EVALUATION OF LOCAL DRINKING WATER SOURCES TO DETERMINE THEIR POSSIBLE CONTAMINATION WITH PARASITE IN LAFIA LOCAL GOVERNMENT AREA NASARAWA STATE, NIGERIA

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ABSTRACT

Water is an essential resource for life and it is used by every human, every day. Globally, water-borne parasitic infections have recently become an area of concern due to the contamination of different sources of drinking water. Therefore, this study evaluated the parasitic contamination of local Sources of drinking water in Lafia Local Government Area of Nasarawa State, Nigeria. A total of 60 samples were collected from different selected sources (wells, streams, ponds and boreholes) within the months of April and May 2016. The water samples were brought directly to the laboratory, using the calcium carbonate ($CaCO_3$) floatation method, the samples were examined microscopically for the presence of parasites. A total of 36 individuals of parasites were recorded which spread across *Giardia lamblia*, *Entamoeba histolytica*, *Trichuris trichiura* and hookworms. The most prevalent parasite encountered was *Giardia lamblia* while hookworm was the least parasite found. However, the prevalence rate across species of parasites in water showed no significant difference (χ^2 = 3.3333, df = 3, P = 0.343). There was no significant difference in the prevalence rate of parasites across the three selected sites in Lafia (χ^2 = 4.1667, df = 2, P = 0.1245). The highest rate of parasitic contamination was recorded in well sources (56.6%), stream sources recorded 27.8% parasites, and pond sources recorded 16.7% parasites while the borehole sources had no parasitic contamination. Therefore, there was a significant difference in the in the number of parasites across water sources (χ^2 =25.378, df = 3, P < 0.0001). The study indicated high rate of parasitic contamination of local drinking water sources in Lafia. Therefore, the tendency of water borne parasitic infection will be high. Keeping the surroundings of the water sources clean and treatment of water before drinking so as to prevent the outbreak of water bone diseases is very crucial.

Keywords: Drinking water, Sources, Contamination, Parasites and Lafia.

INTRODUCTION

Water is an essential resource for life and it is used by every human, every day. Not only do people need water to survive, but it plays an important role in almost every aspect of life, especially for physiological activities such as in the maintenance of the balance of body fluids. The function of which includes digestion, circulation, absorption, creation of saliva, transportation of nutrients and maintenance of body temperature (CDC, 2013; Kathleen, 2008).

Drinking water, also known as potable water or improved drinking water, is said to be any water that is free from any physical, chemical, biological or radiological form of contamination (Diesing, 2009). This is considered safe for drinking and for the preparation of

food (WHO, 2015). When water becomes contaminated by parasites, it is termed water-borne outbreak (Extension, 2015) and it can cause a variety of illness such as amoebaisis, cryptosporidiosis, guinea worm infection and schistosomiasis (CDC, 2013).

Globally, water-borne parasitic infections have become an area of concern recently due to the contamination of different sources of drinking water (CDC, 2013; Ani & Itibia, 2015). According to World Health report (1998), over 1 billion people do not have adequate and safe water supply of which 800 million are in rural areas and nearly 20 million people worldwide die each year of water-borne disease. Approximately one-half of all the world's hospital beds are occupied by patients suffering from diseases associated with lack of access to potable water (Project Concern International, 2015). It is of critical importance to address the consequences, but more importantly the roots of not having safe water (Project Concern International, 2015). However, the assurance of drinking water safety is a foundation for prevention and control of water-borne disease (WHO, 2015).

Sequel to the public health challenges around the world, there is an urgent need to update the information status of drinking water safety so as to improve public health in the Lafia Local Government Area in particular and the State at large. Therefore, this research aims at studying the parasitic contaminants of drinking water sources in Lafia Local Government Area (LGA), Nasarawa State.

Materials and methods

Study Area

The study was conducted in Lafia, the state capital of Nasarawa which is geographically located in the North Central region of Nigeria. It lies about 234 kilometers South of Jos, Plateau State capital and is boarded to the North by Nasarawa Eggon LGA, to the East by Qua'an-Pan LGA of Plateau State, to the South by Doma and Obi LGAs, while Keffi forms the Western boundary. Lafia covers a geographical area of two thousand seven hundred and thirty-seven square kilometres (2,737 km^2) and has the following coordinates 8°29'30"N, 8°31'0"E, with a population of 330,712 inhabitants according to the 2006 census. The major occupations of people in Lafia are civil service, trading, farming, art and craft works. The inhabitants of Lafia also engage in several other economic activities, but agriculture remains the fundamental means of livelihood. The major language spoken is the Hausa language.

Sample Collection

The research was carried out within the months of April and May, 2016. Water sample were collected from 60 different sources of drinking water within Lafia into 2-liters sterile wide mouth screw-capped bottles. Three (3) sample sites (location) were selected in 3 developmental areas of Lafia LGA (i.e. Lafia North, Lafia Central and Lafia East Development Areas) from which 20 samples were collected for each site. Water samples were collected from the following sources; Wells, Streams, Ponds and Boreholes. Sample collection from each site was between the hours of 7:00 am and 1:00 pm. And the samples were analysed within 48 hours of collection. Collected water samples were carefully conveyed to the Department of Zoology Laboratory, Federal University Lafia, Nasarawa State for examination.

Methods

Each water sample was examined directly for odour, clarity and for the presence of visible particles. After which a digital multi-purpose meter was used to measure the following parameters; pH and temperature. 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 10 ml of Calcium Chloride solution and 10 ml of Sodium bicarbonate solution in a labelled beaker. 10 ml 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 particulates in the water to the bottom of the beaker. The supernatant fluid was carefully discarded, while the sediments were dissolved by adding 20 ml of 10% weight/volume sulphuric acid. The dissolved sediments was centrifuged at 3000/rpm for 15 minutes. Smears were made on grease free slides. Two slides were prepared for each sample; one was stained with lugol's iodine while the other was directly examined (Bakir *et al.,* 2003). The slides were examined on the microscope using the objective lens (×40).

Statistical Analysis

Data obtained were analysed using R Console Software (Version 3.3.2). Proportions of occurrence of parasites in water between study sites, the number of parasites and as well as water sources were compared using Pearson's Chi-Square test. The P value less than 0.05 was considered statistically significant.

RESULTS

Checklist of parasites in water across the 3 selected sites in Lafia

A total of 36 individuals of various parasites were recorded in these study which spread across 4 species of parasites belonging to the protozoan group (*Entamoeba histolytica* and *Giardia lamblia*) and the nematode group (*Trichuris trichiura* and hookworm). The protozoan group had higher number of parasites of 23 (63.9%), among which *Giardia lamblia* had 12 (33.3%) and *E. histolytica* had 11 (30.6%), while the nematode group had lower number of parasites of 13 (36.1%), among which *T. trichiura* had 8 (22.2%) and hookworm had 5 (13.9%) (Table 1). There was no significant difference in the prevalence of parasites in relation to the 3 selected sites in Lafia (χ^2 = 4.1667, df = 2, P = 0.1245). The prevalence of parasites in relation to species showed that *G. lamblia* recorded the highest prevalence rate of 33.3% followed by *E. histolytica* 30.6% while *T. trichiura* and hookworm had 22.2% and 13.9% respectively (Table 2). The prevalence of parasites in relation to species showed no significant difference (χ^2 = 3.3333, df = 3, P = 0.343). The number of parasites in relation to water sources showed that well water had the highest number of parasites 21 (55.6%), followed by streams 10 (27.8%), then ponds 6 (16.7%) and no parasites found in borehole source (Table 3). Therefore, there was a high significant difference in the number of parasites among the water sources (χ^2 =25.378, df = 3, P = 0.00001287).

Table 1: Prevalence of parasites across the three selected sites

Drinking Water Site	*T. trichura*	*G. lamblia*	*E. histolytica*	Hookworm	Total
Lafia North Development Area	1	4	2	-	**7**
Lafia East Development Area	4	3	3	2	**12**
Lafia Central Development Area	3	5	6	3	**17**
Total (%)	**8 (22.2%)**	**12 (33.3%)**	**11 (30.6%)**	**5 (13.9%)**	**36**

Between sites: χ^2 = 4.1667, df = 2, P = 0.1245

Table 2: Prevalence of parasites in relation to species

Parasite species	Occurrence	Prevalence rate (%)
G. lamblia	12	33.3%
E. histolytica	11	30.6%
T. trichiura	8	22.2%
Hookworm	5	13.9%
Total	**36**	**100%**

Between parasites: χ^2 = 3.3333, df = 3, P = 0.343

Table 3: Number of Parasites in Relation to Water Sources

Water source	Total No. of parasites	*G. lamblia*	*E. histolytica*	*T. trichiura*	Hookworm	Total No. of parasites	Percentage occurrence of parasites (%)
Ponds	3	3 (100%)	1 (33.3%)	1 (33.3%)	1 (33.3%)	6	16.7
Streams	11	2 (18.2%)	3 (27.3%)	3 (27.3%)	2 (18.2%)	10	27
Wells	26	7 (26.9%)	7 (26.9%)	4 (15.4%)	2 (7.7%)	21	56.8
Boreholes	20	-	-	-	-	-	-
Total	60	12 (20%)	11(18.3%)	8 (13.3%)	5 (8.3%)	36	84

Between Water sources: χ^2 =25.378, df = 3, P = 0.00001287

DISCUSSION

This survey indicated a high parasitic contamination of the different local sources of drinking water in Lafia Local Government Area of Nasarawa State, Nigeria. Parasitic contamination of drinking water sources (well, streams, ponds, boreholes) vary in the rate of occurrence. A good number of researches around the country also recorded a high rate of parasitic contamination (Ekwunife *et al*., 2010; Odikamniro *et al.*, 2014 and Anni and Itiba, 2015).

The health effects of drinking contaminated water may range from no physical impact to severe illness or even death (WHO and United Nations Children's Fund, 2006).

Among the surveyed water sources, well water source has the highest prevalence rate of parasite 55.6%. These may be as a result of the proximity of pit toilets or improperly situated pit toilets to the well water sources. High prevalence of parasite in well water source can also be linked to the condition of the wells; that is most of the wells are usually left open, thus allowing particles and dirt into the wells, also the wells are poorly constructed hence allowing the influx of runoff waters. This is contrary to the findings of Ani and Itiba (2015) who showed that pond water had the highest occurrence of parasites.

Water samples collected from the stream sources also recorded about 27.8% prevalence of parasite. This could be as a result of faecal contaminations and runoffs from farmlands, especially during the rainy seasons. This is in agreement with Ani and Itiba (2015) who found the stream water source to be second in occurrence of parasites.

Water samples collected from pond sources also harboured a reasonable prevalence of parasites of about 16.7%. This can be associated to the reason that ponds are still waters and may serve as reservoirs that collects rain water from different route. The water samples collected from borehole sources recorded no parasitic contamination. This may be due to the reason that boreholes operate closed system.

Two protozoan parasites (*Giardia lamblia* and *E. histolytica*) and two parasitic nematodes (*T. trichiura* and hookworm) were identified in this survey. The parasites were observed in their cystic and larval stages. The identification of the protozoan parasites in some of the drinking water sources concur with the studies carried out by Chollom *et al.* (2013), Odikamnoro *et al.* (2014) and Ani and Itibia (2015) all in different parts of Nigeria. While the identification of the parasitic nematodes in some of the drinking water sources disagrees with the studies carried out by Odikamnoro *et al.* (2014) and Ani and Itiba (2015).

Aside the parasitic contamination of the water, some of the water samples contained dirt and debris while other water samples contained some coloured particles as a result making the water unfit for drinking. The activities that go on within the area of water sources and the flow of surface runoff water into the water source can also be reasons for their contamination. *G. lamblia* was the most prevalent parasite observed having occurrence of 12 tons (33.3%) in a total of 60 water samples examined. Therefore, there is tendency of high rate of *Giardia* infection within Lafia Local Government Area. The high rate of *Giardia lamblia* occurrence agrees with the study by Odikamnoro *et al.* (2014) who recorded high prevalence of 50% in his study. *E. histolytica* also recorded a high prevalence of 30.6% in the water sources. The contamination of the water with faecal matters, or residence of the study area that defecates indiscriminately in the environment could account for the high prevalence. Therefore, there is a tendency of amoebiasis infection in Lafia.

The nematode group had a low prevalence, *T. trichiura* occurring about 8 times (22.2%) and hookworm occuring about 5 times (13.9%) which disagrees with the finding of Chollom *et al.* (2013) who did record high prevalence of hookworm (20.3%) in his study.

The presence of protozoan parasites and the parasitic nematode is closely associated to activities of grazing cattle that harbour and defecate this parasites, the use of animal droppings as local fertilizers in farmlands which eventually drains into water sources, and

also can be associated to the unsanitary attitude of people who defecate near the water sources. This could lead to the outbreak of giardiasis and amoebiasis which could present symptoms like; abdominal cramps, amoebic dysentery.

CONCLUSION

A good number of the drinking water sources that were sampled harboured some parasitic contaminants. This implies that the people of Lafia may be at risk of water borne diseases due to high parasitic load in the drinking water sources. It is therefore crucial that drinking water should be treated before drinking or usage. Activities like grazing, defecation, washing, application of local fertilizers, refuge dumping should be discouraged around the water sources. It is recommended that drinking water from such sources should be filtered, treated with water guards and/or boiled before usage. The government should also endeavour to provide more access to portable water to the people of Lafia Local Government Area as this will aid in curtailing the spread or outbreak of water borne infections.

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