



## Effect of Water Sources on Wasting of Under Five Years Old Children in Nigerian Rural Households

H.O. Obekpa, G.A. Abu and O. Abu

Department of Agricultural Economics,  
Federal University of Agriculture  
Makurdi, Benue State, Nigeria

E-mail of corresponding author: [obekpahephzibah@gmail.com](mailto:obekpahephzibah@gmail.com)

### ARTICLE INFO

### ABSTRACT

#### Key Words

Safe water,  
Food security,  
Infant wasting  
Household  
random effects  
model

Wasting in developing economies like Nigeria is strongly linked to sources of water consumed by children under five. This linkage matters as water has been linked to all four pillars of food and security. This paper, therefore, helps to address a gap in the literature on how sources of water are linked to wasting in under five children in Nigeria. Panel data from the three waves of the Living Standard Measurement survey of households in Nigeria, a representative of Africa's most populous nation, was used for the study. Only households in rural Nigeria were used since majority of rural households are farmers. The empirical approach includes regressions with household random effects to account for time-invariant unobserved and observed characteristics that could jointly determine wasting. It was found that pipe-borne water decreased the probability of wasting while borehole and well increased the probability of wasting in children under five. Specifically, pipe-borne water decreased the probability of wasting marginally by 0.02 at the 5 percent level of significance while borehole on average increased the probability of wasting by 0.09 at the 1 percent level of significance and well increased the probability of wasting by 0.13 at the 1 percent level of significance implying these secured sources of water might not necessarily be safe for direct consumption by children. Our finding is relevant to future policies on nutrition education for mothers to improve the nutrition of their children.

## Introduction

Africa, especially Sub-Saharan Africa, is still struggling with high rates of malnutrition in children from 0 to 59 months, with a high proportion of 41 percent of stunted children (World Health Organization [WHO], 2017), malnutrition remains a burden in Nigeria. According to The National Bureau of Statistics report for 2017, the prevalence of wasting increased marginally from 10.2 percent to 10.8 percent. Wasting which can be used to assess the nutritional status of under five children can result from anthropometric indices of weight for age (Food and Nutrition Technical Assistance [FANTA], 2013). A host of health and economic consequences are associated with wasting. Some of the consequences includes increased risk of infections during childhood,

decline in cognitive productivity, poor educational outcomes and low productivity and earnings in adulthood (Black, et al. 2008). Weight-for-age indicates horizontal growth in a child. Low weight-for-age also called wasting is a consequence of long term, accumulated deficiencies of health and nutrition (Pradeep et al, 2013). Mechanisms underlying wasting remain unexplored in rural areas of Nigeria. As one of the fastest urbanizing country on the continent, Nigeria still faces significant challenges in providing clean water for her increasing population. Population explosion which leads to overcrowding of communities affects sanitation, the quality of housing because of the



pressure exerted on the limited resources, and availability of fresh water due to increasing consumption of water and water-intensive goods and pollution (He et al, 2018). The situation is worsened by poor environmental management and regulation which are failing to prevent the pollution of freshwater resources by accumulation of household and industrial wastewater effluents (Ijaiya and Joseph, 2014). Water, sanitation, and hygiene (WASH) has been linked to all four “pillars” of the food and nutrition security framework Cumming and Cairncross (2016), as immediate or proximate risk factors, but also as more distant causes. The most direct pathway that links poor WASH to undernutrition is via repeated bouts of diarrhea (Brown et al. 2013; Casanovas et al. 2013). Ishakuet al. (2011) reports that water crisis is looming large in the rural areas as well, the effect is felt especially during the dry seasons, leaving as high as 70 percent of the households in serious water insecurity.

#### *Related Literature Review*

Nutrition in Nigeria is important because Nigeria will become the 3rd most populous nation in the world in 2050 with a staggering population of 440 million people (Population Reference Bureau, 2013) and if malnutrition persists in Nigeria then it will become a global problem in 2050. Debale and Sharma, (2014) found male children, no formal mother education, wealth index (poor households), rural residence, low mother's body mass index, frequent bouts of diarrhea and fever to be factors that have a significant impact on the wasting of children under the age of five in Ethiopia, while Balogun and Yakubu (2015) have found diarrhea in Nigeria to be associated with wasting in children aged 0 to 59 months. In their research, Akombi et al. (2017) reiterated wasting-related factors in Nigeria to include living in the geographic northwest region, low parent education, being a male child among other factors such as birth size and Mother's Body Mass Index. A strong correlation has been found between mother's education and wasting in their work on severe acute malnutrition in a population of hospitalized under-five Nigerian children, as reported in Ogunlesi et al. (2015).

Likewise, in their study in Ghana, Novignon et al. (2015) found residence in rural areas, low maternal education, wealth index (poverty), male child and the northern geographical area to be factors

significantly associated with wasting. Beiersmann et al. (2013) stated that rural residence, 24-35 months of age, faith (being a Muslim) and younger siblings were factors impacting wasting in Burkina Faso in 2013. Olusanya et al (2010) also found multiple births, home delivery, male children, young mothers and shared waste-related sanitation facilities in Nigeria were associated with wasting while Odunayo et al (2006) recorded that infants overcrowding, low maternal income and type of supplementary feed were influencing wasting. In their work in Nigeria, Ukwuani and Suchindran (2003) reported that diarrheal episodes, short breastfeeding duration, fever, low birth weight, non-Christian religion and no immunization were the factors significantly associated with their study's wasting.

Other researches on wasting-related factors in Nigeria includes works by authors such as Ojofeitimi et al. (2003) who reported low mother education, children between 12 and 36 months of age, high child parity, no immunization and the polygamous family as wasting-related factors, Abidoye and Ihebuzor (2001) found low mother education, single mothers, non-workers, poor households, prolonged breastfeeding for more than 12 months, poor water supply, regular water supply, housing type and toilet facilities were factors influencing wasting. In 2011, Gewa and Yandell identified female children in their study, diarrheal episode, maternal underweight, low mother education, poor household, living in urban areas as factors associated with Kenya's wasting of under five children. In their research in Kenya, Bloss et al. (2004) documented diarrheal occurrence, early initiation of complementary feeding, unimproved source of drinking water, non-up-to-date immunization, and no kitchen garden as wasting factors. In Uganda, Kikafunda et al. (1998) found residence in rural areas, poor health status, unimproved source of drinking water, lack of charcoal as fuel, lack of milk consumption and lack of personal hygiene were found to be correlated with wasting.

Getaneh et al. (1998) also found children over 2 years of age, low socio-economic status, non-availability of latrine, unimproved source of drinking water, an attack of *pertussis*, non-completion of immunization, inadequate nutritional diet, poor housing and prolonged breastfeeding for more than 12 months were factors associated with wasting in Ethiopia. Alemayehu et al. (2015) also found factors associated with wasting in Ethiopia to include late initiation of breastfeeding, limited

breastfeeding period (6-11 months) and mothers' inability to make financial decisions.

## Research Methods

The population for this study consisted of children under the age of five years in Nigeria. The GHS-Panel survey is modeled after the Living Standard Measurement Study-Integrated Survey on Africa (LSMS-ISA) surveys and is representative at the national, zonal, state and local government area levels. The LSMS which was sponsored by the World Bank consists of an unbalance panel from three waves collected in 2010, 2012 and 2015. Data collection was done at the household and individual level, the components used for this analysis includes the asset component, health component, roaster component and housing component. Only households with children under the age of 5 were selected for the study. Age and weight of the children were converted to z-scores and outliers following WHO recommendation for the range of wasting were dropped, bringing the number of children used for this analysis to 24,813.

### Empirical Approach

The empirical approach adopted includes pooled ordinary least squares (OLS) and random effects probit regressions models. The random effects estimation approach leveraged on the fact that about 24,813 children under five were surveyed in multiple waves. Observed and unobserved household characteristics that do not change between successive waves of the survey become useful in estimating the relationship between households' sources of water and wasting in children. The dependent variable wasting was measured as a dummy variable, 1 was given to children whose standardized z-score is less than -2 indicating they are wasted and 0 was given to children whose z-score is greater than -2 indicating they are not wasted. Our treatment variables (pipe, borehole, well and other sources of water aggregated together) were measured as dummy variables, income which was proxied by asset was measured in naira, age of household head was measured in years, education of household head, education of mothers, sex of household head, sex of child, no water flush toilet, water flush toilet and other types of toilet were measured as dummy variables. Household size was measure per person.

### Variable/Model Specification

Probit random effect showing the effect of water sources on wasting is modeled below following (Train, 2009).

$$P_{nit} = \int_{\varepsilon_{it} \in B_{it}} \phi_{\varepsilon_{it}} \partial \varepsilon_{it}$$

where,

$P_{nit}$  = Probability of wasting that varies for child in time  $t$ .

$\beta_{it}$  are treatment and covariates that varies for individual  $i$  in time  $t$  listed below.

Water sources that varies for individual  $i$  in time  $t$  (treatment variables) and other covariates (income, age of household head, education of household head gender of household head, gender of child, education of mother, number of household size, type of toilet, health status of child, dummy for geo-political zones) that varies for individual  $i$  in time  $t$ .

$\phi_{\varepsilon_{it}}$  = joint normal density with covariance  $\Omega$ .

$\varepsilon_{it}$  = Random error term that varies for individual in time  $t$ .

## Results and Discussion

Table 1 summarizes the number of children in rural areas wasted, sources of water measured like pipe borne water, borehole, well and others as a reference category. Other variables summarized includes income which was proxied by household asset, education of household head measured as a dummy variable, sex of the child, no water flush toilet, water flush toilet, if the child has been sick in the last one month before the survey, education of mother measures as a dummy variable and household size. On average about 7 percent of the children under five were wasted, on average about 12 percent of the respondents live in households' whose source of water is well, on average about 24 percent of the respondents live in households' whose source of water is borehole while 7 percent live in household's whose source of water is well. The log of the value of income is 11.45 on average, the real value in naira is 353,154.8, when compared with the average family size of 6 this implies that majority of household surveyed were poor as it translates to less than 1.25 USD per day, the international poverty line. On average, the age of the household head was 45 years which implies they are still young with energy to work and fend for their families. On average about 87

percent of the head of households had a formal education, 36 percent reported they use toilets with no water flush system while 21 percent used a water flush toilet. About 17 percent of children surveyed were sick in the last one month before the survey and 98 percent of mothers have had a formal education and the average household size was 6.3 which implies a large household on average.

**Table 1: Descriptive statistics of data**

Variables	Number of Children	Mean	Std. Dev.	Minimum	Maximum
Wasted	24,813	0.07	0.25	0	1
Pipe	24,813	0.12	0.32	0	1
Borehole	24,813	0.24	0.43	0	1
Well	24,813	0.07	0.26	0	1
Log (Income)	24,716	11.45	1.50	3.91	18.95
Age of household head	24,486	45.44	12.35	18	85
Education of household head	23,986	0.87	0.33	0	1
Sex of child	24,813	0.49	0.50	0	1
Sex of head of household	24,813	0.50	0.50	0	1
No water flush toilet	24,813	0.36	0.48	0	1
Water flush toilet	24,813	0.21	0.40	0	1
Sickness in the last one month	24,813	0.17	0.37	0	1
Education of mother	24,813	0.98	0.11	0	1
Household size	24,785	6.31	2.84	1	31

Source: Authors analysis

Table 2 shows the estimates of the Probit model and random effect Probit regression for effect of water sources on wasting. The random effect Probit regression is reported because of its obvious advantage of measuring time invariant unobserved heterogeneity and time invariant observed heterogeneity. The result shows that children who had access to pipe borne water were less likely to get wasted by an average of 0.02 at the 5 percent level of significance compared to children who has access to other sources of water. This result could be attributed to the treatment of water by ministry of water works before distribution to households. It should also be noted that access to pipe borne water is an indication of improved resource allocation because pipe borne water is not available everywhere in Nigeria and therefore children in such areas are less likely to suffer from wasting. It is also worth to mention that while access to pipe borne water cannot eliminate wasting, it has the potential of reducing it significantly. This result is also supported and emphasized by Hunter et al. (2009) who found that homes and communities with access to pipe borne water had children under five with better nutrition

including wasting compared to those who do not.

Furthermore, the estimates for borehole and well showed that children who had access to borehole and well were more likely to be wasted by averages of 0.09 and 0.13 at the 1 percent level of significance respectively. Although water gotten from boreholes are assumed to be cleaner than water gotten from wells, but it does not translate into safe water as the depth of boreholes and wells also affects the quality of their water. This result is reinforced by the findings of Hunter (2009) who reported that many improved water sources have poor reliability and are associated with increased health risk like diarrheal which is a major cause of wasting in children.

The coefficient on income is negative and significant at 1 percent implying that an increase in income will reduce the probability of wasting by 0.01. The estimate on income is not surprising as respondents were likely to mention prices of assets which is used as a proxy for income at random when the questions were asked, this should be borne in mind when interpreting the coefficient for assets because of its marginal value. This result is in line with Dev and Ravi (2007) who found that increased wealth is associated with lower malnutrition in India. Male headed households increased the probability of wasting by an average of 0.01 at the 5 percent level of significance, it could be that female headed households are better off because women who head their households commit more resources for nutrition compared to men.

The result on the education of the household head which was measured as a binary variable shows that parents who are educated are less likely to have wasted children by an average of 0.01 at the 1 percent level of significance compared to children with parents who had no formal education, this is also in line with Galgamuwa et al. (2017) who found the probability of wasting to be lower in households with parents who are educated. The result also reveals that male children were more likely to get wasted compared to female children by an average of 0.04, this result agrees with Khan and Kraemer, (2009) who found wasting to be higher in male children compared to their female counterparts. It was also surprising to find out that households who use no water flush toilets like latrine were less likely to have wasted children by an average of 0.04, it could be that households with such toilets take extra efforts to maintain strict hygiene in the toilet and this could also be attributed to the fact that most children under 5 use the potty ( a bowl used by small children as toilet) as against normal toilets. As expected, the sign on the coefficient of water flush



toilet is negative, implying that children in households with water flush system are less likely to be wasted by an average of 0.06 at the 1 percent level of significance. Same with children whose mothers have had a formal education were less likely to be wasted by an average of 0.2 at the 1 percent level of significance compared to children whose mothers have had no formal education, it could be that educated mothers are well informed about nutritional values of food and are quick to understand nutrition education compared to women with no formal education. This result is in line with Black (2013) and Duruet al.(2015) who reported that mother's education reduces the probability of wasting in children.

**Table 2: Effect of Water Sources on Wasting of Children**

Variables	Probit	Random Effect Probit Regression	Effect	Marginal effects for RE
Pipe water born	-0.47(0.07)***	-0.18(0.07)**		-0.02(0.01)**
Borehole	0.48(0.04)***	0.73(0.05)***		0.09(0.02)***
Well	0.71(0.05)***	1.03(0.06)***		0.13(0.03)***
Income	-0.05(0.01)***	-0.06(0.01)***		-0.01(0.002)***
Head of household education	-0.02(0.04)	-0.08(0.04)*		-0.01(0.01)*
Age of household head	-0.01(0.001)***	-0.01(0.001)***		-0.001(0.0004)***
Sex of child	0.26(0.03)***	0.32(0.02)***		0.04(0.01)***
Sex of head of household	0.05(0.03)*	0.07(0.03)**		0.01(0.004)**
No Water flush toilet	-0.25(0.04)***	-0.31(0.07)***		-0.04(0.01)***
Water flush toilet	-0.07(0.05)***	-0.45(0.07)***		-0.06(0.02)***
Sick in the past one month	-0.06(0.04)	-0.03(0.04)		-0.004(0.005)
Mother's education	-1.77(0.09)***	-1.67(0.09)***		-0.20(0.06)***
Household size	-0.02(0.01)***	-0.02(0.01)***		-0.003(0.001)***
North Central	-0.28(0.05)***	-0.16(0.05)***		-0.02(0.01)***
North East	0.85(0.05)***	0.75(0.05)***		0.09(0.03)***
North west	0.52(0.05)***	0.41(0.05)***		0.05(0.01)***
South East	-0.12(0.06)**	-0.18(0.06)***		-0.02(0.01)**
South-South	-0.12(0.05)***	-0.15(0.05)***		-0.02(0.01)**
Number of Observations	23,864	23,864		23,864
Constant	-0.21(0.17)	-0.71(0.30)**		-0.71(0.30)**
Log likelihood	-4954.7571	-4850.3949		-4850.3949

Standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Households with larger family size were less likely to be wasted, this could be as a result of increased family labor which could yield more income and improve their quality of life thereby reducing the probability of wasting. Children in the North-Central part of Nigeria were less likely to be wasted by a probability of 0.02 at the 1 percent level of significance while children in the North-East and North-West regions of Nigeria were more likely to be wasted by probabilities of 0.09 and 0.03 respectively at the 1 percent level of

significance. This is in line with a priori expectation as malnutrition is not homogenous in Nigeria and people in the north suffer more wasting because the northern part of Nigeria is less developed compared to the south-west. The South-East and South-South geo-political zones have in Nigeria had negative coefficients that were significant at the 5 percent level of significance, implying that children in the South-east and South-south regions of Nigeria were less likely to be wasted. Incidence of sickness in the last one month before the survey did not exert any significant difference in the probability of wasting. The binary Probit was ran to ensure internal validity.

### Conclusion

The study analyzed the effect of water sources on wasting of under five years old children in rural households of Nigeria. The study used a panel data from the living standard measurement survey, a representative of Africa's most populous nation. The outcome of the panel regression indicates that only pipe-borne water reduces the likelihood of wasting while borehole and well increased the likelihood of wasting among the respondents as they tend to be unsafe for consumption directly by children under five indicating that additional treatments on the water obtained from these sources might be needed to ensure a reduction in the likelihood of wasting in the study area. Other factors that are associated with wasting in children from the study includes low income, male head of household, male child (boys), younger parents, low education of mothers and living in the north west and north eastern part of Nigeria. Even though the paper can did not consider biological factors like mother's Body Mass Index, breast feeding duration, birth weight of the child and dietary assessments. it does not invalidate the findings. Hence the paper suggests that studies be carried out on the effect of water quality and hand washing on malnutrition of children in rural households in Nigeria.

Findings from this study will help policymakers identify the reliable water source and allow them to carry out the right policy measures in others to reduce the scourge of wasting in children. These policy initiatives will focus on improving access to piped water in rural areas of Nigeria where there is lack of access, improving sanitation, children's health and improving socio-economic status of people. Such measures will include ways on how to improve the quality of the available sources of water and encouraging more women to be educated. The study also established the need for prompt attention to be provided to the north-eastern and north-western regions in other to put all the regions in Nigeria on the road to a well-nourished nation.



The study recommends an improvement in the quality of water available to the public in rural areas as pipe more water only reduces the probability of wasting marginally and a sensitization on the need for people to further purify water gotten from these sources before consumption. Also, an improvement in the economic status of parents will also help reduce the incidence of wasting in their young children.

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