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Research Article

Socio-Economic Perspectives of Household Water Treatment for Safe Drinking in Nigeria

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Abstract

Access to safe drinking water remains a huge challenge to households in developing countries of which Nigeria is one. This is evident from the numerous cases of water related diseases ravaging the country. The United Nations Children Emergency Fund reports that over 150,000 Nigerians and about 117, 000 under five children, die of water borne diseases annually. Since safe water is gotten from water treatment, the challenges associated with ensuring that water is adequately treated for the households are enormous. Considering that the household is generally the primary source of drinking water for the populace, the socio-economic characteristics of a household plays a key role in determining their access to quality water for drinking. It is based on this that this study seeks to evaluate how household socio-economic characteristics influences a household's decision to treat its drinking water. The study uses the Binary Logistic regression model to test for the correlates of household water treatment decisions. The data employed in this study is sourced from the Multiple Indicator Cluster survey conducted by UNICEF. A total of 26359 households were selected for the study. The study shows that about 23,495 of the selected households do not treat their water for safe drinking in Nigeria. The result also shows that source of drinking water is a key determining factor in the water treatment decisions of households, as different sources of water were found to have varying degrees of effects on water treatment decisions by households. Some ethnic groups were also observed to have a poor water treatment culture. Also, education of household head and high wealth status increases water treatment.

Keywords

Water Treatment, Drinking Water, Binary Logistic Regression Model, Households

1. Introduction

Water is an essential element for human survival. Unfortunately, a very large number of the population are yet to have access to a safe drinking water in Nigeria. The World Health Organisation reports that about 70 million Nigerians do not have access to basic drinking water sources [16]. Yet, the need for water keeps increasing due to population increase, urbanisation and other factors [2]. Water treatment at the household level has been identified as the best and least cost method of

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getting clean water that is safe for drinking [7]. About 78 million children are reported to be at risk of water related crisis while over 100,000 children die annually from water related diseases [13]. In 2018 Nigeria's Water Sanitation and hygiene sector was declared to be in a state of emergency [15]. The situation is considered alarming as the UNICEF Water Sanitation and Hygiene program director speculates that it will take Nigeria over 16 years from the year 2023 to achieve a safe water for all in Nigeria.

In the year 2010, the United Nations General Assembly had declared safe and clean drinking water and sanitation a fundamental human right (United Nations right to safe water media brief, 2010). It is thus unfair and a violation of human right when access to safe water is denied. There are different sources of water in Nigeria. The households in the rural areas have access to surface waters like rivers and streams and a little of underground water. About 88% of the households that use surface water are resident in the rural areas. These surface waters are easily contaminated by pathogens arising from natural and human induced factors [1]. Those who reside in the urban and metropolitan areas mostly use underground water sources such as boreholes and deep wells which can also be contaminated [8]. In fact, piped water connections for drinking is lacking in most households in Nigeria. Even in other countries especially in Africa, more than half of the population are observed to not have access to safe drinking water [2]. It is not surprising, that the United Nations Development Program [(UNDP), 2017] report also show that 1 in every six persons do not have access to safe drinking water globally.

At least 2 billion people source drinking water from sources that are contaminated with faeces globally [16]. This calls for concerns as there is a global threat to health due to water, sanitation and hygiene crisis. Water crisis in Nigeria have been adjudged to not just be an environmental issue but also a social, economic and health challenge [8]. The United Nations suggests that safe drinking water and sanitation are important for reducing poverty and achieving sustainable development [14]. The sustainable development goals 6.1 and 6.2 are targeted at achieving clean water and sanitation for all but it is less than a decade to the end of the SDG program and the targets appear to be far from being achieved in Nigeria. In fact, Nigeria is regarded as the worst performing country in the provision of access to a safe drinking water. Gratifying efforts have been made by government, private sectors, civil societies and individuals to resolve the water threats being experienced in Nigeria but the problem has persisted. Achieving Sustainable development goal (SDG) 6 requires extra ordinary efforts and household collaboration [5].

Even though various water treatment methods are available to households for the treatment of their drinking water, available statistics have shown that very few, about 12% of the households in Nigeria agree to have treated their water in a 2018 demographic and health survey. Over 80% of the households reported not to have treated their water. The figure is very poor and worrisome and raises a very important question: Why do households in Nigeria not treat their drinking water? Huge resources are committed annually by international organisations like WHO, UNICEF and UNDP to drive campaigns for water, sanitation and hygiene and provide water treatment instruments to households. The WHO has since 2014 been testing household water treatment products using the organisation's health–based performance criteria but only little changes are recorded.

So many empirical studies have been done on access to and management of safe drinking water in Nigeria. Different studies have evaluated access to safe drinking water in Nigeria. The studies are similar as they all observed that access to a safe drinking water has been and remained a problem in Nigeria [4, 2, 8, 12]. The control of water treatment processes, distribution and handling if access to portable water must be improved in Nigeria [4]. A total overhaul of water quality management processes is necessary at all levels [8]. Furthermore, it has been revealed that an increase in investment improves water projects by the government and other well-meaning organisations [3]. However, it is suggested that improvement in education and entrenching good governance [2].

In a recent study about clean water and hygiene in Nigeria, it is opine that the water and hygiene issues affecting the country is caused by poor policies [10]. Other studies reveals that only 29.9% of the households in Ondo state, Nigeria have access to improved water [9]. Another study evaluated factors influencing a household's source of water and the study having identified wealth level, geopolitical zones, location, education, water collection time as relevant factors, suggests the provision of public piped water and promotion of water treatment for households [1, 11]. Similarly, [7] examines knowledge of water treatment practices in plateau, Nigeria. The study reveals that 54% of the 368 respondents selected for the study practice at least one water treatment method with most using alum.

While all previous studies have identified that there is a problem with access to a safe drinking water for households in Nigeria, with some suggesting the possible factors causing this lack of access and even pointing out the need for water treatment, none of this studies have tried to understand what drives a household's decision to treat or not to treat their drinking water despite the common knowledge that water treatment at the household level is the best method of having safe water for drinking. This study therefore seeks to understudy some household characteristics, in order to identify those peculiar challenges households share that places a burden on them and invalidates their judgement on water treatment. This study is supported by a cultural theory of drinking water risks advanced [6]. The theory which draws its foundation from Mary Douglas cultural theory of risks, identifies four stages of water point management for household's access to safe drinking water. It proposes a model that allows risks and responsibilities of safe water provision to be shared across individuals who are entrepreneurial, communities, institutions like schools, hospitals and religious organisations and the last group being the fatalistic group who turn to alternative sources because they have an established long-term failure in water point management.

2. Data and Methods

This study adopted the binary logistic regression model to reflect the dichotomous nature of the dependent variable (Household decision to treat water or not) is as follows:

$$Blogit = \log \frac{p(y=1)}{1-p(y=1)} = \sum_{k=1}^{k} \alpha_k X_k \quad (1)$$

Equation 1 shows that there is a linear relationship between the logitpx and the vectors of explanatory variables X. Therefore, the study can state the probability of a household making a decision of treating water as thus;

$$\Pr(Y=1) = \frac{\sum_{ek=1}^{k} \alpha_k X_k}{\sum_{ek=1}^{k} \alpha_k X_k} \quad (2)$$

Whereas the probability of household not treating water (which is 1 minus the probability of treating water) is specified thus:

$$\Pr(Y=0) = \frac{1}{\sum_{ek=1}^{k} \alpha_k X_k} \quad (3)$$

Equations 1 to 3 show the binary nature of the dependent variable of household's decision of treating water categorized as 1 and decision of not treating water categorized as 0. The final model for determining the impact of household decision to treat water in Nigeria is specified below as thus;

$$Blogit(P) = ln\frac{P}{1-P} = \alpha_0 + x\beta_1 + x\beta_2 + \cdots . + x\beta_n + \mu \quad (4)$$

This study, therefore, follows Abubakar (2019) and presents the following logistic model

$$In\ P\left(\frac{watertreatment}{no\ watertreatment}\right) = B_0 + B_1 houseownership + B_2 HHSEX + B_3 helevel + B_4 sourceDW + B_5\ watercoltime + B_6 Hhwealth + B_7 ethnicity + B_8 location + \varepsilon_i$$

Where

Water treatment = dependent variable (1 if household treated water and 0 otherwise)

Houseownership= housing stability/type of dwelling

Hhhead=headship of household

Helevel=education of household head

SourceDW=source of drinking water

Ethnicity =ethnicicity of the household

Location= place of residence (1=urban and 0=rural

Data

The data employed in this study is sourced from the UNICEF, Multi Indicator Cluster Surveys (MCIS). It is an international household survey developed by UNICEF covering over 115 countries with close to 330 surveys since the 1990s. The dataset covers a range of low, middle and high-income countries and many which are in post-emergency periods. MICS dataset is also designed to collect statistically sound, internationally comparable estimates of about 130 indicators to assess the situation of children, women and men in the areas of health, education, and child protection. Multi Indicator Cluster Survey covers indicators related to children's well-being, women, and households, ranging from health and education to child protection and water and sanitation. In the most recent rounds of MICS, additional data are also collected on men. Data can be disaggregated for young people age 15-24 and by gender. It is from this dataset that our data was curled from and used in our analysis.

The data was cleaned to remove missing observations and some variables such as location, water treatment decision, household sex, were recoded such that 2 which represents No was assigned 0 for those variables.

3. Results and Discussions

The study's descriptive statistics and binary logistic regression result is presented in this section. The descriptive statistics shows that only 2,864 of the selected household treated their water in Nigeria. The result shows that majority of the households about 12,667 sourced their water from tube well or borehole. Also, most of the households were observed to own their dwelling. Households whose head had no basic education were 8,806 while those with education all together were 17,553.

Table 1. *Descriptive statistics.*

Variable	Frequency
watertreatment	No: 23,495 Yes: 2,864
Houseownership	Own=18,826

Variable	Frequency
	Rent=5622 Others=1,911
Sources of water	Public tap /stand pipe=1033 Tube well/ borehole=12,667 Dug well:protected =2,421 Dug well:unprotected=2884 Spring: protected =300 Spring unprotected=1226 Rain=71 Surface water=4176 Packaged: bottled water=43 Packaged: Sachet water=1219
Household head	Female=5,045 Male=21,314
Household head edlevel	No education=8,806 Primary=6,047 Junior Secondary=1,275 Senior secondary=6,940 Tertiary =3,291
Wealth status	Poorest=7,119 Second=6491 Middle =6304 Fourth =4610 Richest=1835

Source: constructed by authors with data from MICS round6

The average marginal effect was chosen and employed for discussion because coefficients of logistic regression are mostly considered to be significant in showing the direction of effect.

Table 2. *Logistic regression result.*

watertreat	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
1b.houseownership	1	.	.	.	.	.	
2.houseownership	.96	.055	-0.71	.475	.857	1.075	
6.houseownership	1.207	.09	2.52	.012	1.043	1.396	**
13b.sourceDW	1	.	.	.	.	.	
14.sourceDW	.546	.142	-2.33	.02	.328	.908	**
21.sourceDW	.755	.163	-1.30	.194	.494	1.154	
31.sourceDW	1.944	.432	2.99	.003	1.258	3.005	***
32.sourceDW	1.72	.388	2.40	.016	1.105	2.678	**
41.sourceDW	1.893	.531	2.27	.023	1.092	3.282	**

watertreat	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
42.sourceDW	2.39	.558	3.73	0	1.512	3.778	***
51.sourceDW	1.062	.513	0.13	.9	.413	2.735	
81.sourceDW	3.718	.822	5.94	0	2.411	5.734	***
91.sourceDW	.313	.238	-1.53	.127	.07	1.391	
92.sourceDW	.44	.109	-3.33	.001	.271	.714	***
96.sourceDW	.424	.269	-1.35	.176	.123	1.467	
0b.location	1	.	.	.	.	.	
1.location	.971	.059	-0.48	.628	.861	1.095	
watercoltime	1.001	0	5.87	0	1.001	1.001	***
0b.HHSEX	1	.	.	.	.	.	
1.HHSEX	.826	.045	-3.48	0	.742	.92	***
1b.ethnicity	1	.	.	.	.	.	
2.ethnicity	.622	.057	-5.14	0	.519	.746	***
3.ethnicity	1.012	.08	0.15	.877	.868	1.181	
4.ethnicity	1.09	.105	0.89	.372	.902	1.317	
5.ethnicity	.999	.177	-0.01	.993	.705	1.414	
6.ethnicity	2.199	.232	7.46	0	1.787	2.704	***
7.ethnicity	1.521	.191	3.34	.001	1.189	1.945	***
8.ethnicity	3.598	.382	12.06	0	2.923	4.43	***
9.ethnicity	.287	.081	-4.42	0	.165	.499	***
96.ethnicity	.812	.057	-2.97	.003	.708	.932	***
0b.helevel	1	.	.	.	.	.	
1.helevel	1.264	.079	3.75	0	1.118	1.43	***
2.helevel	1.323	.133	2.78	.005	1.086	1.612	***
3.helevel	1.217	.079	3.04	.002	1.072	1.382	***
4.helevel	1.489	.114	5.20	0	1.281	1.73	***
1b.windex5	1	.	.	.	.	.	
2.windex5	1.364	.085	5.00	0	1.208	1.54	***
3.windex5	2.042	.138	10.55	0	1.788	2.332	***
4.windex5	2.458	.202	10.95	0	2.093	2.888	***
5.windex5	3.475	.383	11.29	0	2.799	4.313	***
Constant	.051	.012	-12.91	0	.033	.081	***
Mean dependent var		0.109		SD dependent var		0.311	
Pseudo r-squared		0.092		Number of obs		26359.000	
Chi-square		1660.763		Prob > chi2		0.000	
Akaike crit. (AIC)		16525.942		Bayesian crit. (BIC)		16804.047	

*** p<.01, ** p<.05, * p<.1

Table 3. *Average Marginal Effects Results.*

		Delta-method				
	dy/dx	**Std.Err.**	**z**	**P>z**	**[95%Conf.**	**Interval]**
houseownership						
RENT	-0.004	0.005	-0.720	0.472	-0.013	0.006
OTHER	0.018	0.007	2.410	0.016	0.003	0.032
sourceDW						
PIPED WATER: PUBLIC TAP / STANDPIPE	-0.036	0.017	-2.070	0.039	-0.070	-0.002
TUBE WELL / BOREHOLE	-0.019	0.016	-1.170	0.242	-0.051	0.013
DUG WELL: PROTECTED WELL	0.065	0.018	3.650	0.000	0.030	0.099
DUG WELL: UNPROTECTED WELL	0.050	0.018	2.800	0.005	0.015	0.085
SPRING: PROTECTED SPRING	0.061	0.027	2.280	0.022	0.009	0.114
SPRING: UNPROTECTED SPRING	0.091	0.020	4.470	0.000	0.051	0.131
RAINWATER	0.005	0.038	0.120	0.902	-0.069	0.079
SURFACE WATER (RIVER, DAM, LAKE, POND, STREAM, CANAL, IRRIGATION CHANNEL)	0.160	0.018	8.770	0.000	0.124	0.195
PACKAGED WATER: BOTTLED WATER	-0.056	0.026	-2.160	0.031	-0.107	-0.005
PACKAGED WATER: SACHET WATER	-0.045	0.017	-2.690	0.007	-0.078	-0.012
OTHER	-0.047	0.027	-1.710	0.087	-0.100	0.007
location						
URBAN	-0.003	0.005	-0.490	0.626	-0.013	0.008
watercoltime	0.000	0.000	5.880	0.000	0.000	0.000
HHSEX						
Male	-0.018	0.005	-3.350	0.001	-0.028	-0.007
ethnicity						
Igbo	-0.037	0.007	-5.180	0.000	-0.051	-0.023
Yoruba	0.001	0.007	0.150	0.877	-0.013	0.015
Fulani	0.008	0.009	0.880	0.378	-0.010	0.027
Kanuri	-0.000	0.016	-0.010	0.993	-0.032	0.032
Ijaw	0.095	0.014	6.680	0.000	0.067	0.123
Tiv	0.045	0.015	3.070	0.002	0.016	0.074
Ibibio	0.179	0.017	10.280	0.000	0.145	0.213
Edo	-0.074	0.011	-6.880	0.000	-0.095	-0.053
Other ethnicity	-0.018	0.006	-2.880	0.004	-0.030	-0.006
helevel						
Primary	0.020	0.005	3.730	0.000	0.010	0.031
Junior secondary	0.024	0.009	2.620	0.009	0.006	0.043
Senior secondary	0.017	0.005	3.040	0.002	0.006	0.027
Higher/tertiary	0.036	0.007	4.990	0.000	0.022	0.050

		Delta-method				
	dy/dx	Std.Err.	z	P>z	[95%Conf.	Interval]
windex5						
Second	0.022	0.004	5.010	0.000	0.013	0.031
Middle	0.059	0.006	10.480	0.000	0.048	0.070
Fourth	0.080	0.008	10.170	0.000	0.064	0.095
Richest	0.124	0.013	9.230	0.000	0.098	0.151

Note: dy/dx for factor levels is the discrete change from the base level.
Average marginal effects Number of obs = 26,359
Model VCE: OIM
Expression: Pr (watertreat), predict ()
dy/dx w.r.t.: 2.houseownership 6.houseownership 14.sourceDW 21.sourceDW 31.sourceDW 32.sourceDW 41.sourceDW 42. sourceDW 51.sourceDW 81.sourceDW 91.sourceDW 92.sourceDW 96.sourceDW 1.location
watercoltime 1.HHSEX 2.ethnicity 3.ethnicity 4.ethnicity 5.ethnicity 6.ethnicity 7.ethnicity 8.ethnicity 9.ethnicity 96.ethnicity 1.helevel 2.helevel 3.helevel 4.helevel 2.windex5
3. windex5 4.windex5 5.windex5

Table 3 presents the binary logistic regression results. The results shows that a discreet change from a household that owns their dwelling to those who rent have no significant effect on water treatment decisions. But, a discreet change from owning dwelling to other types of dwelling increases the probability of a household treating their water for drinking. The effect of the source of drinking water shows that sourcing the water from piped water: Public tap or standpipe is statistically significant and reduces the probability of the household treating water by 0.04. Tube well or borehole sources have no significant effect on water treatment decisions. But, sourcing water from a protected well is significant and increases probability of household water treatment by 0.065. Sourcing water from an unprotected well also increases the probability of household water treatment by 0.050.

In addition, sourcing water from a protected spring is statistically significant increases the probability of household water treatment by 0.061 while sourcing water from unprotected spring is also statistically significant and increases the probability of household treating their water 0.091. Sourcing water from surface water like river, lake, stream et cetera increases the probability of water treatment by 0.160. Sourcing water from packaged sources like bottled water reduces the probability of water treatment by 0.056 and that of sachet water by 0.045 respectively. A discreet change from female headed to male headed household reduces the probability of household water treatment by 0.018. The ethnicity shows that being Igbo and Edo reduces the probability of water treatment by 0.037 and 0.074 respectively while being Ijaw, Tiv and Ibibio increases the probability of water treatment by 0.095, 0.045 and 0.179 respectively.

The result shows that a change from no education to attaining any educational level by the household head increases the probability of water treatment. Lastly, moving from the poorest to higher wealth status increases the probability of water treatment and this is consistent with [1] who found that poverty influences household decision on water treatment but differed in the effect of time taken to collect water by households.

4. Conclusion and Recommendation

The goal of this study was to examine the impact of household's socio-economic characteristics influence water treatment decision of households. In conclusion, the study shows that about 23,495 of the selected households do not treat their water for safe drinking in Nigeria. The result also shows that source of drinking water is a key determining factor in water treatment decisions of households as different sources of water were found to have varying degrees of effects on water treatment decisions by households. The result also shows that some ethnic regions like the Igbos and households that live in Edo do not have a culture of treating water for safe drinking while households from Ijaw, Tiv and Ibibio have a culture of treating water for safe drinking. Also, the study found that having an educated household head and increasing household wealth status makes household to treat water for safe drinking while having a male heading a home reduces the probability of the household treating water for safe drinking.

The study therefore recommends the following: 1) More awareness should be created on the importance of treating drinking water before use to fight the outbreak of some water-borne diseases like cholera and diarrhoea through government and civil society organisation's powered sensitization programs especially in ethnic regions that have been identified by the study to have a poor culture of water treatment. 2)

Women in male headed households should be encouraged to adopt good water treatment practices to shield their households from diseases. 3) Basic education should be promoted for all citizens so as to have more households heads who have attained at least primary education. 3. Poverty alleviation policies and programs that could make households leave the poorest quintile of the wealth index should be encouraged by government with assistance from the private sectors.

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Informed Consent Statement

This paper did not require any patients and therefore there were no informed consent.

Author Contributions

Tochukwu Georgina Onyechi: Writing – original draft
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Joseph Iyidiobu Amuka: Supervision, Writing – review & editing
Victoria Ibrahim Hauwa: Writing – review & editing

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Data Availability Statement

The data used in this study is the MCIS available at the World Bank database and it is also available on request.

Conflicts of Interest

The authors declare no conflicts of interest.

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