International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor (2018): 7.426

Relationship between Water Use/Availability and Soil Transmitted Helminth Infections in Rural Communities South-Eastern, Nigeria

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Abstract: ***The relationship between water use/availability and soil-transmitted helminth infections among residents of rural communities in Ihiala Local Government Area of Anambra State, South-Eastern Nigeria, was investigated. Stool samples were collected from 2,737 respondents in a study carried out between July and November, 2016. Stool samples were examined for presence of soil transmitted helminths using Formol-Ether concentration method. Data collected from stool samples were analysed using SPSS for Windows (version 16). Structured epidemiological questionnaires were administered to the residents to find out information on their water use and availability.Results showed that, 1,477(54.0%) out of 2,737 respondents were infected with at least one geohelminths infection. This result revealed that geohelminths infections occurred more where 40 litres of water was available (61.8%) followed by where 80 litres was available (52.9%) while the least were those households having more than 120 litres of water (46.1%). Ascaris and Trichuris occurred more in household with only 40 litres of water available but Hookworm and Strongyloides occurred more in households where more than 120 litres of water is available. These differences were significant statistically. The distance of source of water is co-related with having geohelminths infections especially with those caused by Ascaris and Trichuris but not for Hookworm or Strongyloides. It was also observed that where water is fetched once a day had the highest prevalence rate 83.3%, followed by twice daily 48.1% and then thrice 43.7%. However, it was Ascaris and Trichuris that were more prevalent among those household where water were fetched once or twice but not for Hookworm or Strongyloides. The study revealed a high prevalence of soil-transmitted helminth infections in the study area and this is co-related with water use and availability indicating the necessity of including provision of adequate and safe water to all the households as part of the control strategies.***

Keywords: Geohelminths; Water use; Water availability; Relationship; Prevalence

1. Introduction

Over one billion people are infected with soil-transmitted helminths (STH), with the greatest burden of disease falling on children and the poor [Bethony *et al*., 2006; Pullan *et al.*, 2014; Brooker, 2010]. Safe and inexpensive drugs are available to treat STHs [Utzinger *et al*., 2009], and national deworming programmes are being rolled out in many parts of sub-Saharan Africa and Asia. However, in areas where mass drug administration (MDA) has been instituted, infection often occurs rapidly after treatment [Jia*et al*., 2012]. Environmental control of STH – specifically improving access to safe water supply, basic sanitation and improved hygiene (WASH) – may serve to complement these deworming efforts [Hotez et al., 2006] and prove to be cost-effective. The most prevalent STH species in human infections include the roundworm (*Ascaris lumbricoides*), whipworm (*Trichuris trichiura*) and hookworm (*Necatoramericanus* and *Ancylostomaduodenale*). Man acquires infection by ingestion of food, water, fruits and vegetables contaminated with egg containing L_2 invasive Larva of *Ascaris* and *Trichuris* while Hookworm and *Strongyloides* infections are acquired through the penetration of intact skin or lesion by the filariform (L_3) larva (Alberk *et al.*, 2001). Infections with (STHs) is responsible for different morbidity and mortality cases in the tropics. Clearly soil transmitted infections remain an enormous public health problem in the 21st century.

A sufficient quantity of water of an acceptable standard is a prerequisite to life itself. Bringing supplies nearer to the home can save time for those mainly women who trek long distances to collect water. Increasing the quantity of domestic water used is the most important way to reduce water-washed transmission in which soil transmitted helminths are inclusive (Feachem*et al*., 1983). Where water use is low, water washed transmission is widespread and simply increasing the quantity of water used regard less of its quantity can be expected to reduce the transmission of faecal-oral diseases (Feachem *et al*., 1983). Increasing the quantity of water used by households is probably more important than increasing the quality to reduce the day to day non epidemic toil of disease. Of course, increased water use is not a goal in itself but an indicated of change in hygiene behaviours (Esrey *et al*., 1991). Where water is scare, it is very difficult to maintain clean hands, clean foods, and the clean household environment essential to control many of other routes of faecal-oral transmission. WHO 1993; Feachem*et al.*, 1989; Esrey *et al.*, 1991: WHO, 2007 found reduction in diarrhoea mortality and overall child mortality of 65% and 55% respectively when improvement in water supply (water availability) and sanitation were introduced.

Measures aimed at controlling STHs are based on anti-helminthic treatment, provision of water facilities, sanitation and health education. These control measures can be successfully implemented with information on the prevalence of infection based on baseline survey. Many studies previously carried out in Nigeria gave due attention to the distribution of STHs in different explanatory groups such as pre-school children and pregnant women. However much still remain to be known about STHs in relation to water use and availability among the entire population cutting across the whole age groups. Thus, this study was carried out to investigate the relationship between water use/availability and soil transmitted helminths infections in the study area.

2. Materials and Methods

Study Area

The study area is made up of 10 communities in Ihiala L.G.A, Anambra State namely Okija, Ihiala, Uli, Amorka, Azia, Mbosi, Lilu, Isseke, Ubuluisiuzo and Osmorghu. Ihiala L.G.A is located at the southern part of Anambra State which is very close to Imo State. It also shares common boundaries with Ogbaru, Nnewi North and South L.G.As. It is situated in the tropical rainforest belt and lies on latitude $6^0 45^1$N and longitude $7^0 05^1$E. Ihiala L.G.A is pre-dominated by the Ibos and it covers an estimated area of 92 square kilometres. It is made up of both semi urban and rural settlements of about 302,277 persons comprising of 152, 200 males and 150, 077 females. (Federal Republic of Nigeria, official gazette, 2009). There are two distinct seasons in Ihiala L.G.A: the wet (rainy) and dry season. The wet season lasts from April to October while the dry season lasts from November to March. The annual rainfall ranges from 1,500 mm to 2,000mm. The major sources of drinking water are streams, rivers, borehole and underground and surface tanks. The excreta disposal system is inadequate in the L.G.A as most households have pit latrines detached from the living places while others lack proper toilet facilities and defecate in nearby farmlands and bushes. About 85% of the people are Christians and few traditionalists but all enjoy equal citizenship.

Study design

The study was a cross-sectional study using quantitative and qualitative methods. A prospective study which involved parasitological examination of stoolas well as the use of structured questionnaire, in-depths interviews and direct observations. Determination of prevalence was done by parasitological examination of stoolwhile data on water use and availability were determined using structural Questionnaire, in-depths interviews and direct observation. The survey was carried out between July and November, 2015. Ten communities namely Ihiala, Okija, Uli, Amorka, Ubuluisiuzo, Osmorghu, Mbosi, Azia, Lilu and Isseke were sampled.

Population structure

The study population comprised of 152, 200 males and 150, 077 females aged 1 to 60 years residing in the ten communities of Ihiala LGA.

Sample selection

Sample selection was done using a combination of stratified and systematic random samplings. Villages in the communities were randomly selected using stratified random sampling technique whereas households in the villages were selected using systematic random technique where one household was selected out of every ten households. Male and female were randomly selected from the selected households. Residents were randomly distributed to collect the samples (stratified sampling).

Data Collection

The study data were obtained using structural questionnaire with open and closed ended questions and laboratory analysis of stool samples.

Stool Collection and Examination

A total of 2, 787 stool samples were collected from the community members recruited for the study. The stool samples were collected in wide mouthed screwed containers and transported to the laboratory for processing and analysis. The participants were properly educated on how to collect the stool specimen to avoid contamination by urine, water and free living organisms. The samples were obtained by informed consent of the participants and the permission to that effect was obtained from the ethnical committee. Survey forms as provided by WHO (2002) were given to the selected individuals to fill and a clean wide mouthed screwed containers were also given for stool collection.

The returned completed form and stool samples were assigned a code number for identification. The containers were distributed in the evening while the stool samples were collected in the early morning hours. The stool samples were then fixed immediately in 10% formalin before taken to the laboratory for analysis. All samples collected were analysed within 2-6 hours of collection or put in the refrigerator.

The stool samples were first examined macroscopically to show consistency of the stool. Then examined microscopically using wet preparation method and where it reveals no organism, the more sensitive formol ether concentration technique was applied to determine the presence or not of these geohelminths parasite. The parasites ova and larvae were identified as described by Jeffrey & Leach, 1975. Parasites were subsequently identified using standard tests (WHO, 1991; Cheesbrough, 1992).

3. Statistical Analysis

The data were analysed statistically using SPSS for window version 10.0 (SPSS) Inc. Chicago IL, USA) and Strata version 7 (STATA corporation 2001). One way Analysis of Variance (ANOVA) was used to test for the level of significant differences in spatial and temporal variations in helminth and environmental data. Variations were considered significant at $P<0.05$. Correlation Coefficient r and Coefficient of determination r^2 were used to determine independent effects of explanatory variables such as water use and availability on the prevalence of geohelminths infections using estimated odd ratio at 95% confidence intervals as basis of judgment.

4. Results

Relationship between water use/availability and geohelminths infections. The results of different analysis carried out to determine the relationship between water use/availability and geohelminths infections were shown in Tables 1-3.

Table 1 shows the relationship between quantity of water available in the household and prevalence of geohelminths parasites. It was observed that geohelminths infections occurred more where 40 litres of water was available (61.8%) followed by where 80 litres was available (52.9%) while the least were those households having more than 120 litres of water. *Ascaris* and *Trichuris* occurred more in household with only 40 litres of water available but Hookworm and *Strongyloides* occurred more in households where more than 120 litres of water is available. These differences were significant statistically.

Table 1: Availability of water and its Association with geohelminths infections

Quantity of water (litres)	Total No. Examined	Al +ve (%)	Hk +ve (%)	Ss +ve (%)	Tt +ve (%)	Total +ve (%)
40	989	371 (37.5)	133(13.4)	11(1.1)	96(9.7)	611(61.8)
80	879	188(21.4)	204(23.2)	26(3.0)	47(5.3)	465(52.9)
>120	869	40(4.6)	76(9.5)	21(3.4)	61(7.0)	401(46.1)
Total	2,737	599 (21.9)	604(22.1)	70(2.0)	204(7.5)	1,477(54.0)

Key to Table
Al=*Ascaris* Hk=Hookworm Tt= *Trichuris* Ss=*Strongyloides* +ve= Positive

Table 2 shows the relationship between the distance of source of drinking water and Geohelminths parasites in the study Area. The distance of source of water are co-related with having geohelminths infections especially with those caused by *Ascaris* and *Trichuris* but not for Hookworm or *Strongyloides* as shown below.

Table 2: Relationship between the distance of source of drinking water and geo-helminths parasites in the study Area

Distance of water source	No. of people examined	Al +ve (%)	Hk +ve (%)	Tt +ve (%)	Ss +ve (%)	Total +ve (%)
<1km	800	20 (2.5)	103(12.9)	31(3.9)	46(5.8)	200(25.0)
1-2km	1,057	180(17.4)	300(28.4)	113(10.7)	15(1.4)	608(57.5)
>2km	880	399(45.3)	201(22.8)	60(6.8)	9(1.0)	669(76.0)
Total	2,737	599 (21.9)	604(22.1)	204(7.5)	70(2.6)	1,477(54.0)

Key to Table
Al=*Ascaris* Hk=Hookworm Tt= *Trichuris* Ss=*Strongyloides* +ve= Positive

Table 3 shows the relationship between frequency of water fetching in the household and geohelminths parasites infections in the study area. It was observed that where water is fetched once a day had the highest prevalence rate 83.3%, followed by twice daily 48.1% and then thrice 43.7%. However, it was *Ascaris* and *Trichuris* that were more prevalent among those household where water were fetched once or twice but not for Hookworm or *Strongyloides*. Using the one way ANOVA it was found to be significant at $P<0.05$ showing that frequency of water fetching affects the prevalence of geohelminths infections. The details are shown below

Table 3: Relationship between frequency of water fetching in the household and Geohelminths parasites infections in the study area

Frequency of water fetching	No.of people examined	Al +ve (%)	Hk +ve (%)	Tt +ve (%)	Ss +ve (%)	Total +ve (%)
Once a day	600	159 (26.5)	318(53.0)	3(0.5)	20(3.3)	500(83.3)
Twice a day	980	261(26.6)	103(10.5)	17(1.7)	90(9.2)	471(48.1)
Thrice and above	1,157	179(15.5)	183(15.8)	50(4.3)	94(8.1)	506(43.7)
Total	2,737	599 (21.9)	604(40.9)	70(2.6)	204(7.5)	1,477(54.0)

Key to Table
Al=*Ascaris* Hk=Hookworm Tt= *Trichuris* Ss=*Strongyloides* +ve= Positive

5. Discussion

We examined associations between water use/availability in household and the prevalence of STH species infection. We assessed these associations across four domains: 1) worm species, 2) quantity of water available, 3) distance of water source, and 4) frequency of fetching water at the household-levels. It was found that sanitation is dependent on the availability of water for domestic purposes as water is needed for an improved sanitation and personal hygiene. From the results it was observed that geohelminths prevalence were significantly lower in household with more copious water (>120l/day) than in those with <40l/day. This hinges on the facts that level of sanitation is usually improved with more water as more water is required for flushing and washing toilets, proper hand washing, washing of utensils and proper washing of vegetables and fruits. Transmissions of soil transmitted helminths are encouraged by poor hygiene due to insufficient quantities of water for washing. This report is similar to that of (Oluwaseyi *et al.*, 2017) in which they indicated that the use and availability of safe water sources enhanced a reduction in the prevalence of intestinal helminths infections. Where water is scare, it is very difficult to maintain clean hands, clean foods, and the clean household environment essential to control many of other routes of faecal-oral transmission. WHO 1993; Feachem*et al.*, 1981; Esrey *et al*., 1991; WHO, 2007 found reduction in diarrhoea mortality and overall child mortality when improvement in water supply (water availability) and sanitation were introduced. Other limiting factors included the labour/distance of water source from the homes and also the number of children who carried out the chore of fetching water.

The relationship between the distance of source of drinking water and geohelminths parasite infections in the study area showed that the nearer the distance of water supply the more water is made available as it is easier to fetch water from near places. The prevalence of geohelminths parasites increases significantly with longer distances in this study and this was also reported by (Feachem *et al*., 1983). For instance, a high prevalence was recorded in people whose source of drinking water is above 2km. This can be explained as follows. Farer distances of water supply will certainly reduce the number of times water is fetched and indirectly affect the amount of water available in such households. The amount of water that is made available in the household will definitely affect the level of sanitation of such people. Again these farer distance water are usually natural water bodies like stream which are also heavily and more contaminated than the boreholes. It was discovered in the present study that many households in the study area prefer fetching stream water (usually farer) to borehole due to financial reasons. The streams are not usually sold for any amount of money unlike borehole water that sells between N10 to N50 in the study area and a lot of people as a result of poverty cannot afford these prices. Lower prevalence found among people whose source of water is less than 1km (usually borehole or tap water) can be attributed that these water sources are cleaner than the natural ones and are also readily available leading to improved sanitation. However Hookworm and *Strongyloides* infections were not affected by the distance of sources of water supply as the highest *Strongyloides* infections was recorded in those household where water source is less than 1km and Hookworm where the distance is 1-2km. It was also discovered that those household where water is fetched thrice and/or above a day had lesser prevalence than the others. This as well showed the importance of water in improving the level of sanitation of the people. However high prevalence rates found among those households where enough water are available showed that water availability (quantity) without increasing the quality is not enough in the control of geohelminths as such available water may also be heavily contaminated (Esrey*et al*., 1991; Cairn cross & Feachem, 1993).

References

[1] Alberk, K., Laskey, A. and Moss, O.H. (2001). Roundworms. *Merrill Biology An Everyday Experience*. 2nd edition, Wmc Brown Publishers England Pp. 132 – 134.

[2] Bethony, J., Brooker, S., Albonico, M., Geiger, S, M., Loukas, A. and Diemert, D. (2006). Soil-transmitted helminth infections: ascariasis, trichuriasis, and hookworm. *Lancet. 367(9521)*:1521–32.PubMedViewArticleGoogle Scholar

[3] Brooker S. (2010) Estimating the global distribution and disease burden of intestinal nematode infections: adding up the numbers–a review. *Int J Parasitol. 40(10)*:1137–44.PubMed CentralPubMedViewArticleGoogle Scholar

[4] Cairn cross, S. and Feachem, R. (1993). *Environmental Health Engineering in the Tropics*, 2nd edition. Wiley, Chi Chester Pp.: 4-21.

[5] Chesbrough, M., (1992). *Medical Laboratory manual for tropical countries* (2nd Ed). University Press, Cambridge, Pp.: 20-357.

[6] Esrey, S.A., Potash, J.B., Roberts, L. and Shiff, C. (1991). Effects of improved water supply and sanitation on Ascariasis, diarrhea, drucunculiasis, hookworm infection, Schistosomiasis and trachoma. *Bulletin of the World Health Organization, 69 (5)*: 609 – 621.

[7] Feachem, R.G., Bradley, D.J., Garelick, H. and Mara, D.D. (1983). *Sanitation and Disease: Health aspect of Excreta and waste water management.* World Bank studies in water supply and sanitation. John Wiley and sons U.K. 3-501.

[8] Feachem, R.G., Gug, M.W., Harrison S., Iwago, K.O., Marshall, T., Mbere, N., Muller, R. and Wright, A.M. (1989). Excreta disposal facilitates and intestinal parasitism in Urban Africa. Preliminary studies in Botswana, Ghana and Zambia. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 77: 515 – 521.

[9] Federal Republic of Nigeria (2009). Details of the Breakdown of the National and State Provisional Population Total 2006 Census. *Federal Republic of Nigeria Official Gazelle 24(94)*:175-198.

[10] Hotez, P.J., Bundy, D.A.P., Beegle, K., Brooker, S., Drake, L. and de Silva, N. (2006). Helminth Infections: Soil–Transmitted Helminth Infections and Schistosomiasis. In: *Disease Control Priorities in Developing Countries*. 2nd ed. New York: Oxford University Press; p. 467–82.Google Scholar

[11] Jeffrey, H. and Leach, R.M., (1975). *Atlas of Medical Helminthology and Parasitology* (2nd Ed). Longman Groups Ltd, Hong Kong. 121pp.

[12] Jia, T.W., Melville, S., Utzinger, J., King, C.H. and Zhou, X.N. (2012). 2012Soil-transmitted helminth reinfection after drug treatment: a systematic review and meta-analysis. *PLoSNegl Trop Dis. 6(5)*: e1621.PubMed Central PubMed View Article Google Scholar

[13] Oluwaseyi, T.T., Sam-Wobo, S.O., Idowu, O.A., Talabi, A.O. and Taiwo, A.M. (2017). Comparative assessment of Intestinal helminths prevalence in Water, Sanitation and Hygiene (WASH) in Intervention and non-Intervention Communities in Abeokuta, Nigeria. *Asian Pacific Journal of Tropical Biomedicine 7(6)*: 524-532

[14] Pullan, R.L., Smith, J.L., Jasrasaria, R. and Brooker, S.J. (2014). Global numbers of infection and disease burden of soil transmitted helminth infections in 2010. *Parasit Vectors*. 7(1):37.PubMed CentralPubMedViewArticleGoogle Scholar

[15] Utzinger, J., Raso, G., Brooker, S., de Savigny, D., Tanner, M. and Ornbjerg, N.(2009). Schistosomiasis and neglected tropical diseases: towards integrated and sustainable control and a word of caution. *Parasitol. 136(13)*:1859–74.View ArticleGoogle Scholar

[16] WHO (1991). *Basic Laboratory Methods in Medical Parasitology*. 1211 Geneva 27, Switzerland. 114.

[17] WHO (1993). Improving Water and Sanitation Hygiene Behaviours for the Reduction of Diarrheal Disease. Report of an Informal Consultation. *WHO. CWS 90.7*: 18 – 20.

[18] WHO (2002). Estimates of the disease burden due to soil transmitted helminthiasis. Prevalence and control of Schistosomiasis and soil–transmitted helminthiasis *Technical Report Series 912*: 2 -3.

[19] WHO (2007). The International Network to promote Household Water Treatment and Safe Storage. *WHO. Geneva*.