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Original article

OCCURRENCE OF GEO-PARASITES IN WATER SOURCES FROM NASSARAWA EGGON LOCAL GOVERNMENT AREA OF NASARAWA STATE, NIGERIA

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ABSTRACT

The presence of good consumable water is a vital resource essentially needed in every given community. Hence, the needs to ensure that water are of good quality and safe at all times for consumption and usage. Therefore, this study investigated the composition of geo-parasites in water sources from Nasarawa Eggon L.G.A of Nasarawa State, Nigeria. A total of 60 water samples were collected respectively from ponds, streams, well and boreholes between the months of March and April, 2022 and physicochemical parameters determined in sites. The Formalin concentration method was employed to microscopically examine the water samples for the presence of parasites egg, cyst and larvae. A total of 32 water samples were found positive for protozoan, nematodes and cestodes. The protozoan *E. histolitica* (66.3%) recorded the highest contamination while the cestodes(6.12%) were the least encountered parasites. Parasite prevalence was significantly ($P = 0.0001$) higher in water around the streams (57.14%) while the boreholes recorded zero contamination. The average values of the physicochemical parameters of the water sources were found to have fallen below the permissible limits of WHO and NSDWQ except for pH. The high contamination of parasites in streams suggests that individuals utilizing such water source for domestic usage are at greater risk of water-borne diseases. Since the water from boreholes was observed to record a zero parasite as well as a low parasite from the surrounding soil, it is therefore recommended that more boreholes should be constructed to enable access to safe and good quality water to the inhabitants of the study areas. Also, sensitization on the need to boil water sourced from streams and pond before drinking is here by recommended.

Keywords: Parasites, Water sources, Contamination, Prevalence.

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INTRODUCTION

Water is of fundamental importance for life on earth. The synthesis and structure of cell constituent and transport of nutrient in to cell as well as body metabolism depends on water. It is of equal importance with the air we breathe in maintaining the vital processes of life, and it makes up 60% of body weight in human body [1], [2]

Water-borne Parasitic infections are considered a threat and of public health importance especially in developing countries [3]. Water could be from sources such as borehole/tap water, well water, dams, rivers, streams, lakes, municipal water, and rain water [4]. Every community of humans, animals or plants has one or more of these as their source of drinking water. Pollution of groundwater with pathogenic microorganisms is generally believed to be a consequence of migration or introduction of fecal material either from humans or animals into the subsurface. Fecal pollution can reach groundwater from many concentrated pond sources such as cesspools, landfills, leaking sewer lines, and filled septic systems [5]

Globally, at least 2 billion people uses drinking water sources contaminated with faeces, microbial contamination with faeces poses the greatest risk of drinking water safety [6]. Parasitic infections affect work and productivity as they are usually associated with a diminished capacity to carry out physical work [7]. Despite the promotion of public health and improvement of life style in the recent years, parasitic diseases have remained a public health problem in many parts of the world. In many rural areas of Nigeria, access to clean water remains a major challenge and the few available sources of water are usually characterized by poor water quality. Several studies have incriminated water sources as a major source for acquiring several pathogenic agents including bacteria, viruses, and parasites [8],[9].Thus, this study aims to investigate the composition of geo-parasites from sources of water in Nassarawa Eggon Local government Area of Nasarawa State. Nigeria.

MATERIALS AND METHODS

Study Area

The study was carried out in Agidi, Akun, and Nassaraw Eggon main town of Nassarawa Eggon Local Government Area of Nasarawa State, figure 1. It covers a land mass of about 1,208km^2 and lies between latitude 8^0 51N and longitude $5^0$05E. It is bounded on the North by Akwanga and by Wamba,Kokona and Lafia in the East, West and South. The LGA has an estimated population of 196,560 according to 2006 Population census. The major occupation of the inhabitants is farming and crops commonly cultivated include cowpea, maize, rice, sorghum, groundnut, yam, sweet potatoes, sugarcane, and pepper [10].

The LGA has a tropical climate, characterized by dry and wet seasons. The rainy season commences early in April to October whereas the dry season starts from November to March. The annual average rainfall in the LGA ranges between 180 mm and 200 mm. The climate, soil type, and hydrology allow for the cultivation of most staple foods, grazing land for animals, fresh water for fishing and forestry [10].

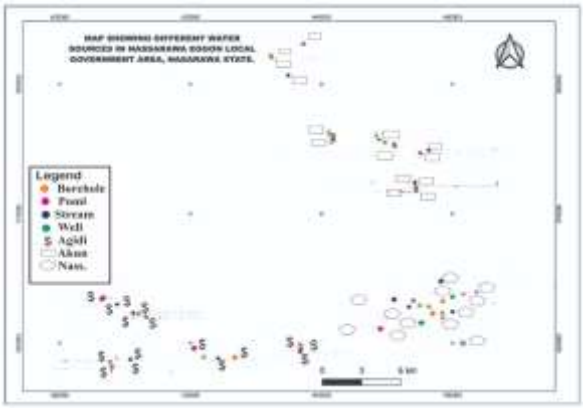

Figure 1: Map Showing the Different Sources of Water Surveyed in Nassarawa Eggon L.G.A.

Study Design

The study was conducted for parasitological evaluation of different water sources from streams, pond, boreholes and wells. A total 60 Samples were randomly collected in different communities within the study area, using the return sample size formula for continuous and categorical data by [11]. The study area was divided into three (3) broad areas namely Agidi, Akun and Nassarawa Eggon town and sampled during the dry season from February to March 2022.

Determination of Physico-chemical Parameters

Physicochemical parameters including Temperature, pH, Total dissolve solids, salinity and Electrical conductivity were obtained prior to samples collection from the various water sources in the field using a hand held multi meter (EUTECH OAKTON). This was carried out by dipping the hand held multi meter inside the water body in a particular spot for 5minutes according to the manufactures guide (AMSTAS), after which each parameter was obtained and recorded.

Sample Collection

A total of 60 samples consisting of 15 water samples each were collected from 4 sources of water consisting of borehole, stream, pond and well into a pre-sterilized one-litre screw cap bottles, [12]. Samples were then carefully transported to Zoology Laboratory of the Federal University Lafia, Nasarawa State for further parasitological analysis.

Sample Preparation and Examination

Parasitological Analysis of water: Water samples were allowed to settle for 24 hours, after which formalin concentration method was carried out according to [13].Water sample were filtered through a filter sieve of 0.5 mesh size. The residue was soaked and rinsed thoroughly in a beaker containing 20ml of 5% formal saline, (5% formallin in 0.85% of NaCl). The filtrate was poured into centrifuged tube and centrifuged at 4000 rpm for 6minutes at room temperature and allowed to settle in test tube racks for 3 minutes, the supernatant was discarded while a drop of the resultant residue was placed in a clean glass slide and iodine solution was added to it, it was then covered with cover slip and examined under a microscope using x10 and x 40 objectives. Parasites were then identified by checking out their morphological structure to identify ova, cyst and larva [14].

Data Analysis

Data obtained was 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 parasites species, as well as in relation to sources of water respectively. The P-value < 0.05 was considered statistically significant.

RESULTS

Composition of parasites from water sources in Nassarawa Eggon L.G.A

Of the 60 drinking water sources sampled, 32 water samples were found with parasitic contamination comprising of 1 protozoan (*Entamoeba histolytica*), 3 Nematodes (*Strongyloides stecoralis, Ascaris lumbriscoides,* hookwormspp.) and two cestodes (*Taenia* spp *and Diphylobothrium latum*) were identified in the study. The protozoan *E. histolytica* had the highest contamination 65(66.3%), followed by nematodes 27(27.52%) which consist of *A. lumbriscoides,* 11(11.2%) *S. stercoralis* 8(8.16%), Hookworm 8(8.16%) while the Cestodes had the least contamination 6(6.12%) consisting of *Taenia* spp. 5(5.10%) and *Diphylobothrium latum* 1(1.02%). Therefore, the prevalence of parasites from the water samples between parasites species was highly significant (χ^2 = 181.18, df = 5, P < 0.0001).

Result from the checklist of parasites showed Agidi area has the highest prevalence 39(39.79%), followed by Nassarawa Eggon town 33(33.67%), while the least was in Akun area 26(26.53%) (Table 1). However, the prevalence of parasites from the water samples in relation to locations showed no significant difference (χ^2 = 2.6429, df = 2, P = 0.2668).

Prevalence of Parasites in Water Samples in Relation to Sources in Nassarawa Eggon LGA

Water samples from streams (57.14%) had the highest parasitic prevalence, followed by water samples collected from ponds (35.71%), while the least was recorded from water samples collected from well (7.140%). Water samples from boreholes had no parasites (Table 2). Thus, there was a very high significant difference (χ^2 = 83.673, df = 3, P- < 0.0001) in the prevalence of parasites from water samples in relation to water sources.

Parasitic Developmental stages from water sources

A total of 65 cyst, 22 ova and 11 larvae were observed from the different source of water sampled (Table 3). Water samples from the stream had the highest number of parasite developmental stages cyst (64.6%) ova (40.90) and larva (45.45) followed by water samples from pond cyst (26.15), ova (54.54) and larva (54.54). The well had the least and only two parasitic developmental stages cyst (9.23) and larvae (4.55). Water samples from boreholes recorded no parasite. Thus, the abundance of parasitic developmental stages in the water samples in relation to water sources showed a very high significant difference (χ^2 = 188.4, df = 7, P- < 0.0001).

Mean Physicochemical Parameter in Relation to Abundance of Parasites in the Study Area

The highest average temperature was observed in water samples sourced from borehole (28.78^{o}C), followed by water samples sourced from well (28.33 ^{o}C), then stream (27.91 ^{o}C).The least mean temperature was observed in the pond (26.38^{o}C) (Table 6).

Mean Total Dissolve Solid (TDS), recorded highest in water samples sourced from borehole (213.68ppm) followed by well (192.52ppm), pond (89.88ppm) while the least TDS was observed in water samples

sourced from stream (69.67ppm). The highest mean salinity was observed in borehole (153.42ppm) followed by well (133.44ppm), pond (64.56ppm) while the least salinity of was observed in water samples sourced from stream (51.95 ppm).

Water samples sourced from pond (6.28) had the highest average pH followed by stream (6.12) well (6.10) while the least pH was recorded in water samples sourced from borehole (5.9).

The highest mean Electronic conductivity was observed in water samples sourced from borehole (269.6us/cm) followed by well (233.18um/cm), pond (120.9us/cm) while the least was recorded in the stream (92.74us/cm) (Table 6). Figure 2 shows the relationship between parasites abundance to physicochemical parameters.

Table1: Checklist of parasites in water source across location

	Location (%)			
Parasite	**N/Eggon Town**	**Akun Area**	**Agidi Area**	**Total (%)**
Ascarislumbricoides	5(45.4)	4(36.3)	2(18.1)	**11(11.22)**
S. Stercoralis	2(25.0)	3(37.5)	3(37.5)	**8(8.16)**
E. histolytica	26(40.0)	15(23.7)	24(36.9)	**65(66.33)**
Hook worm	0(0.0)	3(37.5)	5(62.00)	**8(8.16)**
Taenia spp.	0(0.0)	1(20.0)	4(80.0)	**5(5.10)**
D. latum	1(100)	0(0.0)	0(0.0)	**1(1.02)**
Total	**33(33.67)**	**26(26.53)**	**39(39.79)**	**98**

Table 2: Prevalence of parasites in relation to water sources

	Water Sources (%)				
Parasite	**Pond**	**Stream**	**Borehole**	**Well**	**Total (%)**
A. lumbricodes	8(72.7)	3(27.7)	0(0.0)	0(0.0)	**11(11.2)**
S. stercoralis	5(62.5)	3(37.5)	0(0.0)	0(0.0)	**8(8.16)**
E. histolitica	17(26.15)	42(64.6)	0(0.0)	6(9.23)	**65(66.3)**
Hookworm	1(12.5)	7(87.8)	0(0.0)	0(0.0)	**8(8.16)**
Taenia spp.	4(80.0)	0(0.0)	0(0.0)	1(20.0)	**5(5.10)**
D. latum	0(0.0)	1(100)	0(0.0)	0(0.0)	**1(1.02)**
Total	**35(35.17)**	**56(57.14)**	**0(0.0)**	**7[7.14)**	**98**

Table 3: Developmental Stage of Parasite in Different Water Sources

Group	Parasite	Pond		Borehole		Stream		Well		Total	
		Ova	cyst	Ova	Cyst	Ova	Cyst	Ova	Cyst	ova	cyst
Protozoans	*E .Histolytica*	0	17	0	0	0	42	0	6	0	65
sub total		0(0.00)	17(26.15)	0(0.00)	0(0.00)	0(0.00)	42(64.61)	0(0.00)	6(9.230)	0(0.00)	65(100)
Helminthes		Ova	larva	Ova	Larva	Ova	Larva	Ova	larva	ova	larva
	S. stercoralis	0	5	0	0	0	3	0	0	0(0.00)	8(72.72)
	hookworm	1	1	0	0	4	2	0	0	5(22.72)	3(27.27)
	Ascarislumbricodies	8	0	0	0	3	0	0	0	11(50.0)	
	Taenia spp.	3	0	0	0	1	0	1	0	5(22.27)	
	D. latum	0	0	0	0	1	0	0	0	1(4.55)	
sub total		12(54.54)	6(54.54)	0(0.00)	0(0.00)	9(40.90)	5(45.45)	1(4.55)	0(0.00)	22(100)	11(100)

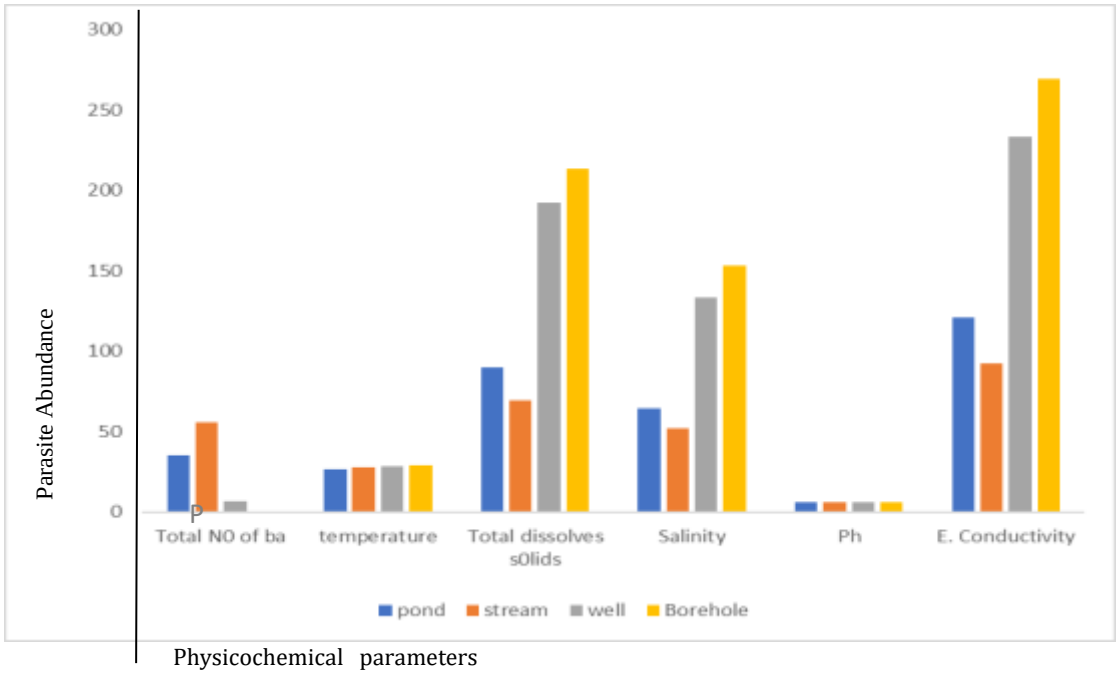

Figure 2: The relationship between parasites abundance and physicochemical parameters

DISCUSSION

Results from the findings of this research work indicates that the water sources in Nasarawa Eggon Local Government Area are contaminated with parasitic pathogens which confirms earlier findings [7],[15],[12],[4]. in Barkin Ladi LGA, Plateau State, Lafia LGA, Nasarawa state, Doma LGA, Nasarawa state and Akure south/North, Ondo State respectively. *Entamoeba histolytica*; the only protozoan parasite recorded was found to be the most prevalent parasite 65(66.3%). The high prevalence of *E. histolytica* recorded across the water sources could be attributed to the contamination of water by fecal matter as a result of indiscriminate defecation by humans as well as animals. This finding aligns with the results of [16], who reported the presence of *E. histolytica* as the most prevalent from water sources Ezza North Local Government Area of Eboyin State of Nigeria. The result however, contradicts the findings of [4] who reported *C. pavum* as the most prevalent parasites from water sources in Akure north and south area of Ondo state, Nigeria. *Diphyllobothrium latum.* of the cestode group has the least prevalence from the water sources studied. This is in line with the result of [13], that reported lower prevalence of *D. latum* from water sources in Dekina LGA, Kogi State, Nigeria.

The high prevalence of parasitic contamination in stream water in this study could be due to the open nature of the stream which predisposes it to contamination by animal feacal matter as well as rain water run-off from nearby refuse dump sites, sewages drainages into the stream. This corresponds to the result of [12], [4] that reported higher parasite prevalence in water sourced from the streams. Nevertheless the result disagree with the findings of[16],[15], who reported higher parasite prevalence in water sourced from the ponds and wells in Ebonyi State and Nasarawa State, Nigeria respectively.

Water sourced from the well has the least parasite prevalence in this study. This could be attributed to better construction and the proper management practices by users which reduces parasitic contamination. It was also found that no parasite contamination was recorded in water sourced from the boreholes which suggest that the boreholes are properly constructed at deeper depths that could rarely support parasites survival. This result correlates with the findings of [7], [15] who reported the absence of parasites in water sourced from boreholes. Although, the result disagrees with the findings of [16] who recorded the presence of parasites in water sourced from boreholes in the eastern region of Nigeria, they opined that the possible reasons for the presences of these parasites in borehole water sources could be due to the proximity or closeness of the facility to septic tanks/soak away pits and the shallowness of the bored hole.

The presence of cyst, ova and larva, in this study, could be due to the availability of exposed water sources which serves as reservoir that harbours and supports the development of these parasites[15],[4], it agrees with this finding that identified varying developmental stages of parasites from different water source in their studies. Interestingly, these developmental stages indicate that parasites could easily complete their lifecycle in the presence of any available host and as such inhabitants of the areas

could be at risk of water-borne related diseases.

The average value of the five physico-chemical parameters determined in the selected water bodies were found to have fallen below the threshold of World Health Organization and Standard Organization of Nigeria standards. The suitable temperature, lower pH and the low salinity levels of the streams could suitably attributes to the high abundance of parasite in the streams. Living organisms survive more at neutral and slightly alkaline pH [17].Also the average salinity recorded in water from the streams in the study was observed to be lower than the 250mg L^{-1} fresh water standard as approved by Environmental Protection Agency (EPA) which suggests that water from the streams could supports parasite development.

The borehole recorded average values which could also support the striving of parasites, but the construction of the facility and the depths of most boreholes tend to limit the survival and growth of parasites. Hence, could be attributed to the lower prevalence of parasites recorded in boreholes in the study area.

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Conflict of interest
None (there is no conflict of interest).

Authors Contributions
S.M conceived the study and carried out the field and laboratory practical. M.J,A.S and O.A helped compute and analyzed statistical data, P.V, S.M, M.J, O.A, P.V and A.S all identified the parasites and drafted the manuscript. All authors read and approved the final Manuscript.

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