Research paper

PARASITOLOGICAL EVALUATION OF DOMESTIC WATER SOURCES IN A RURAL COMMUNITY IN NIGERIA

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Abstract

Aim: To evaluate the level of safety of water sources in a rural settlement in Nigeria with bias to parasitic infections and to make appropriate recommendations to the government and the community dwellers.

Study Design: Investigative study

Place and duration of study: Samples were collected in Heipang community in Barkin Ladi Local Government Area of Plateau State, Nigeria between October-December, 2012. They were processed at the General Laboratory of National Veterinary Research Institute, Vom, Nigeria.

Methodology: 100 water samples were collected from domestic water sources in Heipang, Barkin Ladi Local Government Area of Plateau State, Nigeria. 10 of the samples were from streams, 60 from ponds, 20 from wells and 10 were from bore holes. Samples were investigated for presence of parasites using standard World Health Organisation approved laboratory techniques. Each sample was subjected to macroscopy, filtration, centrifugation and microscopy.

Results: It revealed that 59 out of 100 water sources investigated have parasitic infestation. Ponds have the highest degree of parasitic contamination (78.3%), streams followed closely with 50%, while wells and bore holes have 35% and 0% in that order. Helminthes were the leading parasitic genera encountered with *Ascaris lumbricoides* accounting for 33.9% of the parasites. Hookworm was the second most common Helminth with 20.3% prevalence. *Strongyloides stercoralis* accounted for a paltry 3.4% of the parasites. Protozoan cysts of *Balanditium coli* and *Entamoeba histolytica* accounted for 18.6% of parasites each.

Conclusion: These findings clearly show that most water sources in Nigerian rural communities constitute grave epidemiological threat to public health. Inhabitants of such communities must boil or treat their water before consumption while government authorities must move in provide safe drinking water to the rural dwellers.

Keywords: Water, helminth, protozoa, prevalence, Nigeria

1. Introduction

Water has always been an important and life sustaining drink to man, it is essential to the survival of all micro organisms. Water composes approximately 70% of the human body by mass. It is a crucial component of metabolic processes and serves as a solvent for many body solutes, (Jeffrey, 2007). Water is a liquid at ambient conditions but it often co-exists on earth with its solid state, ice and gaseous state. Water also exists in a liquid crystal state near hydrophilic surface, (Gerald, 2011).

Quality water should be free from chemical and biological contamination and must be acceptable in terms of colour, taste and odour in accordance with the World Health Organisation Guidelines on the quality of drinking water (WHO, 1993).

Wells, bore holes, ponds and streams need a great deal of protection from pollution and contamination by potential parasites, micro-organisms and by harmful chemical substances, unfortunately these water sources have become sites for breeding and harbouring of many disease - causing agents, (Adams, 1999).

Water-borne diseases are usually acquired by the consumption of polluted water containing human and animal faecal matter from patients or healthy carriers (Cairncross and Feachem, 1993).

Human excreta are important sources of pathogenic organisms especially the intestinal parasites which are equally significant in high morbidity in the general population primarily caused by inadequate disposal of excreta and lack of personal hygiene. Most urban and rural communities in the developing countries do not have adequate disposal system for human waste, many of them defecate indiscriminately in places not far from their dwelling places, on the soil and rocks, by the sides of the streams, homes ponds and wells in some cases into the streams (Adegoke, 2000). Furthermore, excreta from children and free roaming animals are particularly hazardous and are a problem in both urban and rural communities (Ukoli, 2000).

Excreta-related communicable diseases become a big problem in areas where untreated human faeces are used as manure. These together with the human faecal wastes that are indiscriminately deposited in the environment are regularly washed into the communities' water bodies and water pollution becomes a big problem with the result that fresh vegetables and water sources become highly contaminated with pathogenic parasites. Consequently, the faecal oral route of infection becomes very important and intestinal parasitism assumes enormous proportion especially amongst indisciplined populations that are equally poor in their personal and environmental sanitation (Fitzerpatrick and Kappos, 1999).

Efficient refrigeration and commercial canning have been very useful in combating the problem of parasitic infection in the developed countries, but these developments are outside the reach of most areas in the developed countries. Fresh food items therefore come straight from the farms and gardens and water is taken directly from streams and ponds for consumption without pretreatment to kill parasites that may be present (Petters, 1986).

Parasitic infections cause various physiological disturbances in the host body. In most species the third stage larva is responsible for infection of new host. The infection of man and animal with these parasites is either by oral route or by active penetration of unbroken skin, and this constitutes one of the public health hazards in tropical Africa and the global world in general (Hassan, 1994).

Parasitic infections affect work and productivity as it is always associated with a diminished capacity to carry out physical work. This is of great significance because in many countries, hard physical work is the means by which families grow their food (Vanden, 1984). WHO (1996) estimated that food and water borne infectious diseases currently infect 3.5 billion people in developing countries and cause about 160,000 deaths per year and 80% of these are children less than 5 years of age. This study is therefore designed to evaluate the parasitic hygiene of water sources in Nigerian communities using the Heipang community as a case study

2. Materials and Methods

2.1. Study Area

Heipang is a growing community in Barking Ladi Local Government Area of Plateau State, Nigeria. Over ninety percent of the people are peasant farmers involved in crop and animal production. The population is … Major water sources are wells, streams, ponds and in isolated cases boreholes. Inspite of the location of the state airport, Polytechnic and the proposed in-land container port in the area, government presence in terms of good roads, electricity, pipe-borne water amongst others are only being enjoyed by less than one-quarter of the community. As such, it serves as a template for a typical rural settlement in Nigeria.

2.2. Sample Collection

100 water samples were collected all together in the entire length and breadth of the community. 10 of the samples were from bore holes, 10 from wells, 60 from ponds while 10 were from streams.

Clean glass specimen bottles were used to collect samples from streams, boreholes and ponds. A public fetcher was used to draw water from wells into a clean sample container. All the water samples were well labeled and transported immediately to the laboratory for examination.

2.3. Sample Processing

Collected samples were examined both macroscopically for colour and presence of adult parasites. For purpose of microscopy, concentration by centrifugation as described by WHO (1991) was adopted. Briefly:

A gauze filter was placed into a funnel and then placed on top of a centrifuge tube; the water samples in each container were shaken and passed through the filter into separate tubes to reach the 10ml mark. The filter was then removed and particulate materials present discarded as of bore holes water sample no particles were found. The tubes were then transferred to the centrifuge tubes and centrifuged for 5 minutes at a pre-determined 300rpm. After the period of centrifugation, the supernatant was discarded by gently inverting the tubes leaving the deposits in the tube. The tubes were placed on a rack and the fluid on the sides allowed to drain down the sediments in tubes. Sediment were then re-suspended. A drop of the deposits was placed on a clean slide for examination under a cover slip.

2.4. Direct Wet Preparation

Using Pasteur pipette, the deposit was placed on a clean grease-free glass slide and was covered with cover slip to avoid air bubbles and over floating. The smear was viewed microscopically using x10 and x40 objective for focusing and identification of parasites respectively.

2.5. Iodine Preparation:

A drop of Lugol's iodine was placed at the edge of the slide. The smear was examined systematically under the microscope using x10 and x40 objectives for focusing and identification of parasites respectively.

2.6. Identification of Parasites

Parasites were identified by the morphological structures of their cysts, ova or larvae when focused under the microscope as documented by Cheesbrough (2000).

3.0. Results

All the samples collected from boreholes in the locality were free from parasitic infestation. However, samples from streams, ponds and wells had varied degrees of parasitic contamination. Out of the one hundred (100) water samples collected and examined, 59 of them had one parasite or the other giving an overall prevalence of 59% in the study site (Table 1).

Water from ponds was the most contaminated with 78.3% positivity to parasites, Well water had 35% of well water sources had parasites just as 50% of stream water sources had parasite. However, water from boreholes was parasite-free (Table 1).

On the whole, seven different parasites were encountered in this study. They include *Ascaris lumbricoides* which accounted for 33.9% of all the parasites, Hook worm (20.3%) *strongyloides stercoralis* (3.4%), *Giardia inestinals* (1.7%), *Balantidium coli* (18.6%), *Entamoeba coli* (3.4%) and *Entamoeba histolytica* (18.6%). Table II. Reveals that *A. lumbricoides* is the most widely distributed as if was found in all but one location accounting to 90% spread in the locality, Hookworm followed closely with 70% spread while *B.coli* and *E. histolytica* have 60% and 50% spread each. The least spread parasites are *G. intestinalis*, *S. stercoralis* and *Entamoeba coli.*

Helminthes were the most prevalent genera accounting to 57.6% of all the parasites recovered with protozoan parasites making up the remaining 42.4%.

Table I: Rate of Contamination of Water Sources by Parasites

Water Source	No Positive	Percentage
Stream *(n=10)*	5	50.0
Pond *(n=60)*	47	78.3
Well *(n=20)*	7	35.0
Borehole *(n=10)*	0	0.0
Total *n=100*	**59**	**59.0**

Table II: Spread of parasites in all the locations investigated

Name of parasite	Locations	Percentage
A. lumbricoides	9	90%
S. stercoralis	1	10%
G. Intestinalis	1	10%
Hookworm	7	70%
B. coli	6	60%
E. coli	1	10%
E. histolytica	5	50%

4.0. Discussion

The outcome of this work indicates clearly that parasitic contamination of water sources in rural communities in Nigeria. The rate of contamination varies between stagnant and flowing water. The ponds in the study area included the deep ponds that lasted throughout the year, shallow ponds last for up to about 6 months and dry up. Others were just water filling an existing depression which might be for few weeks or days. However, since the ponds served as reservoirs that collect run-off water from different routes; it therefore stands greater risk of contamination, hence it recorded the highest number of pathogenic parasites. The public health significance of these results is that the pathogenic parasites may pose serious hazard to human health especially on the community dwellers; like the farmers due to occupation and as children due to habits. Another challenge is on people that use water for washing purposes and children that walk around barefooted as the mode of transmission of some helminthes is by the penetration of the unbroken skin, (Arora and Arora, 2010).

Exactly half the number of streams investigated had on parasitic infestation or the other. This is attributed to the fact that streams are regularly being contaminated with faecal materials and sewage due to indiscriminate defecation and rain water. During the cause of this work, human faecal wastes were found around the sides of some streams, ponds and wells visited.

35% of wells were infested with parasites. This is due to lack of toilet facilities in most of the communities. Also most wells in these communities are usually left opened.

Water samples from boreholes were found to be free from parasites. This is largely attributed to their make-up. Unlike other sources that are opened to external contamination, boreholes are operate a water system that is closed. This therefore asserts that parasitic infestation of water sources is contaminative in nature. It has been previously explained that human parasites do not directly use water bodies for life cycle development. Instead their vectors inhabit water bodies thereby associating their transmission to water bodies and certain water foods (Chollom et al., 2012). Government authorities can therefore improve the quality of life in these communities by making available more borehole and pipe-borne water facilities.

Primarily, the risk from intestinal parasitic infections is assumed to be from hookworm and *A. lumbricoides,* but the prevalence of helminthes in this study ranked higher than those of other parasites. This is in agreement with the observation made by Okwonkwo, (2000). The 18.6% prevalence of *B. coli* in this study is traceable to the fact that a good percentage of the inhabitants of the study area are into swine production and since the protozoa in question are of worldwide distribution and commonly infect pigs, it then means that the contamination probably arose from water contaminated with faecal material from swine which are mostly raised in semi-intensive or extensive system in this community.

Ascaris lumbricoides with prevalence of 33.9% ranked highest than other helminthes. It was closely followed by *Hookworm (*20.3%) and *S. stercoralis* (3%). The outcome is not different from that of Griffin and Krishnas (1998). He also concluded that the occurrence of intestinal parasites in water sources is prevalent among poor people in remote rural communities who lack proper toilet facilities, adequate supply of portable drinking water and poor sewage and waste disposal systems.

The implications of these findings therefore suggest that parasitic organisms are having a viable ecosystem in remote settles in Nigeria where toilet facilities, pipeborne water, poor sewage disposal, and illiteracy thrive the most. The combined effect of which exposes the innocent inhabitants, their children and animals to a cycle of endless parasitism resulting in low productivity and high morbidity and mortality rates in most cases (Adam, 1999).

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