillir les données. Le test du chi carré et la régression logistique binaire ont été utilisés pour les statistiques inférentielles.

Résultat de l'étude : L'âge moyen des répondants était de 40,5 ± 16,7 ans, 81,0 % des ménages pratiquaient la défécation à l'air libre et78, 9 % de ceux qui disposaient de toilettes utilisaient des latrines à fosse. La source d'eau la plus courante était le forage (71,6 %) ; disponible à moins de 5 minutes à pied de la résidence de 68,0 % des participants à l'étude. Soixante-trois pour cent des ménages avaient un nombre élevé de coliformes dans l'eau potable. Le nombre élevé de coliformes dans l'eau potable était influencé par la présence ou l'absence de toilettes (OR = 4,61, IC = 1,22-1,68), les types de toilettes (OR = 2,63, IC = 3,22-5,34) et les sources d'eau (OR = 0,12, IC=0,47-0,68).

Conclusion : L'accès à une eau de bonne qualité et à des installations sanitaires de base est sous-optimal dans le cadre de l'étude, bien qu'il s'agisse d'une communauté urbaine. Les auteurs plaident pour des efforts gouvernementaux plus dynamiques et intentionnels pour assurer un accès équitable aux installations WASH dans les communautés nigérianes. Il s'agit d'accélérer le parcours de la nation vers l'actualisation de l'objectif de développement durable (ODD)-6.

Mots-clés : Organisme coliforme, qualité de l'eau, ménages, hygiène, Nigéria

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INTRODUCTION

Inadequate access to good quality water and sanitation facilities is a global public health issue. According to the World Health Organization (WHO), about 740 million people worldwide do not have access to improved water sources while nothing less than 173 million people still obtain their domestic water from untreated surface waters (1).

Meanwhile, access to potable water and basic sanitation is now a fundamental human right issue. As such, Nigeria was a signatory to the 2010 United Nations General Assembly Declaration of the Right to water (2,3). This pact was supposed to enable all Nigerians to have access to potable water for personal and domestic uses. According to WHO, only about **19%** of the people in Nigeria have access to safe and clean drinking water, even though 70% of the Nigerian population have access to basic water supply (4).

There are several implications of lack of access to good quality water in any community. It has been estimated that 88% of diarrhoea related deaths globally is as a result of unsafe drinking water supply, inadequate sanitation and hygiene (5). Also, improved water supply has been demonstrated to have the potential of reducing diarrhoea incidence by 6-25% (3). Diarrhoea accounted for 8 percent of all deaths among under-five children worldwide in 2016 (6,7). This shows that about 1,300 young children die daily and about 480,000 of them die annually of diarrhoea disease (7). Yearly, Nigeria suffers from the immense socio-economic impacts of outbreaks of diseases such as cholera and typhoid fever which are both water-related diseases. According to United Nations Children's Funds (UNICEF), not less than 70,000 under-five children are lost to diarrhoea disease annually (8). The 2018 National Demographic and Health Survey (NDHS) report for Nigeria reported that 13% of under-five children had diarrhoea episodes within two weeks preceding the survey. Majority of these needless childhood deaths were associated with poor quality of water in most communities (9). Thus, the United Nations' sustainable development goal (SDG) 6 calls for universal access to safe and affordable drinking water, sanitation, and hygiene (WASH), also to end open defecation.

Water quality assessment surveys often involve evaluating its physical, chemical, and biological characteristics. However, our study assessed the biological characteristics of household drinking water by estimating coliform counts in the water. The WHO has stated that getting water from improved sources does not entirely guarantee that the water cannot be contaminated at one point or another. Thus, assessing the quality of drinking water is an important step in preventing many infections and other diseases in the human population.

The presence and concentration of Coliforms organisms in domestic waters have been used as a very good indicator of faecal water-contamination (10). The coliform group of organisms is composed of strains of the four genera of the intestinal group: *Escherichia, Enterobacter, Klebsiella,* and *Citrobacter* of which *Escherichia* and *Enterobacter* cells are the most predominant in human intestine (10).

Coliform count is the test of water contamination in which the number of colonies of coliform bacteria (*E. coli*) per 100ml of water are counted (11). Ideally, drinking water should not contain any coliform organism/100ml of water tested (12). However, coliform count of 1-2 coliform/100ml of water may be acceptable in developing countries; 3-10 coliform/100ml is doubtful while $\geq$ 11coliform/100ml indicates heavy faecal pollution of the water (12). Out of all the coliform organisms, the presence of *E. coli* in drinking water has been used as the most reliable yardstick of measuring the occurrence of recent faecal contamination of drinking water and a breakdown of the water treatment process since the organism is almost exclusively of faecal origin (13). The presence of E Coli also indicates the possible presence of many other faeco-orally transmitted diseases in the water.

Most previous studies had focused on determining water-qualities from water sources such as rivers and streams, the current study aimed at assessing water quality at the point-of-use (households). The study aimed at providing base-line information on quality and adequacy of drinking-water in Ogbomoso town. This information can help governments and policy makers in the field of Environmental Health to intensify efforts at combatting several water-related diseases by providing potable drinking-water to every household in Nigeria.

MATERIALS AND METHODS

The study was conducted in selected communities within Ogbomoso North Local Government Area (LGA). The LGA has a projected population of 284,200 as at 2022 by the National Bureau of Statistics (NBS) (14). The predominant religions of the inhabitants of the LGA are Christianity, Islam, and Traditional religions. The main occupation of people in the

LGA include farming and trading but civil servants constitute a large percentage of the people. While some households in the LGA are irregularly supplied with pipe-borne water from the Oyo State water corporation, most people access to water through other means such as well water, bore-holes, rainwater, and surface water from streams and springs.

This was a descriptive cross-sectional study among heads of household or their partners who were at least 18 years of age and had consistently resided in the selected communities for a minimum of three months. Leslie Kish formula ($n = Z_{\alpha}^{2} (pq)/d^2$) was used to estimate the minimum sample size for the study. Where; n = minimum sample size required in population greater than 10,000, Z_{α} = standard normal deviate of 1.96 at 95% Confidence Level, d = desired level of precision (Margin of error) = 5%, p = proportion of water sample with *E-coli* from previous study = 95% (15) and q=1-p. A minimum sample size of 100 was estimated for the study after adjusting for non-response.

The study employed cluster sampling method in recruiting study participants. Line listing of all the 10 electoral wards within Ogbomoso North LGA was first made; each of the wards constituted a cluster, thus a sampling frame of 10 wards was drawn. Two wards (Isale Alasa and Isale Ora wards) were selected using simple random sampling method (balloting) from the sampling frame made. All the households in the two chosen electoral wards with eligible respondents were visited for the survey. In houses with more than one eligible respondent, one of such respondents was chosen using simple random sampling method (balloting).

The study made use of a semi-structured, interviewer-administered questionnaire developed by reviewing previous studies on our topic. The questionnaire collected information on the Socio-demographic characteristics of the respondents, their most common sources of drinking water, and household's sanitation facilities. The questionnaire was interpreted into Yoruba language for respondents who were more comfortable answering in their local language and back translation into English Language was done to preserve the original meaning of the questions asked. Data were collected over a period of one month (November 2022) by ten nursing students of Bowen University Teaching Hospital (BUTH), Ogbomoso. They were trained on questionnaire administration and household water collection procedures by public health experts in the Department of Community Medicine, BUTH, over a period of three days. The training involved practical sessions and demonstrations. The questionnaire was pretested at low-cost estate area of Ogbomoso South LGA which was not part of those selected for the main study. The exercise helped us to identify some ambiguous questions. Such questions were either re-phrased or removed completely in line with our study objectives.

Laboratory procedures for drinking water coliform count: The Multiple Fermentation Tube Technique

The multiple fermentation tube technique (16) was used in the analysis of the water sample collected from each household included in this study to determine the Most Probable Number (MPN) Index of coliform bacteria present per 100ml of the sample.

About 75mls of drinking water was collected from individual homes into sterile bottles and separate analysis was conducted on 15 portions for each of the test samples: 5 portions of 10mls, 5 portions of 1mls, and 5 portions of 0.1mls each. Each portion was added into 10mls each of single-strength MacConkey broth in test tubes with inverted Durham tubes.

The sample-medium solution was mixed gently and incubated for 48 hours at 37°C aerobic condition for total coliforms. The test tubes which showed turbidity, gas production, and colour change indicating acid production was regarded as positive. The MPN index and 95% percent confidence limits for various combinations of positive results provided for testing drinking were used to interpret the result (13). Results were expressed as Most Probable Number (MPN) index of coliforms per 100 ml of drinking water. The same process was followed for all the samples and asepsis was maintained at all steps.

The main outcome variable was high coliform count. This was defined as presence of at least 11 coliform organism/100mls of household water (16).

Each questionnaire was field edited daily before entering the data into Statistical Product and Service Solutions (SPSS, Version 23) for analysis. Data presentation was carried out using Tables and Charts, mean and standard deviation were used as summary statistics for continuous variables while Chi-square test was used to compare categorical variables. A Stepwise binary regression model was built at the multivariate level. Variables imputed into the model were chosen based on whether they were statistically

significant at the bivariate level. Confidence Intervals and p-values were obtained to identify significant predictors of at least 11 coliform organisms per 100ml of water.

Approval to conduct the study was obtained from the Ethical Review Committee of BUTH, Ogbomoso. Moreover, permission to conduct the study was obtained from leaders of the communities chosen for the study. Respondents were assured of the confidentiality of the information obtained from them during the study; this was done by ensuring that their names were not collected during the interview. Also, information collected from respondents was entered into a computer that was only accessible to the researchers. Study participation was entirely voluntary, written consents were obtained from each participant before they were allowed to take part in the study. There was no discrimination in the selection of respondents.

RESULTS

The mean age of our respondents was 40.5±16.9years while more than half (52.0%) of them were 20-39 years of age. Eighty percent of the respondents were females, 86.0% of them were married and 64.0% were Christians by religion. Respondents with primary education constituted the highest proportion (36.0%) while 41.0% of them were traders (Table 1).

More than three-quarter (78.0%) of the households visited had at least four inhabitants, 81.0% of the households had no toilet facilities while 78.9% of those with toilet facilities used pit latrines. The most consistent water source in the study population was borehole; reported by 71.6% of the households visited, only 1.7% of them had access to piped borne water (Figure 1). Sixty-one percent of the households did not have a satisfactory safe water supply all year round; 68.0% of the households had potable water available within 5 minutes walking distance to their residential homes but 18.0% of them walk for about 30 minutes to access good quality water. Almost all (96.0%) of the respondent do not employ any domestic water treatment method before drinking. Only 37.0% of the households had 0-2 coliform counts per 100ml of water; 31.0% had 10-100 coliform organisms per 100ml of water while 17.0% of them had more than 100 coliform counts per 100ml of water (Table 2).

In Table 3, households without toilet facilities had 5 times increased odds of having water coliform counts of at least 11/100ml of water when compared to those with toilets (OR=4.61, CI=1.22-1.68). Households using pit latrines to dispose of faecal matters were 3 times more likely to have coliform counts of 11 or more per 100ml of water than those with improved sanitation facilities (OR=2.63, CI=3.22-5.34). Similarly, households with boreholes as their most stable water sources were 12 times less likely to have high coliform counts of at least 11/100ml of water when compared with those with other water sources (OR=0.12, CI=0.47-0.68)

DISCUSSION

Our study assessed the adequacy of WASH facilities and examined the biological characteristics of households' drinking water by analysing water coliform counts in the selected clusters within Ogbomoso town.

The study revealed that 81.0% of the households visited had no toilet facilities (were practising open defecation) while 78.9% of those with toilet facilities utilized pit latrines in disposing faecal matters. Several studies had revealed poor levels of sanitary facilities in Nigeria. The main report of the 2016/2017 Multiple Indicator Cluster Survey revealed that only 35.9% of Nigerian households used improved sanitation while just 58.1% of women used safe disposal systems for child's faeces (17). Also, in 2018, Alphonsus *et al.*, showed that 71.7% of households in Edo State Nigeria used pit latrines while 28.3% had no form of toilets (18). Similarly, a study in Bayelsa State published in early 2019 by Raimi *et al.*, revealed that 33.8% of the survey participants used open defecation (19). Yet, empirical pieces of evidence have linked poor household's sanitation systems to the occurrence of different water-borne diseases due to increased risks of water contamination from such faecal disposal systems (20).

The most consistent water source in our study population was borehole; this was reported by 71.6% of the households visited (mainly through the purchase of water from nearby borehole owners but not by individual ownerships). Only 1.7% of our study participants had access to piped-borne water (this is in spite of the availability of municipal water treatment plants in the community). Meanwhile, 68.0% of the households stated that they had potable water available within 5-kilometer walking distance to their residential homes but 18.0% of them had to walk for about 30 minutes to access good quality water, this contradicts the specification according to the World Health Organization (WHO) that the water source has to be within 1,000 metres (1km) of the home and collection time should not

exceed 30 minutes (21).

Almost all (96.0) of the respondent do not employ any domestic water treatment method before drinking. Our findings are in agreement with findings from the 2016-2017 Nigerian MICS in which 64.1% of households had access to improved water sources and only 2.3% of them practiced domestic water treatment before drinking (17). Worst still, UNICEF revealed that only 26.5% of Nigerian households have access to improved water sources and sanitation facilities (8). Thus, the authors advocate for improved government efforts at providing good quality water to Nigerians.

Strong associations existed between households' water and sanitation status and the presence of faecal coliform organisms in the drinking water of participants in the current study. Households without toilet facilities had 5 times increased odds of having high water coliform counts when compared to those with toilet facilities. Households using pit latrines to dispose of faecal matters were 3 times more likely to have high drinking-water coliform counts than those with improved toilet facilities. However, households with borehole as their most stable water sources were 12 times less likely to have high drinking-water coliform counts when compared with those with other water sources. These findings are in consonance with reports from similar studies (22,23). Thus, the environmental unit of Ogbomoso North LGA should be more alert in discharging their responsibilities. Abatement notices should be issued to houses without basic sanitation facilities as enshrined in the Nigerian Public Health Laws.

Considering the main findings of the current study, achieving SDG 3 by 2030 remains an uphill task in Nigeria as poor access to improved WASH facilities continues to pose a serious threat to the health of Nigerians. To solve this critical problem, the authors advocate that the Nigerian Government needs to increase budgetary allocation to the provision of WASH facilities/services. There is an urgent need to enforce the existing law against open defecation in Nigeria as most of our respondents engaged in such practice. Also, there is dire need for the construction of public toilets in most communities of Nigeria since many households in rural /peri-urban communities lack this sanitary facility. The existing monthly sanitation exercise needs urgent review for service improvement. Oyo State government needs as a matter of urgency to revamp and expand the capacity of the Oyo State water corporation to provide good quality and sustained water supply to the populace.

Study Limitation: Due to the paucity of funds, this study was conducted among residents of two electoral wards in Ogbomoso North LGA. It may be difficult to generalise the findings from this survey on the entire Nigerian communities. However, the external validity of the study may have been improved due to the robust sampling technique used by the authors.

CONCLUSION

Water supply and sanitation facilities were sub-optimal in the study population. Many houses had evidences of high drinking-water coliform contamination. There is a need for review and/or design as well as implementation of cost-effective and equitablSe WASH policies in Nigeria in order to achieve the 2030 target of SDG 6.

Conflict of interest: The authors declare that there is no conflict of interest in conducting this research.

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REFERENCES

1. Lyimo B, Buza J, Subbiah M, Smith W, Call DR. Comparison of antibiotic resistant Escherichia coli obtained from drinking water sources in northern Tanzania? a cross-sectional study. BMC Microbiol. 2016;16:1–10.
2. Shaheed A, Orgill J, Montgomery MA, Jeuland MA, Brown J. Why “improved” water resources are not always safe. Bull World Health Organ. 2014;92(4):283–9.
3. World Health Organization. UN-Water Global Analysis and Assessment of Sanitation and Drinking water [Internet]. 2015 [cited 2023 Jan 15]. p. 980–8. Available from: https://cdn.who.int/media/docs/default-source/wash-documents/glaas/glaas-2013-14/glaas-2013-14-country-highlights/nigeria.pdf?sfvrsn=dabd6ba2_8
4. World Health Organization. Nigeria Water Statistics 2023 , fact sheet [Internet]. 2023 [cited

2023 May 26]. Available from: https://www.fitnigerian.com/nigeria-water-statistics/
5. Mebrahtom S, Worku A, Gage DJ. The risk of water, sanitation and hygiene on diarrhea-related infant mortality in eastern Ethiopia: a population-based nested case-control. BMC Public Health. 2022;22(1):343.
6. Saha J, Mondal S, Chouhan P, Hussain M, Yang J, Bibi A. Occurrence of Diarrheal Disease among Under-Five Children and Associated Sociodemographic and Household Environmental Factors: An Investigation Based on National Family Health Survey-4 in Rural India. Children. 2022;9(5):658.
7. UNICEF. Diarrhoea Disease [Internet]. 2022 [cited 2023 Jan 16]. Available from: https://data.unicef.org/topic/child-health/diarrhoeal-disease/#:~:text=Diarrhoea is a leading killer,of a simple treatment solution.
8. United Nations Children's Funds. Water, Sanitation and Hygiene. [Internet]. 2018 [cited 2023 Jan 16]. Available from: https://www.unicef.org/nigeria/water-sanitation-and-hygiene
9. National Population Commission (NPC) [Nigeria] and ICF. 2019. Nigeria Demographic and Health Survey 2018. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF.
10. Li E, Saleem F, Edge TA, Schellhorn HE. Biological indicators for fecal pollution detection and source tracking: A review. Processes. 2021;9(11):1–27.
11. Oyedeji O. Microbiological quality of packaged drinking water brands marketed in Ibadan metropolis and Ile-Ife city in South Western Nigeria Physicochemical and Microbiological Assessment of Selected Hand-Dug Wells for Water Quality in Ilesa Metropolis,Southwest Nig. Artic African J Microbiol Res. 2010;4(1):096–102.
12. Nguendo-Yongsi HB. Microbiological Evaluation of Drinking Water in a Sub-Saharan Urban Community (Yaounde). Am J Biochem Mol Biol. 2011;1(1):68–81.
13. Bhowmik A, Ahsan S. Isolation and Enumeration of Escherichia coli from Soil and Water. Bangladesh J Microbiol. 2019;36(2):75–7.
14. National Population Commission of Nigeria. National Bureau of Statistics [Internet]. 2022 [cited 2023 Jan 16]. Available from: https://citypopulation.de/en/nigeria/admin/oyo/NGA031021__ogbomosho_north/
15. Gwimbi P, George M, Ramphalile M. Bacterial contamination of drinking water sources in rural villages of Mohale Basin , Lesotho? exposures through neighbourhood sanitation and hygiene practices. Environ Health Prev Med. 2019;24:1–7.
16. Adebisi OO, Adetomiwa AA, Gbala ID. Comparative Assessment of Bacteriological Quality of Drinking Water using Membrane Filtration and Multiple Tube Fermentation Methods. J Appl Sci Environ Manag. 2020;24(5):853–6.
17. National Bureau of Statistics (NBS) and United Nations Children's Fund (UNICEF). 2017 Multiple Indicator Cluster Survey 2016-17, Survey Findings Report. Abuja, Nigeria: National Bureau of Statistics and United Nations Children's Fund. [Internet]. 2017 [cited 2023 Feb 2]. p. 109–34. Available from: https://www.unicef.org/nigeria/sites/unicef.org.nigeria/files/2018-09/Nigeria-MICS-2016-17.pdf
18. Aigbiremolen AO, Alphonsus AEA, Nwadike I, Afogbon E, Airefetalor IA, Oaikhena OI. Housing features and household access to sanitation facilities in a rural Nigerian community. Asian Pacific J Heal Sci. 2018;5(1):171–4.
19. Raimi M., Abdulraheem AF, Major I, Odipe OE, Isa HM, Onyeche C. The Sources of Water Supply, Sanitation Facilities and Hygiene Practices in an Island Community: Amassoma, Bayelsa State, Nigeria. Public Heal Open Access. 2019;3(1):1–13.
20. National Population Commission (NPC) [Nigeria] and ICF International. Nigeria Demographic and Health Survey 2013. Abuja, Nigeria, and Rockville, Maryland, USA: NPC and ICF International. 2014.
21. World Health Organization. The Human Right to Water and Sanitation Media brief [Internet]. UN-Water Decade Programme on Advocacy and Communication and Water Supply and Sanitation Collaborative Council. 2011 [cited 2023 May 29]. p. 1–8. Available from: http://www.un.org/waterforlifedecade/pdf/human_right_to_water_and_sanitation_media_brief.pdf
22. Mekonnen GK, Mengistie B, Sahilu G, Mulat W, Kloos H. Determinants of microbiological quality of drinking water in refugee camps and host communities in Gambella region, Ethiopia. J Water Sanit Hyg Dev. 2019;9(4):671–82.
23. Usman MA, Gerber N, Pangaribowo EH. Determinants of Household Drinking Water Quality in Rural Ethiopia. SSRN Electron J. 2017;10(September): 2-3

Table 1: Socio-demographic characteristics of the Respondents (N= 100)

Variable	Frequency	Percent (%)
Age (in years)		
=19	2	2.0
20-39	52	52.0
40-59	22	22.0
=60	24	24.0
Mean age ± SD	**40.51 ± 16.87**	
Gender		
Male	20	20.0
Female	80	80.0
Marital status		
Married	86	86.0
Widowed	13	13.0
Separated	1	1.0
Religion		
Christianity	64	64.0
Islam	33	33.0
Traditional	3	3.0
Level of education		
No formal education	31	31.0
Primary	36	36.0
Secondary	7	7.0
Tertiary	26	26.0
Occupational type		
Civil servant	4	4.0
Self employed	29	29.0
Artisan	19	19.0
Unemployed	5	5.0
Trader	41	41.0
Others	2	2.0

Table 2: Respondents' household characteristics (N= 100)

Variable	Frequency	Percent (%)
Number of persons per household		
2-3	22	22.0
=4	78	78.0
Have a toilet in the house		
Yes	19	19.0
No	81	81.0
Type of toilet	**n=19**	
Pit latrine	15	78.9
VIP latrine	1	5.3
Water closet	3	15.8
Others	0	0.0
Satisfactory water supplies all year round		
Yes	61	61.0
No	39	39.0
Average walking distance to the source of potable water		
I have quality water source in my house	11	11.0
Within 5minutes	68	68.0
Within 30minutes	18	18.0
=30 minutes	3	3.0
Treats water before drinking		
Yes	4	4.0
No	96	96.0
Water storage method		
Nil	2	2.0
Mud-pot	24	24.0
Plastic containers	72	72.0
Fridge/freezer	2	2.0
Water dispenser	0	0.0
Others	0	0.0
Household water coliform count/100ml		
<2	37	37.0
3-9	15	15.0
10-100	31	31.0
>100	17	17.0

Table 3: Determinants of levels of faecal coliform counts in households' drinking water

Variable	Water Coliform count		X^2	*P-value*	Odds Ratio	*95% CI*
	0-10/100ml N=52 n(%)	=11/100ml N=48 n(%)				
Number of persons per household			0.073	0.787	1.14	0.44 – 2.94
2-3	12 (54.5)	10 (45.5)				
=4	40 (51.3)	38 (48.7)				
Have a toilet in the house			0.920	0.002*	4.61	1.22 – 1.68
Yes	15 (79.0)	4 (21.0)				
No	37 (45.7)	44 (54.3)				
Type of toilet			0.608	0.001*	2.63	3.22 – 5.34
Pit latrine	7 (46.7)	8 (53.3)				
Others	3 (75.0)	1 (25.0)				
Satisfactory water supplies all year round			0.087	0.768	0.89	0.39 – 1.98
Yes	31 (50.80	30 (49.2)				
No	21 (53.8)	18 (46.2)				
Average walking distance to the source of potable water			0.670	0.413	0.58	0.16 – 2.14
I have quality water source in my house	7 (63.6)	4 (36.4)				
Within a distance	45 (50.6)	44 (49.4)				
Treats water before drinking			1.217	0.270	0.29	0.03 – 2.93
Yes	1 (25.0)	3 (75.0)				
No	51 (53.1)	45 (46.9)				
Sources of drinking water			0.062	0.000*	0.12	0.47 – 0.68
Borehole	40 (91.0)	4 (9.0)				
Others	11 (19.6)	45 (80.1)				

***Statistically significant**

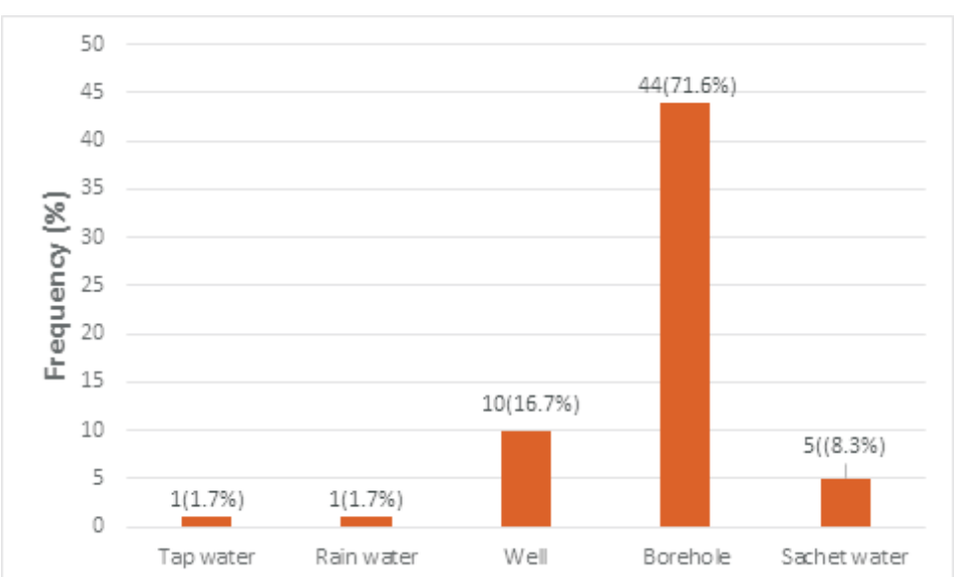

Figure 1: Sources of households' drinking water