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Determinants of Household Access to Drinking Water in Nigeria

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abstract

Equitable access to safe and affordable drinking water has been identified as a fundamental human right. Few studies have also considered household access to drinking water regarding both sources of water and the time taken to get access to water. Thus, this paper computes access to drinking water based on the household's water sources and the time taken to get the water sources. The determinants of household access to drinking water in Nigeria were examined using 2018 Demographic and Health Surveys data. As high as 68.9% of the respondents did not have water sources within their premises, and the majority were from the Northern part of Nigeria. Undeniably, 23.2% of the respondents had poor access to drinking water, and the majority were also from the Northern part of the country. This means regional disparity exists in household access to drinking water in Nigeria. The geopolitical zone, type of place of residence, type of toilet, access to electricity, ethnicity, household population, sex of household head, and wealth index significantly (p=0.01) explained household access to drinking water while religion, age of household head, and highest educational level proved otherwise. We therefore recommend a regional approach to tackle the problem of access to drinking water in Nigeria. There should also be the provision of boreholes, given that it appears to be a more feasible source of drinking water.

Introduction

Over the years, progress has been made in achieving universal, equitable access to drinking water. The WHO and UNICEF (2021) recorded that the percentage of people in the global population that use a safely managed drinking water service increased from 70% in 2015 to 74% in 2020. Despite the progress, the problem of not having physical access to safe drinking water is well-pronounced in developing nations. While physical access is sure in developed countries, it is rather a question of affordability (Martins, Quintal and Antunes, 2019); the problem of physical scarcity of improved water sources is a fundamental issue in developing countries. The inadequacy and/or inequitable distribution of existing water infrastructures has contributed to physical scarcity, among others (Antunes and Martins, 2020). For instance, about 69% of the Nigerian population does not have access to improved water supply within premises, and the average time to fetch water is above 19mins for households whose water points are located outside their premises, whereby there are notable differences based on household income as well as place of residency – urban or rural areas (Federal Ministry of Water Resources, NBS and UNICEF, 2020).

Studies from different developing countries have examined determinants of household access to drinking water sources. These include: Nigeria (Osabuohien, Efobi, and Gitau, 2012; Abubakar, 2019), Ghana (Adams, Boateng, and Amoyaw, 2016; Agbadi, Darkwah, and Kenney, 2019), Nepal (Behera, Rahut, and Sethi, 2020), Cote d'Ivoire (Angoua, Dongo, Templeton, *et al*., 2018), Zambia (Mulenga, Bwalya, and Kaliba-Chishimba, 2017). The determinants of household access to drinking water have been linked to demographic, geographic, political, and socio-economic factors. The majority of these studies have primarily measured household access to drinking water based on types of water sources that have been identified as either improved or unimproved drinking water sources (Abubakar, 2019; Behera *et al*., 2020).

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The availability of drinking water sources does not always translate to proximity to the water source. It has indeed been argued that the amount of time taken to have access to drinking water sources should be considered as it will determine the quantity of water available for the household (Cassivi, Johnston, Waygood, and Dorea, 2018; Cassivi, Tilley, Waygood and Dorea, 2021).

Furthermore, it has been argued that the traditional way of categorizing different types of water sources into a dichotomous variable, "improved" or "unimproved", could be misleading (Manalew and Tennekoon, 2019). Pickering and Davis (2012) provided evidence to say that apart from water sources, water collection time is an important element. They discovered a positive correlation between water collection time and child mortality as well as diarrhoea. This suggests that the measurement of household access to drinking water ought not to be limited to availability, given that access to drinking water is affected by several factors (Smiley, 2017; Antunes and Martins, 2020). Limited studies have examined determinants of household access to drinking water whereby access to drinking water is conceptualized by considering water sources and time spent (distance) to collect the water concurrently (Oskam, Pavlova, Hongoro, and Groot, 2021). The determinants of household access to drinking water within the regional setting are the focus of this present study, given that little is known about this in Nigeria (Osabuohien, Efobi, and Gitau, 2012; Abubakar, 2019).

Study Context

Nigeria is subdivided into six geopolitical zones or regions, with each region having a minimum of five states, as shown in Figure 1. In terms of access to safely managed drinking water supply services, there is a regional disparity, as revealed in the 2019 Water, Sanitation, Hygiene, National Outcome Routine Mapping (WASH NORM) report. While only 14% of the Nigerian population has access to safely managed drinking water supply services, the pattern shows a disparity among the geopolitical zones in the country. The pattern varies from 2% access in the North East to 35% in the South West. The report also reveals that access to safely managed drinking water supply services in urban areas (29%) is four times higher than access levels in rural areas (7%). There are notable differences between the richest and poorest households, as further revealed by the report. The poorest households are 22

times less likely to have access to safely managed services than the richest households.

It has been revealed that public water utilities are unable to provide sufficient drinking water for Nigerians (Balogun, Sojobi, and Galkaye, 2017). People have tended to devise coping strategies such as buying bottled, sachet, or tanked water, fetching water from neighbors, and drilling boreholes (Abubakar, 2018; Emerenini, 2020). These coping strategies have led to the commodification of water whereby only those with physical or economic means, amongst others, mostly have access to drinking water even when the quality is not certain (World Bank, 2021; Oyerinde and Jacobs, 2022).

The backdrop suggests that there are factors influencing access to drinking water in Nigeria. However, limited studies have considered the determinants of access to drinking water, most especially at the nationwide level. Osabuohien *et al*. (2012) considered high access to water when households spent less than 30 minutes collecting water and neglected the quality of water sources, which is an important component in household access to drinking water. On the other hand, Abubakar (2019) examined household access to drinking water based on the quality of water sources and ignored the time spent collecting water, which largely influences the quantity of water available to households. It becomes evident that there is a need to incorporate time spent collecting water and the quality of water sources when examining determinants of access to drinking water in Nigeria.

Materials and methods

This study is based on secondary data from the household survey obtained from the 2018 Nigeria Demographic and Health Survey (NDHS). The 2018 NDHS is the sixth survey of its kind conducted by the National Population Commission (NPC) in association with the International Classification of Functions (ICF), USA through the DHS. Unlike the previous ones, the survey was conducted using computer-assisted personal interviews (CAPI) to aid in the rapid provision of data as well as quality assurance. The data collection took place from August 14 to December 29, 2018.

The primary sampling unit (PSU) for the 2018 NDHS was achieved based on enumeration areas (EAs) used for the 2006 national census in Nigeria, although the census did not provide information on the number of households and population for EA. The cartographic material showing each EA and the Local Government Area (LGA) population from the census were used to identify the list of EAs, estimate the number of households, and distinguish EAs as urban or rural for the survey sample frame.

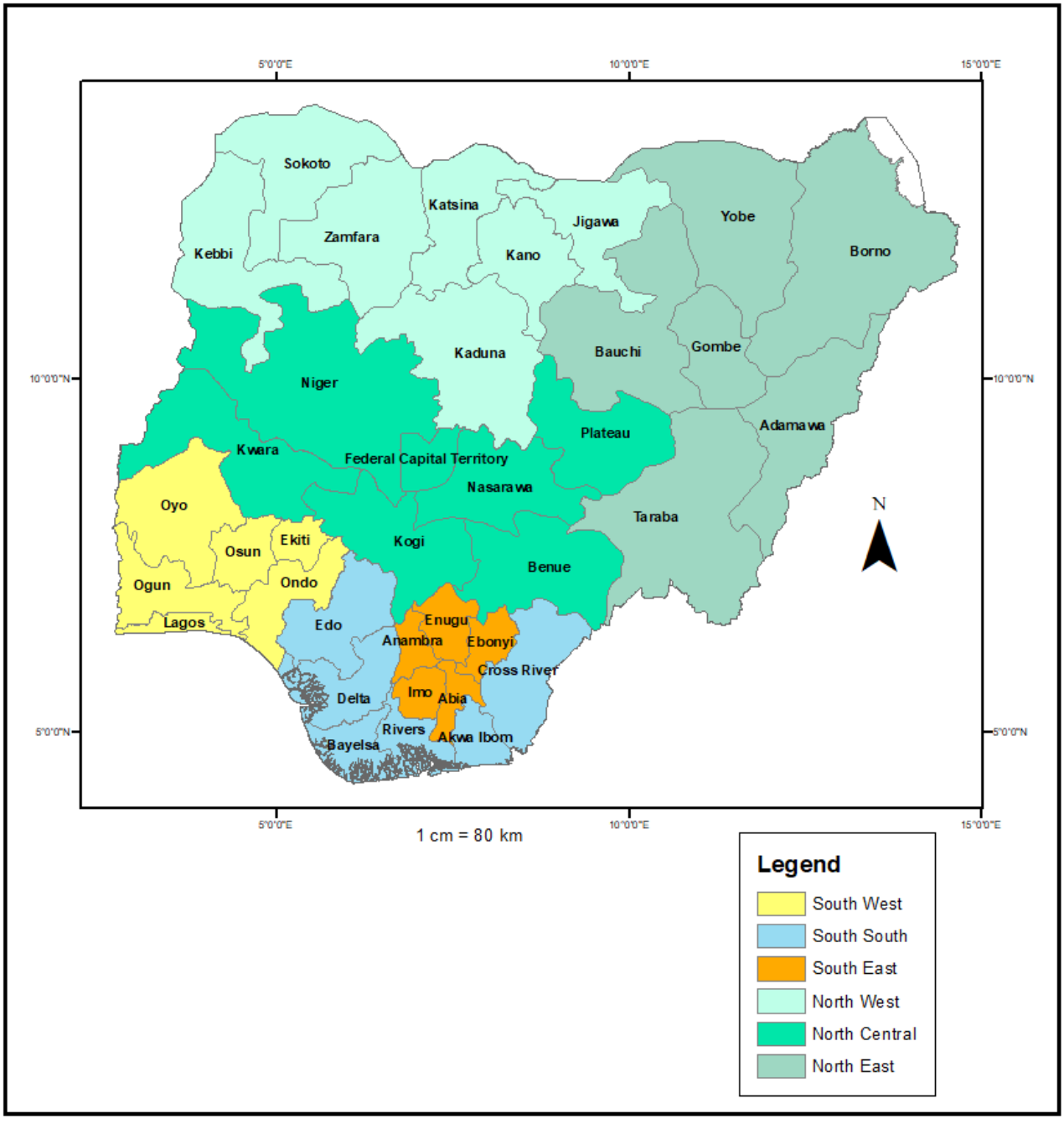

Figure 1: Political Regions with their Respective States in Nigeria

The sample size for the data collection was achieved through multi-stage sampling techniques. Using stratified sampling, the 36 states, as well as the Federal Capital Territory in Nigeria, were stratified into urban and rural areas. Any locality with more than a minimum population size of 20,000 was classified as urban. This implies that 74 sampling strata were identified. The sampling frame was organized based on administrative order and EA size, which is based on the number of households in the EA. In the first stage, 1,400 EAs were selected, and a household listing operation was conducted in all identified EAs, which served as the sampling frame for the households' selection in the second stage. A fixed number of 30 households was selected from the sampling frame using equal probability systematic sampling, which resulted in a total sample of approximately 42,000 households (see NPC and ICF, 2019 for details). Four questionnaires were used for the 2018 NDHS: the household, woman, man, and biomarker questionnaires. The data used for this study was derived from the household questionnaire, which consisted of characteristics of the household's dwelling unit, such as source of drinking water, type of toilet facilities, and materials used for flooring, among other information.

In addition, access to drinking water has been identified to be multidimensional, including availability, adequacy, reliability, acceptability, and accessibility (Dinka, 2018). For this study, we consider both "availability" and "accessibility", whereas the majority of the existing studies have either focused on the former or the latter. Availability refers to the kinds of drinking water sources, and accessibility refers to the time taken or distance covered by the household to access drinking water sources. Already, the Joint Monitoring Programme (JMP) has classified drinking water based on sources into two categories, namely, improved and unimproved water sources. According to WHO (2022), improved drinking water sources are defined as those that are likely to be protected from outside contamination. These include public standpipes, boreholes, protected dug wells, protected springs, and rainwater collection. Unimproved water sources include unprotected wells, unprotected springs, and surface water (e.g. rivers, dams, or lakes).

Vendor-provided water, bottled water, and tanker truck-provided water are identified as improved water sources because they are usually sourced from the boreholes in the study area (Emerenini, 2020). Equally, there are JMP service ladders that classify the level of service based on the time spent accessing drinking water sources (Wagari, Girma, and Geremew, 2022). Given the preceding, this study classified household access to drinking water using five Likert scales, as shown in Table 1.

To achieve the dependent variable for the analysis, each household was profiled to the category of access to drinking water they belong to by considering the main source of drinking water and collection time. Responses related to the independent variables can be seen in Table 2. The independent variables are region of residence, place of residence, type of toilet facility, religion, ethnicity, number of household members, highest educational level, access to electricity, sex of household head, age of household head, literacy, mobile telephone, use of the mobile telephone for financial transaction, and wealth index. With the aid of SPSS 20 software, the data analysis was carried out using ordinal logistics regression.

Table 1: Classification of access to drinking water.

Scale	Meaning
Very high	Drinking water from improved sources is accessible on the premises.
High	Drinking water from an improved source, with a collection time of no more than 30 minutes.
Medium	Drinking water from an improved source; the collection time is more than 30 minutes but less than 60 minutes.
Low	Drinking water from an unprotected dug well, unprotected spring, river, dam, lake, pond, stream, canal, or irrigation canal in which the collection time is less than or equal to 60 minutes OR drinking water from improved sources in which the collection time is between 60 mins and 120 minutes.
Extremely low	Either improved or unimproved water sources in which the collection time is more than 120 minutes or 60 minutes, respectively.

Source: Adapted from WHO (2022), Wagari *et al*., (2022)

Table 2: Descriptive statistics of dependent and independent variables

Key variables	Description	Min	Max	Mean	S.D.
Drinking water source (dependent variable)	10 = Piped water, 11= Piped into dwelling, 12 = Piped to yard/plot, 13 = Piped to neighbours, 14 = Public tap/standpipe, 20 = Tube well water, 21 = Tube well or borehole, 30 = Dug well (open/protected), 31 = Protected well, 32 = Unprotected well, 40 = Surface from spring, 41 = Protected spring, 42 = Unprotected spring, 43 = River/dam/lake/ponds/stream/canal/irrigation channel, 51 = Rainwater, 61 = Tanker truck, 62 = Cart with small tank, 71 = Bottled water, 92 = Sachet water and 96 = Others	11	96	32.88	19.61
Water collection time (dependent variable)	Time spent in minutes to get to the water source and come back – it is a continuous variable	0	900	324.22	452.83
Region of residence	1 = North Central, 2 = North East, 3 = North West, 4 = South East, 5 = South South, 6 = South West	1	6	3.22	1.65
Type of place of residence	1 = Urban, and 2 = Rural	1	2	1.59	0.49
Highest educational level	0 = No education, 1 = Primary, 2 = Secondary, and 3 = Higher	0	3	1.26	1.04
Access to electricity	0 = No, 1 = Yes	0	1	0.55	0.498
Type of toilet facility	10 = Flush toilet, 11 = Flush to piped sewer system, 12 = Flush to septic tank, 13 = Flush to pit latrine, 14 = Flush to somewhere else, 15 = Flush, don't know where, 20 = Pit toilet latrine, 21 = Ventilated improved pit latrine (VIP), 22 = Pit latrine without slab/open pit, 30 = No facility, 31 = No facility/bush/field, 41 = Composting toilet, 42 = Bucket toilet, 43 = Hanging toilet/latrine, 96 = Others	11	96	22.33	7.36
Religion	1 = Catholic, 2 = Other Christian, 3 = Islam, 4 = Traditionalist, 96 = Others	1	96	2.85	6.45
Ethnicity	1 = Ekoi, 2 = Fulani, 3 = Hausa, 4 = Ibibio, 5 = Igala, 6 = Igbo, 7 = Ijaw/Izon, 8 = Kanuri/Beriberi, 9 = Tiv, 10 = Yoruba, 96 = Other, 98 = I don't know	1	98	30.12	40.49
Number of household members	It is a continuous variable.	1	37	6.57	3.89
Sex of household head	1 = Male, 2 = Female	1	2	1.17	0.38
Age of household head	It is a continuous variable.	15	98	45.40	13.56
Literacy	0 = Cannot read at all, 1 = Able to read only parts of sentence, 2 = Able to read whole sentence, 3 = No card with required language, 4 = Blind/visually impaired	0	4	0.86	0.89
Use of mobile telephone for financial transactions	0 = No, 1 = Yes	0	1	0.25	0.43
Household wealth index	1 = Poorest, 2 = Poorer, 3 = Middle, 4 = Richer, 5 = Richest.	1	5	3.02	1.39

Specifically, the proportional odds (PO) model or the cumulative logit model, which is regarded as the most common type of ordinal logistic regression, was done using existing manuals (e.g. Crowson, 2021). A p-value ≤ 0.05 was used in this study to determine the level of significance between dependent and independent variables. The odds ratio (OR) for each predictor was calculated and interpreted. While an OR>1 indicates the multiplicative change in the odds of a case falling into a higher category changes per unit increase on predictor k, an OR<1 indicates decreasing odds of being in a higher category per unit increase, and an OR=0 indicates no change in odds per increase on the predictor.

Results and discussion

This section focuses on the analysis and discussion of determinants of household access to drinking water in Nigeria. The nature of the relationship between these factors and household access to drinking water is examined. Table 3 shows the distribution of household access to drinking water sources by region. The improved drinking water sources are not available for about 30% of households. This finding is similar to a global trend whereby 1 in 3 people do not have access to safe drinking water, as recorded by WHO and UNICEF (WHO, 2019). This finding is also consistent with earlier studies like Simelane *et al*. (2020), in which about 30% of the households in Eswatini were discovered not to have access to improved drinking water sources. In addition, it appears that the availability of improved drinking water sources to households in the study area exhibits regional disparities. Whereas at least 31%, 44%, and 36% of households in North Central, North East, and North West, respectively, had access to unimproved drinking water sources, while 23%, 15%, and 10% of households did not have access to the improved drinking water source in South-South, South East, and South West respectively.

Among other reasons, the higher percentage recorded in North East and South-South for those not having access to improved drinking water sources might be a result of insurgency in the north and oil exploitation in the South. The Boko Haram insurgency in the North East has led to the displacement of people as well as the destruction of infrastructure, including water facilities (Global WASH Cluster, 2017). Equally, the issue of climate change, which may be responsible for the shrinking of Lake Chad, is perhaps the possible reason for the non-availability of improved drinking water sources for households in the region. Similarly, the majority of the exploration of crude oil is within the South-South region – the Niger Delta region. The illegal oil exploration, oil bunkering, and the attack on oil infrastructure by the militant groups may have resulted in oil spills that pollute water that is supposed to be available for drinking in the region.

In terms of collection time, more than 60% of households did not spend more than 30 minutes accessing drinking water sources, and about the same proportion was discovered to be the reality in each region. This indicates that a large proportion of households in Nigeria do not have drinking water sources within their premises. This tends to confirm Oskam *et al*. (2021) in informal settlements in South Africa, where 64% of the households do not have piped taps within their premises. Among other reasons, this finding in the study area might be a result of the inability of public water utilities to adequately serve everyone whose households had to seek alternatives that always require coverage of certain distances (Balogun *et al*., 2017). Abubakar (2018) revealed how households in Abuja, Nigeria, sought alternative water supplies ranging from water storage, bottled and sachet water, water vendors, and fetching water from neighbors. Oyerinde and Jacobs (2022) discovered that the inability of the public water utilities to meet households' water demand in South West, Nigeria, has resulted in a situation whereby a larger percentage of house owners construct wells and boreholes.

Furthermore, as few as 24% of households had appropriate access to drinking water. This indicates that as high as 70% of the respondents' households in the study area do not have appropriate access to drinking water. Furthermore, the study revealed a regional disparity in terms of appropriate access to drinking water. Meanwhile, 25%, 13%, and 21% had appropriate access to drinking water in North Central, North East, and North West, respectively. Not less than 31% of responded households in the Southern region had appropriate access to drinking water. The implication is that the proportion of households having appropriate access to drinking water is discovered to be higher in the south than in the northern regions. Similar findings were discovered by Rani (2022) in India, whereby spatial variations in terms of availability and accessibility to safe drinking water exist.

Table 4 shows that the identified six regions in the study area are a significant determinant (b=-0.025, S.E.=0.0081, p=0.002) of access to drinking water. The regression slope (b), which is negative, indicates that a higher value on categories of predictor variable – region is associated more likely with a lower value on the dependent variable. This means households living in South West region are more likely to have high access to drinking water than any other region in the study area. Among the identified regions, the highest proportion of households with extremely low access to drinking water can be found in the southwest, which is in line with the highest proportion of households that have access to appropriate drinking water.

In addition, the odds ratio (OR=0.975) indicates that the probability of having extremely low access to drinking water is higher among households within the South West region compared to those from other areas. Similar to these findings, Belay and Andualem (2022) showed that the regional disparity was one of the significant determinants of limited access to drinking water services in Ethiopia, such that the proportion ranges from 2.6% in Addis Ababa to 57.35% in the Somali region.

Table 3: Access to drinking water

Water Source	North Central	North East	North West	South East	South South	South West	Total
Improved	5301	4202	6406	4562	3833	4962	29266
Unimproved	2391	3338	3646	832	1165	586	11958
Others	2	0	40	1	11	8	62
Total	7694	7540	10092	5395	5009	5556	41286
Collection time							
On-premises	2231	1659	3679	1695	1680	1927	12871
1 to 30 minutes	4850	5248	5930	2876	2988	3255	25147
31 to 60 minutes	516	523	344	667	281	215	2546
61 to 120 minutes	81	62	89	114	45	33	424
121 minutes and above	12	33	29	42	6	126	248
Don't know	4	15	21	1	9	0	50
Total	7694	7540	10092	5395	5009	5556	41286
Access to DW							
Extremely Low	84	70	51	114	39	136	494
Low	2016	2649	2094	767	1025	539	9090
Medium	440	897	1789	381	206	147	3860
High	3223	2936	4061	2464	2181	2838	17703
Very high	1931	988	2097	1669	1558	1896	10139
Total	7694	7540	10092	5395	5009	5556	41286

Source: Adapted from National Population Commission (NPC) [Nigeria] and ICF. 2019

It was also discovered that place of residence, either urban or rural area, was a significant determinant (b=-0.393, S.E.=0.0293, p=0.00) of access to drinking water. The negative regression slope indicates households living in rural areas were associated with extremely low access to drinking water compared to households in urban areas. The odds ratio (OR=0.675) also indicates the likelihood of having extremely low access to drinking water is higher in rural areas than in urban areas. In other words, for a single household increase in a rural area, the odds of falling into extreme access to drinking water changed by a factor of 0.675. Alternatively, appropriate access to drinking water existed more in urban areas than in rural areas. This finding is similar to studies of Agbadi *et al*. (2019) in Ghana, Simelane *et al*. (2020) in Eswatini, and Irianti *et al*. (2016) in Indonesia. In previous years, Abubakar (2019) discovered that the place of residence was a significant determinant of access to drinking water, as well as a significant disparity between urban and rural households in accessing improved drinking water sources.

Abubakar (2019) suggested that the likely reason for the foregoing is that rural areas are being neglected while development is being concentrated in urban areas. The nature of the settlement pattern in rural areas, which is mainly dispersed, has made the provision of piped-borne water expensive, which also contributes to the inadequacy of improved water sources. On the contrary, the study by Adil *et al*. (2021) in Pakistan discovered a non-significant place of residence in determining household access to drinking water. This dissimilarity may be connected with the way access to drinking water is measured as well as variation in the availability of water facilities. For instance, Adil *et al*. (2021) focused on safe drinking water, which is measured by availability, accessibility, and quality.

Since water facilities are not well distributed in Nigeria, there would always be a disparity between rural and urban areas in terms of access to drinking water. This submission is based on the reality that policymakers who provide good water facilities are closer to the urban population. Also, in a situation where the government has failed to provide water facilities, the majority of the citizens who can afford the financial cost of constructing any of the improved water sources are largely living in urban areas.

Educational level is a significant determinant (b=0.05, S.E.=0.022, p=0.025) of access to drinking water in Nigeria. The positive regression slope indicates that households that had members with higher educational levels had access to drinking water than others. Equally, the odds ratio (OR = 1.05) means that for each unit to increase in higher education, the odds of a household with a higher educational level falling into very high access to drinking water change by a factor of 1.05, as shown in Table 4. This means households with higher education are more likely to have very high access to drinking water compared to households with less education. This finding is similar to studies carried out in Zambia by Mulenga *et al*. (2017), Ghana by Adams *et al*. (2016), Agbadi *et al*. (2019), and Pakistan by Adil *et al*. (2021). Belay and Andualem (2022) discovered that education was significantly associated with limited access to drinking water services in Ethiopia. Adams *et al*. (2016) revealed that respondents with tertiary education had a 2.18 times greater chance of having access to improved sources of water compared with those without education. Among other reasons, this finding is a result of the reality that higher education attainment of individuals would result in more opportunities to get a well-paid job whereby there will be a financial resource for the person to have appropriate access to drinking water. They also have the financial capacity to invest more in proper access to drinking water because they are well-informed on potential health risks associated with unhygienic drinking water (Adam *et al*., 2016).

Angoua *et al*. (2018) noted that the continuous increase in the unemployment rate has made higher educational attainment not translate to a well-paid job. This situation emphasizes the idea that access to drinking water is independent of the education level, as discovered by Angoua *et al.* (2018) in Abidjan, Cote d'Ivoire. In the same vein, Simelane *et al.* (2020) found that the education level of the household head did not significantly determine access to the improved drinking water source in Eswatini. Despite the fact that some of the household heads had higher educational attainment, the inability to get a well-paid job has made them unable to afford improved drinking water sources, as discovered by Simelane *et al.* (2020). It was discovered in this study that the level of literacy does not significantly determine (b=0.023, S.E.=0.0235, p=0.326) access to drinking water. The foregoing suggests that educational attainment cannot generally be established as one of the determinants of access to drinking water in Nigeria, although otherwise was discovered by Armah *et al*. (2018), Abubakar (2019), and Adil *et al*. (2021).

Furthermore, the sex of the household head is identified as one of the significant determinants of household access to drinking water in the body of literature (e.g. Mulenga *et al*., 2017; Armah *et al*., 2018; Agbadi *et al*., 2019). This present study also discovered that the sex of the household heads was the significant determinant (b=0.144, S.E.=0.0326, p=0.00) of access to drinking water. The positive regression slope indicates that very high household access to drinking water was associated with female household heads. The odds ratio (OR=1.155) also indicates that for each unit increase in "household headed by female", the odds of a household with a female head falling into very high access to drinking water changes by a factor of 1.155 in Table 4. This means a female-headed household is 1.155 times more likely to access appropriate drinking water than male-headed households. This finding is against the existing studies. For instance, Abubakar (2019) observed that male-headed households are 1.2 times more likely to use improved drinking water sources than female-headed households. This disparity in the findings might be a result of differences in the conceptualization of household access to drinking water and the usage of the different datasets for analysis. However, it is generally believed that female children and mothers or women are responsible for household chores, which include making sure drinking water is available at home, especially in Africa (Adam *et al*., 2016; Angoua *et al*., 2018).

Table 4: Logistics regression results

Parameter		B	Std. Error	95% Wald Confidence Interval Lower	Upper	Hypothesis Test Wald Chi-Square	df	Sig.	Exp(B)	95% Wald Confidence Interval for Exp(B) Lower	Upper
Threshold	[Time_Water=0]	-4.237	0.1337	-4.499	-3.975	1004.506	1	0	0.014	0.011	0.019
	[Time_Water=1]	-1.307	0.1191	-1.54	-1.073	120.457	1	0	0.271	0.214	0.342
	[Time_Water=2]	-0.76	0.1189	-0.993	-0.527	40.86	1	0	0.468	0.37	0.59
	[Time_Water=3]	1.757	0.1196	1.522	1.991	215.851	1	0	5.792	4.582	7.322
Region		-0.025	0.0081	-0.041	-0.009	9.656	1	0.002	0.975	0.96	0.991
Place of residence		-0.393	0.0293	-0.45	-0.336	179.936	1	0	0.675	0.637	0.715
Highest educational level		0.05	0.0222	0.006	0.093	5.003	1	0.025	1.051	1.006	1.097
Type of toilet facility		-0.044	0.002	-0.048	-0.04	495.214	1	0	0.957	0.953	0.96
Household access to electricity		0.106	0.0369	0.034	0.178	8.231	1	0.004	1.112	1.034	1.195
Religion		-0.004	0.002	-0.008	0.00003178	3.78	1	0.052	0.996	0.992	1
Ethnicity		-0.001	0.0003	-0.002	-0.001	12.537	1	0	0.999	0.998	0.999
Number of household members		0.014	0.004	0.006	0.022	11.823	1	0.001	1.014	1.006	1.022
Sex of household head		0.144	0.0326	0.08	0.208	19.63	1	0	1.155	1.084	1.231
Age of household head		0.001	0.001	-0.001	0.003	0.572	1	0.449	1.001	0.999	1.003
Literacy		0.023	0.0235	-0.023	0.069	0.967	1	0.326	1.023	0.977	1.072
Use of mobile tele. for financial transactions		0.076	0.034	0.01	0.143	5.048	1	0.025	1.079	1.01	1.154
Wealth index		0.527	0.0177	0.493	0.562	892.452	1	0	1.694	1.637	1.754
(Scale)		1b									

a. Set to zero because this parameter is redundant

b. Fixed at the displayed value

This paper observes that the age of the head of household is a non-significant determinant (b=0.001, S.E.=0.001, p=0.449) of household access to drinking water, which is consistent with existing studies (Adil *et al*., 2021; Armah *et al*., 2018). It contradicts findings from other investigations that found the age of the head of household to be a significant determinant of household access to drinking water (Abubakar, 2019; Oskam *et al*., 2021). Although it is not well documented in the literature, it has been argued that individuals aged 35 years and above in most African communities have a sense of responsibility to make sure they have access to improved drinking water sources (Agbadi *et al*., 2019). Despite the insignificance of the age of the head of household in this study, the odds ratio indicates households with older household heads have 1.001 times the likelihood of having very high access to drinking water compared to households where their heads are younger.

The household size was discovered to be a significant determinant (b=0.014, S.E.=0.004, p=0.001) of household access to drinking water. The higher the household size, the higher the likelihood of having appropriate access to drinking water. Truly, the higher the household size, the higher the possibility of the household having 1.014 times access to drinking water compared to lower household sizes. Whereas this finding is consistent with existing studies by Behera *et al*. (2020) in Nepal and Irianti *et al*. (2016) in Indonesia, some previous studies have also shown otherwise (Agbadi *et al*., 2019; Adil *et al*., 2021). Interestingly, previous studies in the study area reported household size to be a non-significant determinant of household access to drinking water (Osabuohien, 2012; Abubakar, 2019). Contrary to earlier studies, toilet types were a non-significant determinant of household access to drinking water (Abubakar, 2019), although it was established in Indonesia that households with good toilet facilities had a higher likelihood of higher access to improved drinking water sources (Irianti *et al*., 2016).

As expected, access to electricity is discovered as one of the significant determinants (b=0.106, S.E.=0.0369, p=0.004) of household access to drinking water such that household with access to electricity has higher chances of 1.112 times having access to appropriate drinking water compared to those without. This finding aligns with a previous study conducted by Abubakar (2019). Interestingly, we expected the findings to be in this direction, given that household access to drinking water in Nigeria is perhaps a private service and not a public service (Oyerinde and Jacobs, 2022). This implies households with some level of affluence tend to have appropriate access to drinking water compared to others. Indeed, the majority of the independent variables examined, which are indicators of affluence, have been discovered to be significant determinants of household access to drinking water. For instance, the wealth index was a significant determinant (b=0.527, S.E.=0.0177, p=0.00) of access to drinking water.

There is a positive association between household access to drinking water and wealth index such that households who are referred to as the richest have higher chances of 1.694 times to have appropriate access to drinking water compared to others. It is worth noting that there is extensive evidence from previous studies, especially from developing countries, establishing wealth index as a significant determinant of household access to drinking water (Mulenga *et al*., 2017; Armah *et al*., 2019; Simelane *et al*., 2020; Behera *et al*., 2020; Adil *et al*., 2021).

This study also discovered ethnicity as a significant determinant (b=-0.001, S.E.=0.0003, p=0.00) of household access to drinking water in line with Abubakar (2019). However, there is a variation in household access to drinking water based on the variable. For example, among the major ethnicities in Nigeria, Hausa, Igbo and Yoruba, about 20% of the Hausa households have very high access to drinking water compared to about 33% recorded in either Igbo or Yoruba households. Generally, among the ten ethnicities identified in this study, Ekoi, Fulani, and Igala have the highest proportion of households with low access to drinking water. A similar study in Punjab, Pakistan, by Adil *et al*. (2021) also discovered the ethnicity of the household head as a significant determinant of household access to safe drinking water. Though they are limited in number, findings from prior studies have discovered religion as a non-significant determinant of household access to drinking water (Osabuohien *et al*., 2012; Angoua *et al*., 2019). In the same vein, this study discovered religion as the non-significant determinant (b=-0.004, S.E.=0.002, p=0.052) of household access to drinking water. In all, among the thirteen independent variables considered in this study, only three variables (literacy, age of household head, and religion) are non-significant determinants of household access to drinking water. A total of 8 out of the 13 independent variables considered have higher odd ratios of $\geq$ 1, which indicates that these variables have a higher likelihood of determining household access to drinking water.

Conclusion

This study emphasizes the inadequacy of existing public utilities in Nigeria in providing sufficient drinking water for households. Despite the reality that the digging of a borehole does not always come cheap, there appears to be a proliferation of boreholes in Nigeria, as the digging is mostly done individually. The present study discovered that about 50% of the households that had access to boreholes as the source of drinking water were within the wealth categories of "richer and richest" despite that the population of households within these categories represented 42% of the total households considered in this present study. Equally, among households that had appropriate access to drinking water, about 63% belonged to the "richer" and "richest" wealth categories. The foregoing suggests that in a relative term, some level of financial implication is involved for the household to have appropriate access to improved drinking water in Nigeria. It becomes obvious that the government of Nigeria needs to invest more in the provision of water facilities through the digging of boreholes, which the community will manage. We, therefore, recommend digging boreholes, especially in poor neighbourhoods, because it seems people of high income in the country can afford to dig the borehole for themselves. Regional disparity has also been discovered in Nigeria's household access to drinking water. We, therefore, recommend a regional approach to tackle the problem of household access to drinking water in Nigeria.

We are of the submission that, among other variables, income inequality tends to explain household access to drinking water better. The wider the income gaps among households, the higher the unequal household access to drinking water in the study area. The foregoing is just a deductive statement based on our findings that need to be verified through empirical research. This means there is a need for further studies that focus on how income inequalities influence household access to drinking water in the study area.

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