The Association between Water, Sanitation and Hygiene Practices and the Occurrence of Childhood Pneumonia in Abia State, Nigeria

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Abstract **– Poor water, sanitation and hygiene practices directly and indirectly impact on the dynamics of endemic childhood diseases. This study was thus conducted to assess association between the water, sanitation and hygiene practices and the dynamics of endemic childhood pneumonia in Abia State. One thousand two hundred and nine caregivers of children 0-5 years were randomly recruited with one child from each household. The care givers were administered the 2006 UNICEF and WHO harmonized checklist while the children were screened for pneumoniausing community based diagnoses. The children that had cough or difficult breathingwere further screened for pneumonia using respiratory timer counts. Prevalence of pneumonia among the children was 18.4%, and this was statistically significantly associated with access to water, sanitation practices and personal hygiene of their caregivers ($\rho<0.05$). This study concludes that poor access to water, and poor sanitation and hygiene practices of care givers are directly related to the prevalence of pneumonia among their children. It is hereby recommended that access to water, proper sanitation and hygiene practices should be scaled up in Abia State in order to improve the overall health of the children 0-5 years.**

Keywords **– water; sanitation; hygiene; caregivers; children; households; pneumonia**

I. Introduction

Globally, pneumonia remains the leading cause of childhood death from infectious diseases (UNICEF, 2018). In 2016, pneumonia accounted for 16% of all deaths in children under five globally (Watkins & Sridhar, 2018). Developing countries have the heaviest burden of childhood pneumonia, and half of all deaths occur in only five countries including Nigeria (Howie & Murdoch, 2018). According to (UNICEF, 2019), pneumonia accounted for 18.6% of under-five deaths in Nigeria in 2017. In Abia State, 10% of childhood deaths have been attributed to pneumonia (Nwafor, Abali, & Nnoli, 2014). It is estimated that about 1,920 children die from pneumonia every year in Abia State (FMOH, 2018). Pneumonia is preventable and treatable (UNICEF, 2018). Unfortunately, childhood pneumonia is relatively neglected and recently labelled 'a global cause without champions' (Watkins & Sridhar, 2018).

Water, sanitation and hygiene (WaSH) services have been a cornerstone of public health progress having contributed to decreased morbidity and mortality from many infectious diseases (Hennesy*et al.,* 2008). But the WaSH components of many disease control programs have been relatively neglected. Thus, Nigeria records one of the lowest accesses to sanitation and drinking water (Osuchukwu *et al.*, 2017). In Abia State, the hygiene practices are lower than the national average, however the water and sanitation practices are higher than the national average (NBS & UNICEF, 2017). Luby *et al.* (2005) suggested that the role of adequate handwashing in preventing respiratory diseases maybe biologically plausible since some viruses that infect the respiratory tract can be transmitted from person to person by hand contact (Luby*et al.,* 2005). The role of water in promoting pneumonia may be through inhaling aerosol from mists created by contaminated water sources (Rakic, 2017). Additionally, young children (and their caregivers) are thought to spend more time near the domestic hearth; and the role of sanitation is thought to be by household air pollution through inhalation of soot by children (WHO, 2018).

There is a strong belief that high prevalence of pneumonia and other respiratory tract infections in Abia State is associated with poor access to WaSH, but there is little or no empirical data to support this. This study thus sets out to determine the relationship between water, sanitation and hygiene practices and childhood pneumonia in Abia State, Nigeria.

II. Materials and Methods

The study area is Abia State, situated in the Southeast geopolitical zone of Nigeria. Abia State is located within latitudes $4^o40'$ and $6^o14'$ north and longitudes $7^o10'$ and 8^o east.The study population is children aged 0 to 59 months (under-fives) with their caregivers in all 3 senatorial zones of Abia State.

This was a community based cross sectional study, conducted over 3 years in 9 of the 17 LGAs of Abia State. A multistage sampling technique was used to select study participants. A total of 1,209 under-fives who had cough or difficult breathing in the previous six months and their caregivers from 1,209 households were randomly selected

from 27 communities which has an estimated under-five population of 11,349 across the 9 LGAs.

Data analysis for this study was with Statistical Package for Social Sciences (SPSS) version 22 (International Business Machine, 2015). The methods of data analysis were: descriptive statistics with frequency tables and graphs; and inferential statistics using multiple regression analysis and chi square to determine relationships between variables.

III. Results

3.1 Age and Sex Characteristics of Under-Fives

Table 3.1 shows the age and sex characteristics of the 1,209 children in the study comprising 271 (22.4%), 181 (15.0%), 116 (9.6%), 394 (32.6%) and 247 (20.4%) from 0-11 months, 12-23 months, 24-35 months, 36-47 months and 48-59 months respectively. From the above age groups, 36-47 months ranked first, followed by 0-11 months, then 48 to 59 months, 12-23 months and 24-35 months. Six hundred and twenty three (51.5%) of all children below five years were male and 586 (48.5%) were female.

Table3.1: Age and Sex Characteristics of the Under-Five Children

Age Group (Months)	Male n (%)	Female n (%)	Total N (%)
0-11	98 (8.1)	173 (14.3)	271 (22.4)
12-23	143 (11.8)	38 (3.2)	181 (15.0)
24-35	50 (4.1)	66 (5.5)	116 (9.6)
36-47	164 (13.6)	230 (19.0)	394 (32.6)
48-59	168 (13.9)	79 (6.5)	247 (20.4)
Total	623 (51.5%)	586 (48.5%)	1,209 (100.0%)

3.2 Pneumonia Prevalence in Children Under Five

Table 3.2 shows that the six-month childhood pneumonia prevalence is 18.4%.

Table 2 Prevalence of Pneumonia in the Under-Five Children

Characteristic	Frequency	Percentage (%)
Pneumonia	222	18.4
No Pneumonia	987	81.6
Total	1209	100.0

3.3 Relationship of Water Supply Practices and Childhood Pneumonia

The result of the multiple regression analysis run to predict childhood pneumonia from water supply practice predictors as in table 3.3 shows that: main source of drinking water, respondent's reasons for not having private piped water, main water storage container and means of getting water from container statistically significantly predicted prevalence of pneumonia among children aged 0-59months, $F(6, 1202) = 19.288$, $p = 0.000$, $R= 0.296$.

Table 3.3: Assessment of Water Supply Practices of Caregivers and the Occurrence of Childhood Pneumonia

Water Supply Practices	Childhood Pneumonia		P-Value
	YES	NO	
Main Source of Drinking Water			0.000
Improved water sources	127	565	
Non-improved water sources	95	422	
Total	222	987	
Main Container for Water Storage			0.000
Plastic bucket	31	137	
Plastic jerry can	74	330	
Plastic drum/barrel	66	292	
Storage tank	22	96	
Clay water pot	1	5	
Metallic drum/barrel	21	91	
Metallic bucket	1	2	
Other (moulded drum)	7	33	
Total	223	986	
Means of Getting Water from Container			0.009
Pour from container	76	336	
Container has spigot/faucet	40	178	
Use dipper with handle	57	254	
Use dipper without handle	45	202	
Other (drink from container)	4	17	
Total	222	987	
Reasons for No Private Piped Water			0.000
Rented house: owner didn't install	81	360	
Installation too expensive	52	233	
Financial problem	45	201	
Have private well	14	60	
Easy access to public taps	10	43	
Easily available water vendor	7	29	
Rain water used when available	4	19	
Do not feel its importance	1	5	
Do not know	1	5	
Total	215	955	

3.4 Relationship of Sanitation Practices and the Occurrence of Childhood Pneumonia

As in table 3.4, the multiple regression analysis to predict childhood pneumonia from sanitation predictors show that: having private toilet facility, where toilet wastes go, reason for not having toilet facility, and what respondent thinks is the benefit of having latrine statistically significantly predicted prevalence of pneumonia among children aged 0-59months, $F(6, 1202) =$, $p = 0.000$, $R= 0.220$.

3.5 Relationship of Hygiene Practices and the Occurrence of Childhood Pneumonia

The multiple regression analysis to predict childhood pneumonia from hygiene practices predictors show that availability of place of handwashing, cleansing material at place of hand washing, and respondents thoughts on the most important times to wash hands statistically significantly predicted prevalence of pneumonia among children aged 0-

59months, F(6, 1202) = 15.197, p = 0.000, R = 0.266 (table 3.5).

Table 3.4: Assessment of Sanitation Practices of Caregivers and the Occurrence of Childhood Pneumonia

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Total	222	987	
REASONS FOR NO PRIVATE PIPED WATER			0.000
Rented house: owner didn't install	81	360	
Installation too expensive	52	233	
Financial problem	45	201	
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Easy access to public taps	10	43	
Easily available water vendor	7	29	
Rain water used when available	4	19	
Do not feel its importance	1	5	
Do not know	1	5	
Total	215	955	

Table3.5 Assessment of Hygiene Practices of Caregivers and the Occurrence of Childhood Pneumonia

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Total	215	955	

IV. Discussion

There were 1209 under five children in the study area, among whom were more males (52.1%) than females (47.9%). This pattern closely aligns with the reports by the national population estimate for under-fives where there were male (51.0%) and female (49.0%) under-fives in Nigeria (NPopC, 2018). Additionally, this pattern is also in line with the Multiple Indicator Cluster Survey (MICS) of 2016 to 2017 which reports that 50.6% were males and 49.4% females (NBS & UNICEF, 2017); as well as with the National Demographic Health Survey (NDHS) of 2013 with estimates for Nigerian under-fives of 50.4% males and 49.6% females (NPopC & ICF, 2014). The most common age group in this study were the 36 – 47 month olds at 32.6%, followed by the 0 – 11 month olds at 271, the 48 – 59 month olds, the 12 – 23 month olds and the 24 – 35 month olds. This pattern is similar to the NDHS (of 2013). Thus, the age structure of the under-fives in this study is a close reflection of the demographic structure of Abia State and Nigeria. This shows that there was minimal age bias within the study participants.

The result of this study on water supply shows that only 57.2% of the households use improved sources of drinking water and this is comparable to the NDHS (2013) report showing that only 62.6% of households used improved drinking water sources. Lukman *et al.*(2016) however, recorded a lower percentage (47%) of households using improved water supply in Abia State, and this could be due to their definition of improved water source which excluded any inclusion criteria for rain water, bottled and sachet water (Lukman*et al.,* 2016). In addition, in this study, 9.8% apply appropriate drinking water treatment. This is also close to the MICS (2017) result wherein only 6.1% of the households were adequately treating their drinking water (NBS & UNICEF, 2017). According to Agwu *et al.* (2013), majority of the populace in Aba, Abia State depend on untreated borehole and sachet waters which they generally assume are clean and safe, forming part of the reasons for very low drinking water treatment rates in Abia State (Agwu *et al.*, 2013).

The role of water storage containers in disease is multidimensional. First, plastic-based storage containers usually contain bisphenol A that can seep into the water in

large quantities and can lead to health challenges in children. In this study, 86.7% of the households had the main containers for water storage as plastic and 9.5% used mainly metallic water storage containers. In the study conducted by Okogun *et al.* in 2013, plastic containers and metal cans supported majority of the larva species of anopheles (Okogun *et al.*, 2013). These are corroborated by another study in Abia State (Agwu *et al.*, 2013). On the other hand, the use of clay pots which is a beneficial source of alkaline (clay) for proper pH balance was observed in only 0.5% of households. Again, unhygienic storage containers predispose children to diseases that further depress the immune system; and most water supplies become heavily contaminated during storage (Blum*et al.*, 1990). From the results of this study, up to 21.1% of households in Abia State used non-covered water containers which are unhygienic.

In this study, an average of 37.9 liters of water was fetched for each person per day. This value is close to the water consumption per capita of Nsukka in the South East Nigeria which is 34.9 L per day (Nnaji *et al.*, 2013). This study result, as well as of another south east city are below the recommendation of United Nations Population Division (UNDP) on the national average water use per person per day as being 50 litres (UNDP, 2016). The international standard, according to United Nations High Commission for Refugees (UNHRC), is 50-100 Litres of water per person per day to ensure that most basic needs are met and few health concerns arise (UNHRC, 2008). The John Hopkins &Red Cross and Red Crescent in 2008 however argue that this minimum should be individualized to depend on many factors including the climate, the type of excreta disposal facilities used, people's habits and cultural practices, foods eaten and practices in food preparation (Frazier, 2008). The later part of the results section if this poor water quantity index reflects on childhood pneumonia status.

In this study, 8.5% practised open defecation, and this is close to the finding of Amadi (2014) that 7% of households in Abia State practiced open defecation (Amadi, 2014). The MICS (2018) reports a lower figure of 3.8% of households practising open defecation in Abia State and the NDHS (of 2013) report a higher rate of 29.4% of Nigerians practising open defecation. In places where open defecation is practiced, the leachate percolates into the ground water and cause contamination of water sources with associated lowered immunity and predisposition to disease.

Children's faeces are more likely than adults' to contain enteric pathogens (Gil *et al.*, 2004). Safe disposal of a child's faeces ensures that the faeces does not contaminate the water sources, nor retain unhygienic contact with the child which consequently reduced resistance to infections. According to the National Nutrition and Health Survey (NNHS), young child stool disposal is the percentage of children below 3 years whose last stools were disposed of safely (NBS, NPopC & FMOH, 2018). And out of the 568 young children aged 0-35 months in this study, 284 (50.0%) had their stools disposed safely. The NNHS (2018) reports that 55.4% of young children's stools were disposed safely, and the MICS (2017) reports a 54.4% safe stool disposal of young child faeces in Abia State. The disparity between the lower observed value in this study (50%) and the national surveys (NNHS at 55.4% and MICS at 54.4%) maybe due to the difference in data collection periods. This study was conducted over a 3 year period and is the average practice over the years, whereas the national surveys were conducted over a period of less than 5 months, for MICS (Sept 2016 to January 2017) and NNHS (February to June 2018).

A proxy measure for handwashing practice is the availability of a place for handwashing in the home (Kamm*et al.*, 2014). The results of the personal hygiene practices of caregivers in this study show that a place of handwashing was observed in 10.5% of households. However, a place of handwashing was observed in 4.4% of households in Abia State in MICS (2018). The higher results for handwashing in this study could be due to the timing of the surveys. The MICS (2018) was conducted during the dry seasons when water is scarce for handwashing and this could explain the much lower presence of places for handwashing. This is in line with the conclusion that as many as four times more households could have a place for handwashing in the rainy seasons, compared with the dry seasons (Kamm *et al.*, 2014).

The result of the six-month childhood pneumonia prevalence in the study areas is 18.4% for pneumonia. This is closer to the prevalence of 15.4% observed by another study in Aba, Abia State (Okoronkwo *et al.*, 2018) and 16.9% in neighbouring Port Harcourt, Rivers State (Yaguo-Ide & Nte, 2011). However, lower as well as higher prevalences have been noted in other studies in different states. A lower prevalence of 13.3% in Ilorin, Kwara State (Abdulkarim *et al.*, 2013), possibly because Abdulkarim *et al.* used strict radiological diagnosis for childhood pneumonia, whereas this study used the WHO IMCI community diagnosis of pneumonia using rapid respiratory rate (WHO, 2005).In contrast, higher childhood pneumonia prevalences were reported as 23.5% in Ilesha, Osun State (Kuti & Oyelami, 2016), 27.68% in Makurdi, Benue State (Amai*et al.*, 2018) and 31.8% in Ibadan, Oyo State (Ayede*et al.*, 2018). Aside geographic differences, these higher results may be due to these being (tertiary) hospital based studies wherein prevalence will be affected by the healthcare-seeking behaviours of the caregivers, whereas this study is community-based.

The result of the multiple regression analysis run to predict childhood pneumonia from water, sanitation and hygiene practices add to the sanitation and disease data for Abia State as no prior studies have been undertaken to predict childhood pneumonia from water, sanitation and hygiene practices in Abia State. Thus in Abia State, childhood pneumonia is predicted by water supply practices of caregivers as follows: childhood pneumonia is predicted by caregivers' water supply practices which are: main source of

drinking water, respondent's reasons for not having private piped water, main water storage container and means of getting water from container ($\rho<0.05$). Additionally, childhood pneumonia in Abia State is predicted from sanitation practices of caregivers in: having private toilet facility, where toilet wastes go, reason for not having toilet facility, and what respondent thinks is the benefit of having latrine ($\rho<0.05$). Childhood pneumonia in Abia State is also predicted by hygiene practices of caregivers which are: having hand washing device, material used in hand washing, and respondents' thoughts on the most important times to wash hands ($\rho<0.05$).

V. Conclusion

The results of this study showed that in general, there were poor water, sanitation and hygiene practices among caregivers of under-fives in Abia State and these were statistically significantly associated with high childhood pneumonia prevalence of 18.4%.

Thus, there is need to increase improved sources of drinking water and improved sanitation facilities in Abia State. Particularly, health education on adequate WaSH practices to reduce the prevalence of childhood pneumonia need should be intensified in Abia State. Additionally, child protection policies to protect the right of every child to a clean environment should be enforced by the State and Federal Ministries of Women Affairs. There are relationships between WaSH practices and childhood pneumonia as evidenced in this study. It is hereby recommended that pneumonia control programs should integrate WaSH programmes for better outcomes and impact.

There is also need for this research to be carried out in other States of the country in order to find out the effects of their sociocultural peculiarities. This will help in better targeted programming and faster attainment of the targets of the sustainable development goals (SDGs). There is also need to expand this research to elicit the associations between water, sanitation and hygiene practices and childhood malnutrition and anaemia in order to increase the spectrum of childhood disease that are associated with WaSH practices in Nigeria.

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Conflict of Interest Statement

The authors have declared there is no conflict of interest.

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