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Studies on Parasitic Contamination of Soil and Local Drinking Water Source in Doma Local Government Area of Nasarawa State, Nigeria

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Abstract
Water is a natural resource that is essential to all living things on earth, but if contaminated can pose a lot of risk to human health when consumed. This study evaluates the parasitic contamination of drinking water sources and surrounding soil in Doma Local Government Area of Nasarawa State, Nigeria. A total of 48 water samples and 48 soil samples around the water sources were collected from different selected sources (wells, streams and boreholes) between the months of March to July 2017. The water samples were analyzed using the Calcium carbonate ($CaCO_3$) floatation method while a modified baermann technique was used to examine the soil samples microscopically for the presences of parasites. A total of 32 water samples were found with parasites. These include 2 species belonging to the protozoan group (*Entamoeba histolytica, and Giardia lamblia*) 3 from the nematode group (*Trichuris trichiuria, Ascaris lumbricoides and* Hookworm), and 1 Trematode group (*Fasciola hepatica*). The nematode group had the highest contamination rate 19(59.38%) followed by the protozoan group 12(37.50%) while trematode was least with 1(3.13%). The most contamination was in stream water sources for late dry and early wet season with 69.23% and 94.74% respectively. The wells had 30.77% and 5.26% in late dry and early wet season respectively. The boreholes had zero contamination for both seasons. Prevalence of parasites in relation to sources of water showed a high significant differences (χ^2 = 49.741, df = 2, P = 0.0000001), while there was no significant difference in relation to late dry and early rainy seasons (χ^2 = 2.3438, df = 1, P = 0.1258). Geohelminths was highest around the borehole area 15(35.71%) followed by well area 14 (33.33%) and was least in the stream area 13(30.95%). However, there was no significant difference (χ^2 = 0.94915, df = 2, P = 0.6221) in the prevalence rate of geohelminths in relation to sources of water area. Result indicated a high rate of parasitic contamination of soil and drinking water sources in the study area. Hence there is need for advocacy and enlightenment on the importance of proper drinking water treatment.

Keywords: Parasite, Water, Soil, Doma

Introduction

Water is a natural resource that is essential to all living things on earth, it is potable when it poses no risk to human health when consumed or used for food preparations but detrimental to human health if contaminated (Grandjean, 2008).According to the World Health Organization (2000) the source of water supply is either improved or unimproved. Improved water sources include public standpipes, household connections, boreholes, protected dug wells, protected springs, boreholes and springs connected via a pipe system to a tap, as well as rainwater. Unimproved water sources include unprotected wells, unprotected springs, vendor-provided water, rivers and water provided by tanker trucks (WHO, 2000; Gundry *et al.,* 2004). Water is said to be of good quality if and when it is free from contaminations, has no taste or smell and the pH is between 7.0 and 9.5 indicating a healthy level of alkaline mineral (WHO Water Fact Sheet, 2015).

According to the Environmental Protection Agency (2008), 68% of community water system users received their water from surface water sources; people use surface water for everyday purposes like drinking, cooking and basic hygiene. Surface water is more exposed to contamination and in many communities in the world people drinks untreated water straight from the river and stream. Consuming this unsafe water may cause very dangerous human health infections such as Giardiasis, typhoid, amoebiasis and hepatitis (WHO, 2015). Portable water can also be contaminated with soil transmitted helminthes by defecating and urinating directly into the water or by run-off from contaminated soil into the various sources of drinking water. *Trichuiris trichiura, Ascaris lumbricoides, Strongyloides stercolaris and* hookwormare among the common soil transmitted parasite responsible for causing major worldwide infections. They can be transmitted through fecal-oral route by direct or indirect sources as food and water (Cheesbrough, 2000). Recently waterborne parasitic infections have become an area of concern all around the world due to contaminations of the different sources of drinking water and their surrounding soil.

This research aims at studying the parasitic contaminant of soil and local drinking water source in Doma Local Government Area of Nasarawa state in other to improve the health standard of the People in the community.

Materials and Methods

The study was conducted in Doma Local Government Area of Nasarawa State. The state is within the Savannah region of Nigeria and its characterized by a cold dry season from the month of November to April and a rainy season from May to October. This research was carried out within the month of March to July, 2017. Water sample was collected from 48 different sources of drinking water within Doma local government area into a two-liter screw cap bottle while 20g of 48 different topsoil (down to depth of not more than 3 cm) were collected from all the sources into a polythene bag using a clean hand trowel. Four sample communities (location) were selected (Galadima district, Sabongari district, Sarkindawaki district and Madauchi district) and 12 samples were collected from each community. Water samples were collected from wells, streams and boreholes.

The samples were collected from eight (8) boreholes by allowing the water to run to waste for 2-3 minutes before allowing it to flow into a two-liter screw cap bottle, and then quickly covered. The bottles were labeled with full details of Time, date and numbers.Samples were collected from eight wells using a public fetcher to draw the water into a two-liter screw cap bottle, and then quickly covered.Samples were collected from eight streams by stirring the water before the two-liter screw cap bottle was deep into it and the water was taken just below the surface water. Sample collection from each site was between the hours of 7:00am to 2:00pm and the samples were analyzed within 48hrs of the collection. The collected samples were conveyed carefully to the department of Zoology Laboratory Federal University Lafia Nasarawa State for examination.

Each water sample was examined macroscopically at the site to check for clarity, odor and for the presence of visible particles and debris. The samples were then examined with the aid of the Calcium carbonate ($CaCO_3$) floatation method (Cheesebrough, 2002). One litre water sample was treated with 10ml of calcium chloride solution and 10ml of sodium bicarbonate solution, in a labeled beaker, 10ml of sodium hydroxide solution was added to the sample to raise the pH of the solution to 10. The solution was mixed thoroughly and allowed to settle for two hours at room temperature. The calcium carbonate that was formed absorbed and pushed the particles in the water to the bottom of the beaker. The supernatant fluid was carefully discarded, while the sediment was dissolved by adding 20ml of 10% weight/volume Sulphuric acid, the dissolved sediment was centrifuged at 3000/rpm for 15 minutes smears were made on grease free slides. Two slide was prepared for each sample one was stained with lugols iodine while the other was directly examined (Bakir, *et al.,* 2003) the slide were then examined under the microscope using (×10 and ×40) objective. A modified Baermann funnel technique was used for the extraction of the geohelminths in the soil samples. A glass funnel was attached to a retort stand, cotton wool was placed inside the funnel for filtering, a rubber tube was connected to the bottom of the funnel and a test tube was attached to the end of the tube as a collection container.Trimmed layer cheesecloth, the size of the funnel was placed on top of the funnel, so that none of the potentially infective solution will drip over the side of the funnel and contaminate the surrounding bench. The funnel was filled with water and 5g of the soil sample was mixed and placed on top of the cheesecloth making sure that it is in contact with the water (Gillespie and Hawkey, 1994).The apparatus was left to stand for twenty-four hours before a portion of the fluid was viewed under the microscope using 10× and 40× objectives.

Data obtained were analyzed using R Console software (Version 3.2.2). Pearson's Chi-square test was used to compare the proportion of parasites prevalence rate between species, across seasons, and as well as in relation to sources of water. The p-values < 0.05 were considered statistically significant.

Results and Discussion

A total of 32 water samples were found with parasites. These include 2 species belonging to the protozoan group (*Entamoeba histolytica, and Giardia lamblia*), 3 from the nematode group (*Trichuris trichiuria, Ascaris lumbricoides and* Hookworm), and 1Trematode group (*Fasciola hepatica*). The nematodes contaminated the highest number of samples at 19(59.38%), these includes Hookworm 11(34.38%), followed by *A. lumbricoides* 6(18.75%) and *T. trichiuria* 2(6.25%); the protozoans had 12(37.50%) this includes *E. histolytica*7(21.88%), followed by *G. lamblia* with 5(15.63%) while trematodes were the least prevalent with*F. hepatica* 1(3.13%). However the prevalence rate of parasite across the four selected location showed no significant difference ($\chi^2 = 6$, df = 3, P = 0.1116).The prevalence of parasite in relation to species from (Table1) below showed that hookworm recorded the highest prevalence rate of (34.38%) followed by *E. histolytica* (21.88%) while *A. lumbricoide, G. lamblia, T. trichuria* and *F. hepatica* had 18.75%, 15.63%, 6.28% and 3.13% respectively although thisdisagrees with the work carried out by Chollom *et al.* (2013) who reported highest prevalence in *Ascaris lumbricoides* (33.9%) in their findings. There was a significant difference (χ^2 = 13.781, df = 5, P = 0.01706) in the prevalence rate of parasites in water between species recorded in this study.

Table 1: Prevalence of parasites across the four selected sites of study

	Districts				
Parasites	Galadima Distr (n=12)	Sabon Gari District (n=12)	Sarkin Dawaki District (n=12)	Madauchi Distr (n=12)	Percentage
A. lumbricoides	2(16.67%)	2(16.67%)	1(8.33%)	1(8.33%)	6(18.75%)
Hookworm	1(8.33%)	3(25.00%)	2(16.67%)	5(41.67%)	11(34.38%)
E. histolytica	1(8.33%)	1(8.33%)	3(25.00%)	2(16.67%)	7(21.88%)
G. lamblia	1(8.33%)	2(16.67%)	0	2(16.67%)	5(15.63%)
T. trichiuria	1(8.33%)	1(8.33%)	0	0	2(6.28%)
F. hepatica	0	1(8.33%)	0	0	1(3.13%)
Total	6(50.00%)	10(83.33%)	6(50.00%)	10(83.33%)	32(66.67%)

Table 2 shows that during the late dry season, streams recorded the highest number of parasites 9(69.23%) and wells recorded the lowest number of parasites 4(30.77%).The distribution of the parasites in the early wet season revealed that the streams had the highest number of parasites 18(94.74%) followed by the wells 1(5.26%), water sampled from boreholes recorded no parasite in both seasons. Therefore, prevalence rate of parasites in relation to sources of water showed very high significant difference (χ^2 = 49.741, df = 2, P = 0.0000001) while there was no significant difference (χ^2 = 2.3438, df = 1, P = 0.1258) in the prevalence rate of parasites in relation to seasons.

Table 2: Prevalence of parasites in relation to seasons and the different water bodies

Parasites	Late dry season				Early wet season			
	Wells (n=8)	Borehole (n=8)	Stream (n=8)	Total (n=24)	Well (n=8)	Borehole (n=8)	Stream (n=8)	Total (n=24)
A. lumbricoides	1(12.5%)	0	2(25.0%)	3(12.5%)	0	0	3(37.5%)	3(12.5%)
Hookworm	3(37.5%)	0	3(37.5%)	6(25.00%)	0	0	5(65.5%)	5(20.83%)
E. histolytica	0	0	2(25.0%)	2(8.33%)	1(12.5%)	0	4(50.0%)	5(20.83%)
G. lamblia	0	0	1(12.5%)	1(4.17%)	0	0	4(50.0%)	4(16.67%)
F. hepatica	0	0	1(12.5%)	1(4.17%)	0	0	0	0
T. trichiuria	0	0	0	0	0	0	2(25.0%)	2(8.33%)
Total	4(30.77%)	0	9(69.23%)	13(40.63%)	1(5.26%)	0	18(94.74%)	19(59.38%)

Table 3 showed that during the late dry season streams and boreholes have the highest prevalence of geohelminths (34.64%) and wells have the lowest prevalence of (30.76%). Prevalence of the parasites in the early wet season shows that the wells had the highest prevalence of (45.46%) followed by the borehole (30.30%) and streams (24.24%).The prevalence of geohelminths was higher in early wet season 33(55.93%) than dry season 26(40.07%). However, the prevalence rate of soil geohelminths in relation to seasons showed no significant difference (χ^2 = 1.44, df = 1, P = 0.2301). Soil geohelminths around water sources were highest in well area 23(39.00%) followed by borehole area 19(32.00%) and was least in the stream area 17(29.00%). However, there was no significant difference (χ^2 = 0.94915, df = 2, P = 0.6221) in the prevalence rate of soil geohelminths in relation to sources of water area.

Table 3: Prevalence of parasites in soil collected around the different water bodies in relation to season.

Parasites	Late dry season				Early wet season			
	Wells (n=8)	Boreholes (n=8)	Streams (n=8)	Total	Wells (n=8)	Boreholes (n=8)	Streams (n=8)	Total
A.lumbricoides	1(12.5%)	2(25.0%)	2(25.0%)	5(20.83%)	6(75.0%)	2(25.0%)	3(37.5%)	11(45.83%)
Hookworm	5(65.5%)	3(37.5%)	3(37.5%)	11(45.83%)	3(37.5%)	2(25.0%)	4(50.0%)	9(37.50%)
S. stercolaris	2(25.0%)	4(50.0%)	3(37.5%)	9(37.50%)	5(65.5%)	4(50.0%)	1(12.5%)	10(41.67%)
T. trichiuria	0	0	1(12.5%)	1(4.17%)	1(12.5%)	2(25.0%)	0	3(12.50%)
Total	8(30.76%	9(34.64%)	9(34.64%)	26(40.07%)	15(45.46%)	10(30.30%)	8(24.24%)	33(55.93%)

Conclusion

The outcome of this research has revealed that a good number of the drinking water sources and their surrounding soil sampled harbored some parasitic contaminants. This implies that the people of Doma Local Government Area are at risk of water-borne diseases and soil-transmitted infections due to high rate of parasitic infection of water sources in their surroundings. Generally, people should cultivate the habit of boiling or treating water meant for consumption and also avoids walking barefooted as a mode of transmission of helminth is by penetration of the broken skin. Activities like grazing, defecation, washing, application of local fertilizers; refuge dumping should be discouraged around the water sources. Also government and non-governmental agencies should endeavor to make pipe-borne water available to the people of Doma Local Government Area due to its high level of microbial safety as revealed in this research as this will aid in curtailing the spread or outbreak of water borne-infections.

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