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Evaluation of the Parasitic Contamination of Local Sources of Drinking Water in Abakaliki, Ebonyi State, Nigeria.

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Abstract: *Water-borne parasitic infections have become a source of concern in recent times due to the contamination of various drinking water sources. A survey on the parasitic contamination of drinking water sources was carried out in Ezza North Local Government Area of Ebonyi State, South East Nigeria. This is to evaluate the extent of contamination of these water sources and their public health implication. A total of 63 water samples were investigated from five major water sources within the study area. The samples were collected from ponds, wells, streams, boreholes and rainwater and examined using Calcium Carbonate Floatation and Simple Microscopic methods. Among the water sources, pond water had the highest occurrence of parasites 35.9% followed by stream 28.1%, well 21.9%, borehole 9.4% while rainwater had the least 4.7%. Each of the sample sources harboured at least one parasite. Three parasites- Gardia lamblia, Entamoeba histolytica and Cryptosporidium parvum were observed in their cystic and oocystic forms. Among these parasites, Entamoeba histolystica had the highest prevalence of 29(45.3%), Gardia lamblia 22(34.4%) and Cryptosporidium parvum 13(20.3%). The results showed the extent of parasitic contamination of the various drinking water sources in the study area and the susceptibility of the populace to water-borne diseases. Hence, provision of portable water is of utmost importance within the area and the state in general. The inhabitants of the area should also stop activities that lead to the contamination of the water bodies and boil their drinking water before consumption.*

Keywords: *Water-borne, parasites, Contamination, Cyst, Oocyst*

I. Introduction

Water-borne parasite infections are considered a threat and of public health importance especially in developing countries [1].Water is inevitably the source of life on earth and without it life sustenance becomes difficult. Water of good quality is of basic importance to human physiology and man's continued existence depends very much on its availability [2]. Drinking water could be gotten from sources such as borehole/tap water, well water, dams, rivers, streams, lakes, municipal water and rain water. Every community of humans, animals or plants has one or more of these as their source of drinking water. It is important for the health and survival of man in all his habitation. Unfortunately, water consumers are usually not aware of the potential health risks associated with exposure to water borne contaminants [2]. It has been reported that an estimated 1.1 billion persons (one sixth of the world's population) lack access to clean water and 2.6 billion to adequate sanitation [3]. Biological contaminants such as bacteria, viruses, fungi, protozoa and helminthes constitute the major cause of food-borne and water-borne diseases with varying degrees of severity ranging from mild indisposition to chronic or life-threatening illness or both (3). Over 3 million deaths per year is attributed to water-borne diarrhoeal diseases especially among infants and young children in poor communities in Africa, Asia and South America (4). Parasitic infections affect work and productivity as they are usually associated with a diminished capacity to carry out physical work [7].

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 Organization guidelines on the quality of drinking water [5]. To achieve this, different sources of water such as wells, bore holes, ponds and streams need to be protected from pollution and contamination by potential parasites, micro-organisms and harmful chemical substances. However, most of these water sources are located some distances away requiring transportation to homes. It has been recorded that during such transportation, water get contaminated with parasites which grow and proliferate during storage in the homes and cause infection [6].

These contaminants also gain access into water bodies through human and animal faecal matter from patients and healthy carriers of parasitic diseases. The most dangerous form of water pollution occurs when faecal contaminants enter water supply [1]. Most urban and rural communities in the developing countries do not have adequate disposal system for human waste. Inhabitants, therefore, defecate indiscriminately in places not far from their dwelling places, including directly on the soil and rocks, by the sides of the streams, home

ponds, wells and in some cases into the streams[8]. Excreta from children and free roaming animals are particularly hazardous and potential source of health problems in both urban and rural communities [8]. Excreta-related communicable diseases have also become a major problem in areas where untreated human faeces are used as manure as they are regularly washed into the communities' water bodies [9]. Transmission of parasites occur when water is contaminated with the parasites.

In developing countries, water-borne protozoan pathogens are frequently associated with morbidity, particularly in children [10]. These protozoan parasites are the most common causes of infection worldwide [11,12]. The consumption of contaminated water has been implicated and proven to be a major source of Giardia lamblia, Crysptosporidium parvum, Entamoeba histolytica, Isospora beli and Microsporidium infections in various outbreaks/ epidemics [13]. It has also been reported that significant proportions of the 600 million infections due to Giardia lamblia and Cryptosporidium parvum worldwide are water-borne [14]. Amoebiasis is yet another water-borne disease that is gaining prevalence in the world. The prevalence of infections with the causative agent, Entamoeba histolytica is estimated to be 50 million cases each year [15]. According to [16] the outbreaks of amoebiasis have been caused by sewage-contaminated water supplies.

Most studies on the epidemiology of water-borne parasitic infections have been carried out in developed countries while there is little data on the occurrence of these infections in most developing countries [17]. Lack of information on the pathogenic and parasitic microorganisms in drinking water sources in our rural communities creates uncertainties in our understanding of the overall quality of drinking water in these areas. To bridge this information gap, there is need for the evaluation of parasitic contamination of drinking water sources in our rural communities. A good knowledge of the microbial qualities of raw water is necessary so as to guide its suitability for use. This study therefore aimed at evaluating parasitic contamination of drinking water sources in Ebonyi State, South eastern Nigeria so as to provide information that could improve public health of the populace and prevent disease outbreaks in the state.

II. Materials And Methods

Study area

The study was carried out in the rural villages of Ezza North Local Government Area of Ebonyi State, Nigeria. Ezza is one of the largest clans in Ebonyi State. It is composed of more than 6 communities and over 25 villages. The mean minimum and maximum temperatures in the area ranges from 27°C to 40°C. It has estimated population of 141, 438 according to 2006 census. The vegetation is characteristic of derived savannah with high rainfall intensity, high run-off volumes and high relative humidity and an average rainfall of about 1600mm-2000mm per annum (18). The area is still developing, hence, adequate social and infrastructural amenities are lacking. It is uniquely known to harbour the largest quarry sites where stones used by quarry industries are excavated in the state. Some of the abandoned quarry pits serve as ponds for inhabitants of the area. The major occupations of the inhabitants are farming and petty trading. Agriculture provides productive employment to over 85% of the residents and the main agricultural products include rice, yam and cassava. However, agricultural production is still rudimentary as the same local tools, old cultural practices and farming systems used over the ages are still in vogue. Sources of water for drinking and other domestic activities in the area include ponds (locally called 'Okpuru'), boreholes, streams, wells and rain water.

Sample collection

Water samples were collected directly from the various sources of drinking water within the area into 2-litre sterile wide mouth screw-capped bottles. Nine sample sites which included Onunwafor Pond, Ugalaba well, Onunweke stream, Awalaugo stream, Okaleru pond, Azuiyiugwu bridge stream, CSS borehole, Nwafor Ishiagu borehole and rain water from Ndiagu village were investigated from 5 communities in the area. During each trip, a sample was collected from each sample site between 2pm and 4pm and analyzed within 48 hours of collection. A total of 63 water samples were collected in 7 trips.

Methods

Each water sample was viewed with unaided eyes after which fresh drops of samples were also viewed under a light microscope to note the presence of visible particles/debris. The samples were then examined by Calcium Carbonate Floatation method as described by [19]. In this method, each two-litre water sample was treated with 20mls of calcium chloride solution and 20mls of sodium bicarbonate solution. Twenty mililitres of sodium hydroxide solution was also added to the samples to raise the pH of the solution to 10. The solutions were mixed thoroughly and allowed to settle for two hours at room temperature.

The calcium carbonate formed, absorbed and pushed the particulates in the water to the bottom of the beakers. The supernatant fluid was discarded with care while the sediments were dissolved by adding 40mls of 10%w/v sulphuric acid. The dissolved sediments were centrifuged at 3000 rpm for 15 minutes. The supernatant was discarded while smears of the sediments were made on grease-free slides. Two slides were prepared for

each sample; one was stained with Lugol's iodine [17] while the other was stained with acid fast stain using Ziehl-Nelson technique as described by [20]. The stained slides were covered with cover slips and viewed under the light microscope using 10x, and 40x objective lens.

Statistical Analysis: Differences were tested by Chi-square and a P value of < 0.05 was taken as significant.

III. Results

All the drinking water sources recorded at least three water-borne parasites. Three different parasites were encountered in this study. These include the cysts of Entamoeba histolytica which accounted to 45% of all the parasites, cysts of Giardia lamblia 34.4% and oocysts of Cryptosporidium parvum 20.3% (See Table 1). Among the water sources, ponds had the highest level of contamination with parasites (35.9%) followed by the streams (28.1%), the wells (21.9%), the borehole (9.4%) while the rain water had the least (4.7%) (See Table 2). The differences in the level of contamination were statistically significant ($P < 0.05$). Figure 1 shows the percentage occurrences of the identified parasites in the different water sources.

Table 1 shows the various drinking water sites investigated and the number of parasites identified in each site. The result reveals that all the sites harboured at least two parasites. Ugalaba well harboured the highest number of parasites (14), followed by Okaleru pond (12), Onunwafor pond (11), Onunweke stream (7), Awaraugo stream (6) while CSS borehole had the least parasites (2). Entamoeba histolytica cysts were the most widely distributed as it occurred in all but one site, followed by Cryptosporidium parvum oocysts while Giardia lamblia cystes were the least distributed.

TABLE 1: Summary of the results of the various drinking water sites examined and the number of times each parasite was observed.

Sample label	Drinking water site	G. lamblia	E. histolytica	C. parvum
A	Onunwafor pond	3	4	4
B	Ugalaba Well	6	6	2
C	Onunweke stream	-	5	2
D	Awaraugo stream	4	2	-
E	Okaleru pond	7	3	2
F	Azuiyiugwubridge stream	-	4	1
G	CSS borehole	-	2	-
H	NwaforIshiagu borehole	-	3	1
I	Rainwater from Ndeagu	2	-	1
	Total	**22**	**29**	**13**
	Percentage (%)	**34.4**	**45.3**	**20.3**

Table 2: Summary of the rate of occurrence of parasites in different water sources in the area

WATER SOURCES	TOTAL NO. OF SAMPLES	PARASITES FOUND			TOTAL NO. OF PARASITES	PERCENTAGE OCCURRENCE OF PARASITES (%)
		G. lamblia	E. histolyica	C. parvum		
Ponds	14	10(71.4%)	7(50%)	6(42.9%)	23	35.9
Wells	7	6(85.7%)	6(85.7%)	2(28.6%)	14	21.9
Streams	21	4(19.0%)	11(52.4%)	3(14.3%)	18	28.1
Boreholes	14	-	5(35.7%)	1(7.1%)	6	9.4
Rainwater	7	2(28.6%)	-	1(14.3%)	3	4.7
TOTAL	**63**	**22(34.4%)**	**29(45.3%)**	**13(20.3%)**	**64**	**100%**

$P < 0.05$

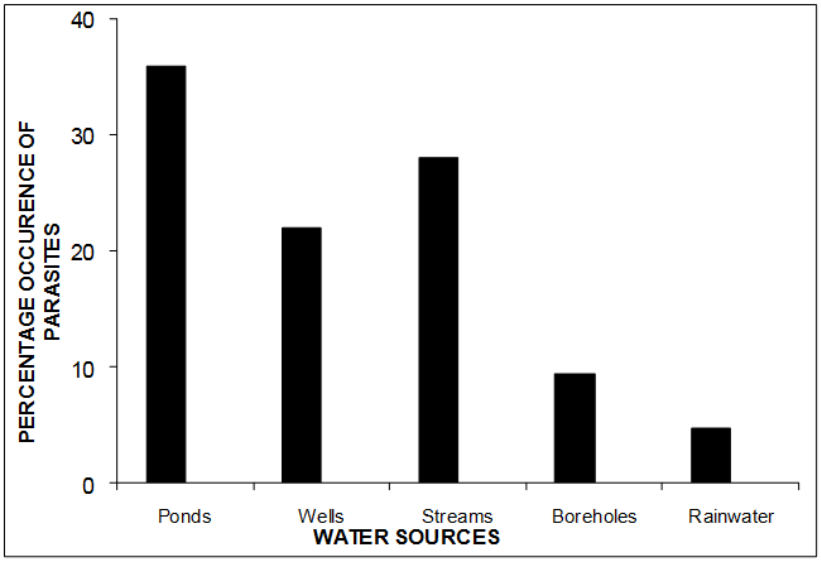

FIG. 1: Bar chart showing the percentage occurrence of parasites in the drinking water sources.

IV. Discussion

The research recorded high parasitic contamination of the different water sources in rural villages of Ebonyi State, Nigeria. The rate of contamination varies between the different sources of water (ponds, wells, streams, boreholes and rainwater). Several researchers have also recorded several high rates of contamination of water with parasites at different parts of the country [21,22,13]. The public health implication of these findings is that the pathogenic parasites may pose serious hazard to the health of rural dwellers such as farmers due to their occupation and children due to poor sanitary habits [7].

Among these water sources, pond water recorded the highest prevalence of parasites (35.9%). This could be attributed to the fact that during the rains, ponds serve as reservoirs that collect run-off water from different routes. They therefore stand a greater risk of contamination with parasites [7]. More than half of the number of stream samples investigated were infested with parasites. This could be as a result of feacal and sewage contamination of the rivers especially during rainy seasons. Water samples from boreholes and rainwater had low rates of infestation (9.4% and 4.7%) respectively. This is because boreholes operate closed system while water harvested from rains are usually covered. This agrees with the fact that infestation of water is contaminative in nature as human parasites do not directly use water bodies for life cycle development. Rather, their vectors inhabit water bodies thereby associating their transmission to water [7].

Three water-borne protozoan parasites, Giardia lamblia, Entamoeba histolystica and Cryptosporidium pavum were identified in this study. The parasites were seen in their cystic and oocystic forms. The identification of these parasites in various drinking water sources agreed with the studies carried out by [13, 7, 21] all in different parts of Nigeria and [17] on the drinking water sources in Ankara, Turkey. Apart from the presence of these parasites, most of the water samples contained dirt and debris while some others contained coloured particles, thus, making the water unsafe for drinking. The activities that go on within the area of the water sources in addition to erosion and influx of surface water into the water sources could also account for their contamination.

Entamoeba. histolytica was the most prevalent of the parasites having occurred 29 times in a total of 63 water samples examined. Hence, there is the tendency of high rate of amoebiasis infection within the study area. The high occurrence of E. histolytica is in contrast with the report of [24] who recorded low prevalence of E. histolytica in his study.

Giardia lamblia also gained high prevalence in these water sources. This could be associated with high rate of contamination of the water sources with faecal matters as residents of the study area defecate indiscriminately in their environment. Cryptosporidium parvum and Giardia lamblia are protozoan parasites that cause major human infections through water- borne transmission. The presence of these two parasites is closely linked with unsanitary attitude of people who defecate near the water bodies and activities of farm animals which harbour the parasites. This could result to the outbreak of cryptosporidiosis and giardiasis in the area. These organisms are also implicated in the cause of diarrhoea along with noticeable weight loss, pain and abdominal colic [25].

V. Conclusion And Recommendations

Most of the drinking water sources in the area of study were contaminated with water-borne parasites. Rural communities in the state are therefore at risk of water-borne diseases due to the high rate of parasitic infestation of these water sources. Therefore, there is need to keep all drinking water sources clean and free from parasite contamination. The water sources should also be protected from dumping/ littering of refuse, defecating, grazing, washing and other activities that contaminate them. Drinking water from these sources should be boiled and allowed to cool before use. Provision of portable water by both government and non-governmental organisations to the residents of the rural villages and communities in the state is also recommended as this will reduce the rate at which the spread of water-borne parasitic diseases occur.

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