Effect of Access to Potable Water and Sanitation on Health of Under-five Children in Rural Nigeria

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Abstract

This paper examined the effect of access to potable water and sanitation on the health of under-five children in rural Nigeria employing the Demographic and Health Survey (DHS) 2008 data. Exactly 13,571 households were analysed using descriptive statistics and probit regression. The results show that the average age of child was 27 months, more than half of the mothers had no formal education and 63.67% had access to potable water. Probit regression results reveal that access to potable water decreases the probability of an under-five child being underweight ($p<0.05$) and having diarrhoea ($p< 0.01$). Access to improved sanitation decrease the probability of under-five child being underweight ($p<0.05$) and having diarrhoea ($p<0.01$). Access to potable water and sanitation reduces nutritional disorders and diarrhoea prevalence among under-five children. The development of appropriate mitigation measures will aid in the achievement of the Sustainable Development Goals (SDGs).

Keywords: Diarrhoea, Health, Potable water, Under-five children.

Introduction

Potable water is important for human survival. It is a basic necessity for good health. However, water related illnesses are the prominent health threat in the developing world. About 1.7 million deaths annually are related to drinking unsafe water and poor disposal of wastes (WHO, 2008). Unsafe water can be a significant carrier of diseases such as trachoma, cholera, typhoid and schistosomiasis (UNICEF/AFGA, 2009). Children especially under the age of five are most vulnerable to the effects of contaminated water and lack of hygienic sanitation due to their low natural immunity (Adewara and Visser, 2011). Studies in different countries have shown that the quality of water has significant positive relationship with reductions in diarrhoea and mortality (Classen *et al*., 2007; Kremer *et al*., 2009).

Water problems affect half of humanity. About 1.1 billion people in developing countries lack access to water and 2.6 billion people lack basic sanitation (WHO and UNICEF, 2006). According to the World Bank, 88% of diseases in the developing world is caused by unsafe drinking water (Ashbolt, 2004). Diseases from microbial pollution may be the result of the contamination of drinking water by human or animal faeces containing pathogenic bacteria and viruses that may cause cholera, amoebic and bacillary dysentery and other diarrhoeal diseases (Fogden and Wood, 2009). Today, Africa is facing the challenge of how to make up the deficiencies in creating sustainable access to potable water. Despite aid to water and sanitation targeted at regions most in need of better access to water and sanitation (Sub-Saharan Africa received about a quarter (26%) of total aid to the sector, and

South and Central Asia 21%), many developing countries' improved water supply schemes are not functioning properly (Vasquez *et al*., 2009; Kleemier, 2000). As reported by Baumann (2005), 35 % of all rural water systems are not functioning. Thus, the sustainability of both new and existing water systems is essential and should be considered.
One of the key areas of the Sustainable Development Goals (Goal 6), is to ensure access to safe water sources and sanitation for all (United Nations, 2015). According to Multiple Indictor Cluster Survey (MICS) report for Nigeria (2011), over 63 million Nigerians lack access to improved water source while 112 million people do not have access to adequate sanitation. Over 97,000 children die every year from diarrhoea caused by unsafe water and poor sanitation. The loss of 443 million school days each year in Nigeria results from water-related illness. Close to half of people in developing countries suffer at any given time from a health problem caused by water and sanitation deficits with millions of women spending several hours per day collecting water. Also, water infrastructure is suffering from severe neglect. Rural areas in particular face a decline in services and in urban areas people are forced to buy water from private vendors, which most cannot afford. Local governments often do not have the funds to make necessary improvements and can instead be forced to use short-term solutions which cannot be maintained by the communities who need them.
(www.wateraid.org/ng/what-we-do/the-crisis/water).

At all levels (micro and macro), access to safe potable water is important as a health and development issue and improving this access can be an effective part of poverty alleviation strategies. There is a widespread assumption that safe; affordable water for potable and domestic use is available to all but the reality is that some rural areas (low-income communities) lack access to water for the most basic human needs. This lack of access to clean, safe potable water can be caused by contamination in the water or because of a lack of adequate potable water and wastewater infrastructure, such as old or nonexistent plumbing facility (WHO, 2008). Also, inadequate access to potable water may be responsible for diseases in women and children especially in rural areas who bear the primary responsibility of carrying water, often for long distances (MICS Nigeria, 2011).

Furthermore, lack of access to safe potable water and sanitation results in high mortality rate, malnutrition of children especially under five children. As observed by Eneh (2005), malnutrition is responsible for high rate of stunting (33.5%), underweight (30.7%) and wasting (15.6%) among under-five children. Water is one of the most important nutrients for keeping children healthy and helping them perform better. Annually, 4 billion cases of diarrhoea occur in Nigeria, of which 88% is attributable to unsafe water, inadequate sanitation and poor hygiene. It is reported that 1.8 million people die every year from diarrhoea diseases, the vast majority of whom are children under five years of age. WHO estimates that 94% of diarrhoea cases are preventable through modifications of the environment including through interventions to increase the availability of clean water, and to improve sanitation and hygiene. (WHO, 2008).

Although a number of reviews exist on water and human health (DFID, 2004), only a few focused on public health and economics at the household level. Adekalu *et al.* (2002) studied the demand for drinking water and

Agbelemoge and Odubanjo (2001) worked on supply, while willingness to pay for potable water supplies was examined by Casey *et al*. (2005) and Adepoju and Omonona (2009). They all placed little focus on children.

This study therefore assessed effect of access to potable water and sanitation on health of under-five children in rural households in Nigeria. It also examined the effect of potable water and sanitation at the household level on the health and nutritional status of under five children in rural Nigeria. This is important considering the fact that high infant mortality is greatly associated with contaminated water. It differs from pervious paper on diarrhoea as it considers the probability of under five children being stunted, wasted and underweight. Therefore, this study used anthropometric measures (stunting, wasting and underweight) and the incidence of diseases (diarrhoea) to examine the effect of access to potable water and sanitation on the health of under five children and answered the following questions:

1. What are the water, sanitation and nutritional characteristics of under-five children?
2. What is the effect of access to potable water and sanitation on the nutritional status and diarrhoea prevalence of under-five children?

Materials and Methods

Study area

The study area is rural Nigeria. Nigeria, the most populous nation in Africa, is made up of 36 States and a Federal Capital Territory (FCT), grouped into six geopolitical zones: North West, North East, North Central, South East, South South, and South West and with 774 constitutionally recognized local government areas (LGAs). Nigeria lies between latitudes $4^0 16'$ and $13^0 53'$ north and longitudes $2^0 40'$ and $14^0 41'$ east with population of 140,431,790 (NPC, 2006).

Data Sources and Collection

The study employed the 2008 Demographic and Health Survey (DHS) a nationally representative data. Data was extracted for rural Nigeria and a total of 13, 571 households were considered for this paper.

Methods of Analysis

This paper employed both descriptive statistics and the probit regression analysis.

Probit regression model

The probit regression analysis was used to isolate the effect of access to potable water on the health of under-five children in rural Nigeria.

The general model is specified as:

$$P_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_n x_n + v \ldots\ldots (1)$$

P_i, which is the health of child, was measured in two forms:

i. Nutritional status measured using the anthropometric measures (stunting- 1= stunted and 0 otherwise; wasting 1= wasted and 0 otherwise; underweight 1= underweight and 0 otherwise)
ii. Diarrhoea prevalence (1= yes and 0 otherwise)

The explanatory variables are presented in Table 1.

Table 1: Explanatory variables

	Variable	Measurement
X_1	Age of child	Years
X_2	Sex of Child	Male = 1, Female =0
X_3	Mother's years of education	Years
X_4	Wealth Index	Poorest = 1, Poorer = 2, Middle=3, Richer=4, Richest= 5
X_5	Access to source of water	[1] Improved=1, Unimproved=0
X_6	Mother's age	Years
X_7	Access to toilet facility	Improved=1, Unimproved=0
X_8	Household size	Number
X_9	Fathers years of education	Years
X_{10}	Father's Occupation	Agricultural services=1; Non-agricultural services=0
X_{11}	Floor material	Improved=1, Unimproved=0
X_{12}	Roof material	Improved=1, Unimproved=0
X_{13}	Wall material	Improved=1, Unimproved=0
X_{14}	Region	North Central, North East, North West, South East, South West, South South
X_{15}	Duration of Breastfeeding	Months

Results

Socioeconomic Characteristics

The socioeconomic characteristics in Table 2 indicates that 49.54% of the under five children were males and 50.46% were females with about 25% of them between 0-12 months of age. The mean age was 27 months . The mothers were mostly between 20 and 39 years old (83.08%). In addition, 54.30% of the mothers had no form of formal education. Majority of the households had about 4-6 members (42.98%). About 58% of household heads were engaged in agriculture–related activities while only 41.78% were engaged in non-agricultural occupation.

Water, Sanitation and Nutritional Characteristics

The proportion of rural households with access to potable water was 36.45%, which is low in relation to those without access (63.55%). Also, 56.82% of households had access to improved toilet facility/sanitation. Improved toilet sources include; flush to piped sewer system, flush to septic tank, flush to pit latrines, ventilated pit latrine and pit latrine with slabs. Unimproved sources include; composting toilet, bucket toilet, hanging toilet and bush. In addition, most of the under five children were breastfed between 13-24 months, 45.94% were stunted; 26.98% were underweight; 15.51% were wasted and only 11.1% had diarrhoea.

Table 2: Socio-economic Characteristics of Under Five Children in Rural Nigeria

Characteristic	Frequency	Percentage
Sex		
Male	6723	49.54
Female	6848	50.46
Child's age in months	3324	24.49
0-12	2664	19.63
13-24	2470	18.20
25-36	2757	20.32
37-48	2356	17.36
49-60		
Household Head occupation	7901	58.22
Agricultural services	5670	41.78
Non-agricultural services		
Household Size	1099	8.10
1-3	7833	42.98
4-6	3886	28.63
7-9	2753	20.29
10 and above		
Mothers age	774	5.70
< 20	11275	83.08
20-39	1522	11.22
40-59		
Mother's education	7369	54.30
No education	3363	24.78
Primary	2507	18.47
Secondary	332	2.45
Higher		
Region of origin	2481	18.28
North central	3206	23.78
North East	6674	28.68
North West	1485	7.34
South East	2465	12.83
South West	1638	9.25
South South		

[1]Improved water sources in this paper is termed as potable water. According to UNICEF (2003), the improved water sources included water piped into dwelling, piped into yard/plot, public tap/stand pipe, borehole, protected well and protected spring, while the unimproved sources were the unprotected well, unprotected spring, river, rain water, tanker truck and tart with small tank.

Table 3: Distribution of under-five children by Potable water source, Sanitation and Nutritional characteristics

Characteristics	Frequency	Percentage
Water		
Improved potable water source	8624	63.55
Unimproved potable water source	4947	36.45
Sanitation		
Improved toilet facility	5860	43.18
Unimproved toilet facility	7711	56.82
Nutritional Characteristics		
Duration of Breastfeeding (months)		
No breastfeeding	588	4.33
1-12	1096	8.08
13-24	6719	49.51
25-36	208	1.53
37-48	2	0.02
Still breastfeeding	4958	36.53
Stunted	6234	45.94
Not stunted	7337	54.06
Underweight	3661	26.98
Not underweight	9910	73.02
Wasted	2105	15.51
Not wasted	11466	84.49
Had Diarrhoea	1506	11.1
No Diarrhoea	12065	80.90

N= 13571

Effect of access to potable water and sanitation on the health of the under-five children

Effect of access to potable water and sanitation on nutritional status of under-five children

The effect of access to potable water on the probability of a child being stunted, underweight and wasted is presented in Table 4. Access to potable water was significant and negative with the probability of a child being underweight at 5%. The marginal effect estimates reveals that the probability of a child being underweight decreases by 0.02. Access to improved sanitation facilities was significant and negative with the

probability of a child being underweight. The marginal effect estimates reveal that this probability decreased by 0.02 percentage points.

Other significant factors that affect nutritional status of under-five children are discussed. The age of child was negatively related to the probability of stunting and underweight but positively related with the probability of a child being wasted. The marginal effect estimates reveals that this probability decreased by 0.01percentage points for both stunting and underweight while the probability of a child being wasted increased 0.01 percentage points as the age of child increases. The sex of the child was significant and positive. The marginal effect estimates reveals that the probability of being stunted, underweight and wasted increases for being a male by 0.06, 0.03 and 0.01, respectively.

The age of the mother was negative and significant to the probability of the child being stunted and underweight. The marginal effect estimates reveals that the probability of a child being stunted and underweight decreased by 0.01 percentage points. Mother's education was negative and significant with the probability of a child being stunted, underweight and wasted. The marginal effect estimates reveals that this probability decreased by 0.04, 0.06 and 0.03 percentage points for stunted, underweight and wasted respectively as the mother's years of education increase. Duration of breastfeeding was significant and negative with the probability of a child being stunted and underweight at 1%. The marginal effect estimates reveal that the probability of child being stunted and underweight decreased by 0.02 and 0.01 percentage points, respectively.

Effect of access to potable water and sanitation on the probability of a child having diarrhoea

As presented in Table 4, access to potable water was significant and negative with the probability of an under-five child having diarrhoea. The marginal effect estimates reveal that this probability decreases by 0.002 percentage points. Access to improved sanitation is also negative and significant at 1% and the marginal effect estimate reveals that the probability decreased by 0.007 percentage points.

Table 4: Effect of access to potable water and improved sanitation on health of under-five children

Independent	Stunting		Underweight		Wasted		Diarrhoea	
Variables	Coefficient	Marginal Effect	Coefficient	Marginal Effect	Coefficient	Marginal Effect	Coefficient	Marginal Effect
Access to potable water	-0.04±0.03	-0.01±0.01	-0.05±0.03**	-0.02±0.01**	-0.04±0.03	-0.01±0.01	-0.01± 0.00***	-0.001± 0.001**
Age of Child	-0.03±0.01***	-0.01±0.00***	-0.04±0.01***	-.012±0.00***	0.06±0.01***	0.01±0.00***	-0.13±0.01***	-0.02±0.00***
Sex of child	0.14±0.02***	0.06±0.01***	0.08±0.02***	0.03±0.01***	0.05±0.03**	0.01±0.01**	-0.06±0.03**	-0.01±0.01**
Age of Mother	-0.02±0.01**	-0.01±0.003**	-0.02±0.01***	-0.01±0.002***	-0.01±0.01	-0.004±0.002	-0.004±0.01***	-0.003±0.002***
Duration breastfeeding	-0.05±0.01***	-0.02±0.003***	-0.005±0.01***	-0.001±0.003***	-0.02±001	-0.004±0002	-0.003±0.01	-0.001± 0.002
Household Size	0.01±0.01	0.003±0.005	-0.014±0.014	-0.005+0.005	0.006±0.02	0.001±0.004	0.01±0.02	0.002±0.003
Access to improved sanitation	-0.01±0.03	-0.004±0.01	-0.05±0.03**	-0.02±0.01**	-0.02±0.03	-0.005±0007	-0.05±0.003***	-0.01±0.01***
Father Occupation	-0.01±0.01	-0.01±0.003	-0.002±0.009	-0.001±0.003	-0.01±0.01	-0.002±0.002	-0.04±0.01***	-0.01±0.002***
Fathers Education in years	-0.001±0.01	-0.001±0.01	-0.04±0.016***	-0.013±0.01***	-0.08±0.02***	-0.02±0.004***	-0.02±0.02	-0.004±0.00337
Wealth index	-0.07±0.02***	-0.03±0.01***	-0.03±0.02	-0.008±0.01	-0.03±0.02	-0.007±0.005	-0.04±0.03	-0.007±0.005
Roof material	-0.03±0.03	-0.01±0.01	-0.04±0.03	-0.01±0.01	-0.07±0.04**	-0.02±0.008**	-0.06±0.04	-0.01±0.001
Wall material	-0.09±0.03***	-0.03±0.01***	-0.07±0.04**	-0.022±0.01**	-0.04±0.04	-0.008±0.00947	-0.05±0.05	-0.01±0.008
Floor material	-0.01±003	-0.003±0.013	-0.09±0.04***	-0.030±0.01***	-0.09±0.04***	-0.02±0.009***	-0.010±0.04	-0.002±0.007
Mother Education(years	-0.11±0.02***	-0.04±0.01***	-0.18±0.02***	-0.06±0.007***	-0.13±0.02	-0.03±0.01***	-0.003±0.026	-0.0006±0.004
North East	0.01±0.04	0.004±0.01	0.280±0.04***	0.093±0.014***	0.43±0.05***	0.11±0.01***	0.62±0.05***	0.13±0.01***
North West	0.08±0.04***	0.03±0.01***	0.38±0.04***	0.13±0.014***	0.46±0.05***	0.11±0.01***	0.39±0.05***	0.08±0.01***
South East	-0.39±0.05***	-0.15±0.02***	-0.17±0.06***	-0.05±0.02***	-0.18±0.07***	-0.04±0.02***	-0.07±0.08	-0.01±0.01
South West	-0.21±0.04***	-0.08±0.02***	-0.13±0.05***	-0.04±0.02***	-0.02± 0.06	-0.005±0.01	-0.12±0.07***	-0.02±0.01***
South South	-0.14±0.05***	-0.05±0.02	-0.14±0.05***	-0.04±0.02***	-0.03±0.06	-0.01±0.01	0.11±0.07	0.02±0.01

N= 13571; Values are means ± standard error; ***1%, **5%, *10% level of significant.

Discussion

The socioeconomic characteristics showed that there is no great disparity in the sex distribution of under-five children with an average age of under-5 children being 27 months. Majority of the mothers were in their economically active years with more than half of these mothers without formal education (54.30%). Adewara and Visser (2011) posited that the investment in human capital especially women has great importance in the role that women play in the upbringing of a child. Households were fairly large and household heads mostly engaged primarily in agriculture-related activities. This is typical of rural areas where the occupation is predominantly agriculture.

The proportion of rural households with access to potable water was low and slightly more than half of the households had access to improved toilet facility/sanitation. Improved toilet sources include; flush to piped sewer system, flush to septic tank, flush to pit latrines, ventilated pit latrine and pit latrine

with slabs. Unimproved sources include; composting toilet, bucket toilet, hanging toilet and bush. Most of the under five children had a minimum of up to 13 months of breast feeding and were stunted (45.9%), underweight (27%), wasted (15.5%) with 11.1% of them having diarrhoea which is a concern considering the population of under-five children affected. Access to potable water and sanitation have been found out to reduce or reverse malnutrition (stunting, wasting and underweight and diarrhoea) in under five children and vice versa (Merchant *et al*., 2003; Schmidt, 2014)**.** Lack of access to potable water is one of the major causes of ill-health in under-five children (WHO, 2008; Adewara and Visser, 2011). Also, the rampant causes of diarrhoea across the country among children has been attributed to lack of potable water most especially during the dry season Uneze (2015).

Access to potable water significantly decreases the probability of a child being underweight. This implies that access to potable water plays a huge role for reducing underweight among under-five children in the country. This is in line with the findings of Gamper-Rabindran *et al*. (2007) that improving access to piped water and sanitation has been shown to significantly reduce infant mortality rates. The probability of an under-five child being underweight decreases with access to potable water. In addition, access to potable water was not significant for stunting and wasting, though negative. This could be that access to potable water is not a major cause of stunting and wasting among under-five children in rural Nigeria. This further implies that under-five children with access to potable water are less prone to be underweight compared with those that lack access to potable water.

Access to improved sanitation facilities significantly reduces underweight among under-five children. This result agrees with the findings of Adewara and Visser (2011; Babatunde *et al*. (2011 that availability of improved toilet facility for human waste is essential for healthy life and adequate growth of children and lower the risk of infectious diseases and malnutrition.

As the age of child increases, the probability of the child being stunted and underweight reduces significantly but increases the probability of a child being wasted. This implies that other things being equal, older children are more likely to be less stunted and underweight. This finding is consistent with that of Babatunde *et al*. (2011) and Adewara and Visser (2011) who reported similar results for stunting and underweight. The sex of the child was significant and positive, implying that male under-five children are more likely to be stunted, underweight and wasted. This is similar to findings in sub-Saharan Africa that male under-five children are more likely to become stunted, underweight and wasted than their female counterpart of the same age group (Ozor *et al*., 2014).

The age of the mother was negative and significant to the probability of being stunted and underweight. This implies that as mothers grow older, the probability of a child being stunted and underweight reduces due to the experience acquired in child nutrition/raising. Mother's education was also negative and significant with the probability of a child being stunted, underweight and wasted. This result is not far-fetched as it is believed that educated Mothers have better information on children's health care and generally earn higher incomes than mothers who are not educated. It is expected that the more educated a mother is, the more likely she is to be receptive to developmental initiatives such as the Childhood Survival Strategies, have improved family nutrition and less risk of childhood malnutrition (UNICEF, 2000;

Webb and Block, 2004). Furthermore, under-five children with longer periods of breastfeeding are less likely to be stunted and underweight.

Other factors that have significant but negative effects on the probability of a child being stunted, underweight and wasted are fathers' education, wealth index, using improved roof material, wall material and floor material, and being resident in the southern region of the country. However, being resident in the northern regions of the country has a positive influence on the probability of under-five children's nutritional status.

Access to potable water is significant and negative with the probability of an under-five child having diarrhoea. This implies that children with access to potable water are less prone to diarrhoea. Access to improved sanitation was also negative. This suggests that access to improved sanitation facilities reduces the probability of a child having diarrhoea as it has been posited that lack of clean water and adequate sanitation is the leading contributor to diarrheoa diseases in children (Gamper-Rabindran *et al*. 2007), which account for 19 percent of total child deaths (Boschi-Pinto *et al*., 2008).

Other correlates that negatively influence the probability of an under-five child having diarrhoea are age of child, being a male child, mother's age, fathers' occupation (engaged in agriculture, being resident in the southern region of the country. While under-five children resident in the northern regions of the country have positive effect.

Conclusion

Potable water is important for sustaining human health especially under five children. Findings from this study show that access to improved source of water will prevent under five children from being stunted, underweight and wasted. Drinking from unsafe/ unimproved water source can lead to diarrhoea in under five children. There is the need to provide access to safe potable water and maintenance of the already existing water source in rural areas in a way of achieving the MDG goals, now SDG goals of combating diseases, reducing child mortality and eradication of extreme poverty and hunger.

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