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Parasitological quality of drinking water gotten from major sources in parts of Ogun State, Nigeria

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ABSTRACT

Water drunk by humans and animals should be safe for consumption worldwide. Humans unknowingly ingest contaminants found in drinking water. This cross-sectional study aimed at assessing parasites associated with drinking water sources in parts of Ogun State, Nigeria. One hundred and thirteen (113) accessible water sources across seven (7) study communities were subjected to sedimentation method and examination of parasites with the aid of a microscope and a World Health Organization identification chart. Data were analyzed, and presented in frequencies and percentages. An overall prevalence of 70(61.9%) had parasites with Hand-Dug Wells (HDWs) having the highest prevalence with 43(61.4%). Out of the 69 HDWs, 43(61.4%) harbored 8 parasites namely *Taenia* sp. (1.2%)>Hookworm sp. (3.3%)>*Trichuris trichiura* (3.3%)>*Entamoeba histolytica* (4.2%)>*Strongyloides stercoralis* (5.5%)>*Giardia duodenalis* (6.6%)>*Cryptosporidium parvum* (10%)>Ascaris *lumbricoides* (50%). For water from Boreholes (BH), 23(32.9%) of the samples were detected to harbor 7 parasites namely; Hookworm sp. (0.8%)>*Taenia* sp. (3.3%)>*Entamoeba histolytica* (5.8%)>*Trichuris trichiura* (6.0%)>*Strongyloides stercoralis* (9.8%)>*Giardia duodenalis* (20.8%)>*Ascaris lumbricoides* (30.8%). Lastly all the sampled streams were parasite-infected with *Ascaris lumbricoides* being the most occurring with 100%. In conclusion, water from the major drinking water sources in the study area have been found to possess parasites, an indication that it is unsafe for inhabitants of the study area to drink as they could lead to gastrointestinal diseases. The health authorities must carry out sensitization programs on the awareness on the potential health risks associated with constant consuming of the parasitic-contaminated water.

Key Words: Boreholes; Drinking-water; Hand-dug wells; Nigeria; Ogun State; Parasites; Streams.

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1. INTRODUCTION

Water is fundamental to human beings, as it constitutes approximately 60% of human body weight (Simon-Oke et al., 2020). Generally, water safe for consumption must be odorless, colorless, transparent and free of impurities. However, over 785 million people worldwide do not have access to basic drinking water (WHO and UNICEF, 2017). Various sources of water in Nigeria have been mentioned by Simon-Oke et al. (2020) and water gotten from these sources is ingested and used for domestic purposes including cooking of food and washing of utensils.

According to the World Health Organization, over 80% of the diseases infecting humans is directly or indirectly be transmitted through water (Haseena et al., 2017). Worldwide, ingestion of water containing impurities such as heavy metals, viruses, bacteria and parasites remain a menace health wise. This is because continuous water intake

from contaminated sources could lead to cancer, gastrointestinal diseases and other life-threatening diseases. Over the time, international and local health authorities have continuously raised concerns over the quality and management of water sourced from various sources.

Worldwide, there has been an increase in the number of cases of outbreaks of water-related parasitic diseases (Omarova et al., 2018). Several studies have also indicated that pathogenic parasites can also be used as potential indicators of pollution in waters (Slodkowicz-Kowalska et al., 2015; Sures et al., 2017; Amadi et al., 2020). Poor knowledge on how the quality of water has impact on safe drinking water could be one of the factors leading to the increase in parasitic related water diseases. Presently, there is limited data on parasitic contamination among drinking water sources in Ogun State. The availability of such data could prompt appropriate water and health agencies towards achieving the 2030 Agenda by the Sustainable Development Goals, which includes having access to safe drinking water. In the light of this, this study was carried out to evaluate the parasites associated with drinking water gotten from major sources by the residents in parts of Ogun State, Southwest Nigeria.

2. MATERIALS AND METHODS

2.1 Study area

Ijebu-North Local Government Area (LGA) with a land area of 967 km^2 comprises of some rural communities, which include Ago-Iwoye, Ijebu-Igbo, Ilaporu, Oru, Awa and Mamu. The LGA has a population projection of 465, 118. Although it houses educational institutions, hospitals and markets, agricultural activities which include animal rearing and planting of crops are also carried out in the L.G.A. Water from boreholes are presumed to be clean and safe for human consumption in the communities. Abeokuta which is the capital seat of Ogun State is situated on the east bank of the Ogun River.

2.2 Study design

The sampling technique used for this study was purposive sample as houses reported to have a source of water were to be recruited into the study. Early morning visits were made to the study communities and the purpose of our study was explained to the household members. The sources of drinking water identified were Boreholes (BHs), Hand-dug wells (HDWs) and streams. The presence and locations of stream were applicable were inquired. Thereafter informal consents were sought from household members to collect water from their water source. The only limitation encountered during sampling was refusal of some household members to give consent to taking water from their water sources. Altogether, 40 water BHs, 69 HDWs and 4 streams cross-sectionally across the 6 selected communities of Ijebu-North Local Government Area and Abeokuta in Abeokuta-South Local Government Area were accessible and sampled. Using clean polyethylene water containers, 2L of water was collected from water sources, labeled, preserved in iceboxes to avoid any contamination and transported immediately to the Laboratory for further analysis.

2.3 Parasitological Procedures

Each sample was checked macroscopically (color and odor) before proceeding for the microscopy stage. In other to avoid loss of the characteristic morphology of the parasites, all samples were preserved with 10% formaldehyde. The detection of parasitic contamination in each water samples involved 1L of water sample subjected to the calcium carbonate floatation method as described by Cheeseborough (2005). Using a labeled beaker, 10ml of sodium

carbonate, 10ml of calcium chloride ($CaCl_2$) and 10ml of sodium hydroxide (NaOH) was mixed with 1L of water sample. The beaker was shaken thoroughly and left to settle for 2 hours at room temperature after which the supernatant fluid was gotten rid of and the sediment dissolved by the addition of 20ml of 10% weight/volume of sulphuric acid (H_2SO_4). After this, the final sediment was centrifuged for 15 minutes and was subjected to direct microscopy on a clean glass slide using x40 objective lens to view under the microscope. The trichome staining procedure as described by CDC (2016) was carried out and the essence of this procedure was to aid in the identification of the cysts of the protozoans. The WHO (2019) chart was used in the identification of cysts, eggs and larvae of parasites detected using their morphological characteristics.

2.4 Statistical analysis

The Data collected was entered into Microsoft Excel 2016 and transported into Statistical Package for Social Science (SPSS) software version 24. Descriptive statistics (frequency and percentages) were presented in tables.

3. RESULTS

3.1 Overall prevalence of infected water sources

Overall, 70 (61.9%) of the water samples were found to be infected with parasites (Table 1) with water samples from Mamu being the highest 5(83.3%) and water samples from Oru being the lowest with 7(41.1%) (Table 1).

3.2 Parasites observed in borehole water samples

Figure 1 provides information on the diverse species of parasites found in the water samples collected from BHs in the study area. It was observed that the eggs of *Ascaris lumbricoides* (*A. lumbricoides*) were the most occurring parasites across the study locations. The least occurring parasites across the study locations were the cysts of *Entamoeba histolytica* (*E. histolytica*), ova of Hookworm sp. and eggs of *Taenia* sp.

3.3 Parasites observed in hand-dug wells water samples

Ascaris lumbricoides eggs were the most occurring parasites across the study communities while *Trichuris trichiura*, Hookworm eggs and *Taenia* sp. had the least occurrences. It was also observed that protozoans which were cysts of *Giardia duodenalis* (*G. duodenalis*), *Entamoeba histolytica* (*E. histolytica*) and *Cryptosporidium parvum* (*C. parvum*) were also isolated (Figure 2).

3.4 Parasites observed in stream water samples

Parasites detected amongst the four (4) streams' water samples are shown in Table 2 below. It was observed that all the 4 streams had parasites isolated from them. The eggs of *A. lumbricoides* were the most occurring across the communities while the ova of *Trichuris trichiura* (*T. trichiura*) and the cysts of *C. parvum* were the least occurring. Furthermore, observations showed that streams located at Mamu harbored more parasites than streams located at Ago-Iwoye and Oru.

4. DISCUSSION

Our cross-sectional study assessed parasites associated with drinking water sourced from BHs, HDWs and Streams by the residents in the study area. A total of eight (8) parasites belonging to five (5) Phyla namely; Amoebozoa, Apicomplexa, Metamonada, Nematoda and Platyhelminthes were isolated in the water samples. Despite the opinion of Dare et al. (2019) that drinking water sourced from BHs and wells could help prevent water-borne diseases, the isolation of the 8 parasites from the water sources suggests that residents in the

study area are susceptible to parasitic infections. Various parasitic species have been found in numerous investigations on the parasitological quality of water samples that have been undertaken globally (Siwila et al., 2020; Muhammed et al., 2022). These water-borne parasitic and protozoan infections are frequently linked to morbidity in humans especially in children and pregnant women in developing countries (Ejike et al., 2021; Aschale et al., 2022).

Table 1. Overall prevalence of drinking-water sources containing parasites in the study communities in Ogun State, Nigeria

Variables		Number of water sources examined for parasites	Number positive (%)
Water sources	BHs	40	23 (32.9)
	HDWs	69	43 (61.4)
	Streams	4	4 (5.7)
	Total	**113**	**70 (61.9)**
Study communities	Awa	12	6 (50)
	Ago-Iwoye	28	21 (75)
	Ijebu-Igbo	20	15 (75)
	Ilaporu	10	7 (70)
	Mamu	6	5 (83.3)
	Oru	17	7 (41.1)
	Abeokuta	20	9 (45)
	Total	**113**	**70 (61.9)**

Parasite (Number of occurrences in the study communities) for HDW: *Ascaris lumbricoides* eggs (3); cysts of *Giardia duodenalis* (2); Hookworm sp. (2); cysts of *Entamoeba histolytica* (2); *Cryptosporidium parvum* cysts (1); ova of *Trichuris trichiura* (1).

Table 2. Species of parasites found in drinking-water sourced from streams across the study communities in Ogun State, Nigeria.

Location	Number of streams examined for parasites	Number of Streams positive (%)	Parasites isolated in the streams
Ago-Iwoye	1	1(100)	*A. lumbricoides,* Hookworm sp.
Mamu	2	2(100)	*A. lumbricoides, C. parvum G. duodenalis, T. trichiura, E. histolytica*
Oru	1	1(100)	*A. lumbricoides, G. duodenalis,* Hookworm sp., *E. histolytica*
Total	4	4(100)	

% - Percentage

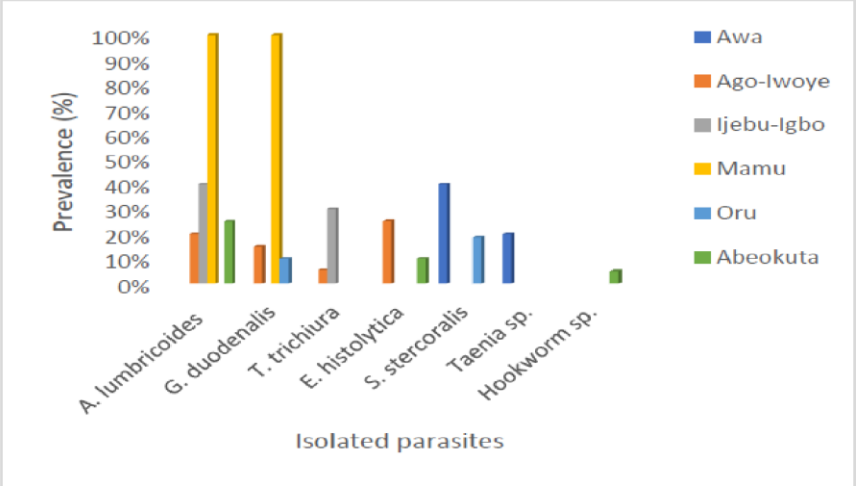

Figure 1: Parasites detected in drinking water sourced from Boreholes across the study communities in Ogun State, Nigeria.

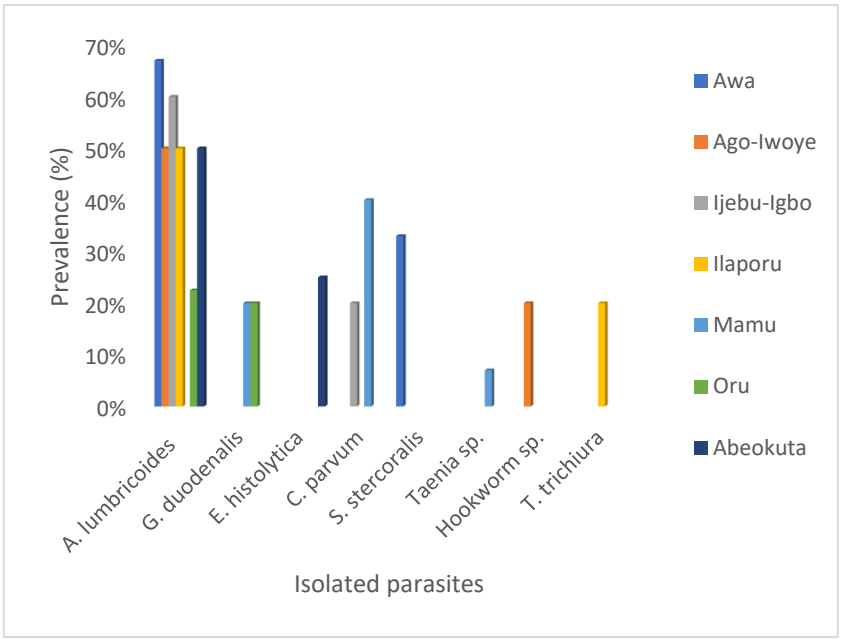

Figure 2: Species of parasites found in drinking-water sourced from Hand-Dug Wells across the study communities in Ogun State, Nigeria.

Hand-Dug Wells (HDWs) observed amongst the drinking water sources contained parasites the most and this was also in line with Gyang et al. (2017) who reported 56.6% of HDWs amongst parasite-contaminated drinking water sources in Nassarawa State, Nigeria. It was observed in our study that most of the HDWs were left unprotected and because of this, egg, larvae, cysts and oocysts of parasites in the environment could find their route into these wells. In addition, poor construction of HDWs was another reason given for parasites being found in them (Gyang et al., 2017; Ikeh et al. 2024). Ani and Itiba (2015) and Ejike et al. (2021) reported in contrast that ponds and streams were detected to possess the most parasites in Ebonyi and Abia States, Nigeria as they were unprotected and continually exposed to contaminated run-offs. All the streams' water samples in our study had parasites isolated from them.

Boreholes are termed to be the safest source of drinking water however contamination of BHs could be due to its depth not deep enough or distance of the BH to sewage tanks or landfills. In a residential area, the requirements to be fulfilled when sinking a BH is the standard depth of 60 to 100 meters and maintaining a distance of >10 meters from a sewage tank. As reported by Chollom et al. (2013) a borehole that is sunk <10 meters from a sewage tank is more prone to faecal pollution from landfill and septic tank seepages if the recharge point is located very close to the pit. Despite being regarded to be the safest source of water, our BH water samples contained parasites that could be dangerous to human health as they lead to intestinal illnesses in people. In other words, the presence of these parasites in some of the BHs in our study area could be due to the location of the BHs either not deep enough or been sunk beside sewage tanks. For these reasons, studies by Ani and Itiba (2015) and Iyaji et al. (2016) isolated parasites from the BH water sources in Ebonyi and Kogi States of Nigeria respectively. In contrast, no parasite was found in the water collected from BHs used for drinking in Nassarawa, Katsina and Ondo States in Nigeria (Gyang et al., 2017; Abdullahi et al., 2018; Simon-Oke et al., 2020). This indicated that residents who lived in these areas stood a lower risk of been exposed to water borne illnesses when compared to our study area.

Three protozoans namely *C. parvum, G. duodenalis* and *E. histolytica* known to cause gastroenteritis, giardiasis and amoebic dysentery respectively in humans have been described in Nigeria by Ani and Itiba (2015), Vantsawa et al. (2020), Simon-Oke et al. (2020), Ejike et al. (2021) in Nigeria and Kifleyohannes and Robertson (2020) in Ethiopia. Further studies in Mexico assessed the risks associated with giardiasis and gastroenteritis gotten from wells (Balderrama-Carmona et al., 2014). As long as the environmental conditions are favorable, these parasites can survive in water for a long period. Apart from been environment resistant, Baqer et al. (2018) mentioned that *C. parvum* had built resistance to water disinfectants so their ability to survive is high.

The isolation parasites of *A. lumbricoides, which* was the most prevalent, Hookworms, *T. trichiura* and *S. stercoralis* that are being spread by the fecal-oral route, suggests that there may be broken sewage nearby the water sources that were found infected. Furthermore, open defecation by parasite-infected humans who do not have access to toilet facilities could also contribute to the high prevalence of these parasites in the environment through environmental factors such as eroding of the top layer of the soil through water or wind. Other parasites observed in drinking water include *Taenia saginata*, *Fasciola hepatica* and *Naegleria fowleri* (Simon-Oke et al., 2020). Factors such as run-offs of exposed gutters especially during the rainy season and wash-offs of

faeces defecated by animals in the surroundings are additional ways through which parasites could also get into the water sources.

In fact, some of these contaminated water sources could serve as sources for pure-water sachet producers as most people consume water through pure-water sachets in peri-urban areas thereby enhancing ongoing transmission. Studies by Uthman and Adeyi (2021) and Umeanaeto et al. (2022) have confirmed the contamination of sachet water with parasites in parts of Nigeria. Often, other household and agricultural uses of drinking water in the study area include irrigating crops and providing animals with water to drink. Various parasites have been detected in vegetables and fruits in parts of Ogun State, Nigeria (Adenusi et al., 2015; Adesetan et al., 2022). Lastly, further researches on conducting longitudinal studies to monitor changes in parasitic contamination levels in the study area should be embarked on.

5. CONCLUSIONS

In conclusion, although the water samples from the drinking water sources in our study area looked clean and odorless, our research has shown that there is presence of impurities (cysts, parasite eggs, and larvae) which indicates that they are unfit for human consumption. Therefore, we recommend that the drinking water sources be treated through the use of water treatments such as boiling, chlorination and ultraviolet purification before consumption by residents in the study area. Local health authorities can help organize community sensitization programs on quarterly basis for community members on periodic treatment of their water and also on the use anti-helminthic.

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