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Seasonal Variation in the Prevalence of Parasites in Drinking and Domestic Water Sources in Osara, Kogi State, Nigeria

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ABSTRACT

Access to safe drinking water remains a major public health challenge in rural Nigeria, where sources like wells, streams and boreholes are used for drinking and domestic purposes without adequate treatment. The aim of this study is to determine the seasonal variation in the prevalence of parasites in drinking and domestic water sources in Osara, Kogi State. A total of 60 water samples were collected, 30 in the dry season and 30 in the rainy season, from wells, boreholes, streams and stored rainwater. Samples were examined microscopically for parasite cysts, ova and larvae. Prevalence was calculated as the number of samples positive for a parasite divided by the total number examined, expressed as a percentage. Data were analysed using Chi-square test at $p < 0.05$. A total of 47 parasite occurrences involving seven species were recorded. Entamoeba histolytica was the most prevalent species overall (36.67%) accounting for 46.81% of all occurrences, followed by Ascaris lumbricoides (13.33%) and Giardia lamblia (10.00%). Balantidium coli had the lowest prevalence (1.67%). Protozoa (48.33%) were more prevalent than helminths (30.00%). The prevalence of E. histolytica increased significantly from 20.00% in the dry season to 53.33% in the rainy season ($\chi^2 = 7.18$, $p = 0.007$). Borehole water had the lowest contamination in both seasons, while well water in the rainy season recorded the highest prevalence of E. histolytica (90.00%). Stream water also showed high contamination, particularly for Ascaris lumbricoides (60.00% in the rainy season). In conclusion, parasitic contamination of drinking and domestic water sources in Osara is widespread and significantly higher in the rainy season, with Entamoeba histolytica as the dominant parasite. Borehole water was the safest source, while well and stream water posed the greatest health risk. Regular treatment, protection of wells and streams from runoff, and public health education are recommended, particularly during the rainy season.

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INTRODUCTION

Water is essential for life. It is used for many purposes such as drinking, bathing, agricultural and industrial activities. Water has been considered as environment for many pathogenic organisms (helminths and protozoan parasites) to grow and develop (Adeboye *et al.,* 2025). Drinking water could be gotten from sources such as borehole/tap water, rivers, streams, lakes and rain water (Iyaji *et al.*, 2018).

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Water is said to be of good quality if and when it is free from contaminations, has no taste or smell and the pH is between 7.0 and 9.5 indicating a healthy level of alkaline mineral (WHO, 2015). The importance of water to the survival of living organism cannot be over emphasized. It is used in every aspect of human metabolism and also very essential to plants. Apart from aiding in the survival of both plants and animals, water is also used in carrying out various life activities which include recreational, agricultural and domestic activities (Okpanachi *et al.,* 2018; Hossain, 2021). Therefore, it is important that water used in carrying out these activities is kept in a good state, free from contamination.

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. Water is a major source for acquiring several pathogenic agents including bacteria, viruses, and parasites (Etudaye & Upahi, 2024). Biological contaminants could also enter the distribution system due to reasons such as broken pipelines (Kristanti *et al*., 2022). In some cases, households in low and middle-income countries, supplement an improved primary water source with unimproved water throughout the year, as unimproved sources of water are more likely to be contaminated with fecal contamination than improved sources, this practice provides the potential for unmonitored exposure to unsafe drinking water (Daly and Harris, 2022).

The health risk of using dirty water can be life threatening as diseases such as typhoid, schistosomiasis, giardiasis, cryptosporidiosis, dysentery does not manifest unconnected with water use (Ekine *et al*.,2026). Nevertheless, every community have water source within its disposal, and the quality of such water source determine the healthiness of the members of such community. Therefore, parasitic contamination of water source can be considered a public health threat.

Parasitic organisms are maintained by a viable ecosystem in remote settlements in Nigeria, where toilet facilities, pipe borne water, poor sewage disposal, and illiteracy thrive the most. In rural regions, fecal contamination of water arises from runoffs from nearby bushes and forest which serve as defecation sites for rural dwellers (Manetu and Karanja, 2021; Rohmah *et al*., 2022). It is estimated that more than 80% of diseases are caused by contaminated drinking water. This means that water is the main cause of most diseases, for instance, drinking contaminated water can lead to scabies, a skin disease very strong and contagious, accompanied by severe itching and a rash that looks like pimples. Parasitic infections have also been discovered to cause unexplained weight loss (Hikal, 2020).

Parasitic worm or helminth infection is one of the crucial health issues in many developing countries and low-income communities. The species of helminth found in water sources cause health impacts on humans such as abdominal swelling and pain, nausea, vomiting, diarrhea, a dry cough, and skin rashes (Akinsanya *et al*., 2021). Previous research indicates that drinking water quality is influenced by changing weather patterns, with water quality usually deteriorating in the rainy season (Kostyla *et al.,* 2015). Hence, the aim of this study was to compare parasitic contamination in drinking and domestic water sources in Osara during the dry and rainy seasons.

MATERIALS AND METHODS

Description of Study Area

The study was conducted in Osara community, a rural settlement located in Adavi Local Government Area (LGA) of Kogi State, North-Central Nigeria. Kogi State is popularly referred to as the 'Confluence State' due to the meeting point of Rivers Niger and Benue within its territory. Osara lies within the central part of the state and falls under the Guinea Savanna ecological zone. Geographically, Osara community is situated at approximately latitude 7°40´52" North and Longitude 6°25´42"East. The area has an average elevation of about 170 meters above sea level, resulting in relatively gentle and flat terrain, which is suitable for human settlement and agricultural activities.

Osara experiences a tropical savanna climate, characterized by two distinct seasons: the

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rainy season, which is typically from April to October, and the dry season, which lasts from November to March. The annual rainfall and temperature pattern support the growth of savanna vegetation made up of grasses and scattered trees. This climatic condition influences water availability and may affect the survival and transmission of water-borne parasites. The physical environment of Osara includes streams and small water bodies, notably the Osara Gada stream, which serves as important sources of water for domestic use, agriculture and livestock. These water sources include streams, wells, and boreholes, which are commonly used for drinking and household activities, especially in rural settings where access to treated pipe-borne water is limited.

Socio-economically, Osara community is predominantly agrarian, with most inhabitants engaged in subsistence farming, trading, and other small-scale economic activities. Crops commonly cultivated include cassava, maize, yam, and vegetables. The dependence on natural water sources for daily activities increases the community's vulnerability to water contamination, making it suitable for studies on parasitic contamination of drinking water sources. Notably, the community also hosted the institution, Confluence University of Science and Technology (CUSTECH), Osara, Kogi State, Nigeria.

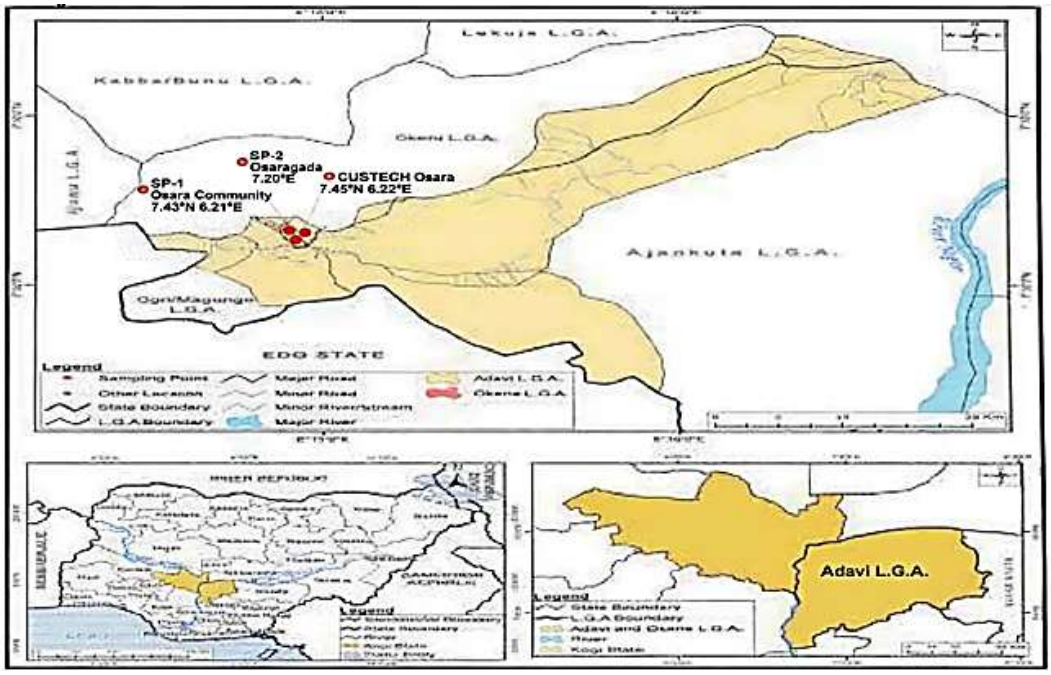


Fig 1: Map showing the study area

Sample Collection

Sixty (60) samples were collected directly from the various drinking water sources based on availability. Fifteen (15) well samples, ten (10) borehole samples and five (5) samples from different parts of the Osara Gada stream were collected during the dry season (February to March, 2026), while ten (10) well samples, five (5) borehole samples, ten (10) samples of stored rain water and five (5) samples from the Osara Gada stream were collected during the rainy season (May-June, 2026). Sampling was done from Osara Gada, Osara community and CUSTECH campus, into a screw-capped cleaned plastic water container, prior to the sampling all the bottles were washed and rinsed thoroughly with distilled water.

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The borehole water was allowed to run for about two minutes before using the sample bottles to take samples, the well water sample was fetched from below the well into the sample bottles to avoid sediments and particles, stored rain water were obtained from different households while the stream water sample was collected from five different points. After collection, water samples were clearly labelled with the sampling location, date, time, and type of source, and were taken to the Department of Biology laboratory in CUSTECH, Osara for analysis.

Parasitological Analysis

For the parasitological analysis, large volume of water was used to increase the probability of detecting parasites present at low concentrations, and sedimentation method was applied concentration technique. In sedimentation, the water sample was allowed to stand undisturbed for several hours so that heavier particles, including parasite eggs, cysts, and larvae, settle at the bottom. The supernatant was carefully decanted, leaving the sediment, which is then centrifuged to further concentrate the parasites (Cheesbrough, 2018). The concentrated sample was finally prepared for microscopic examination, which was done by placing a drop of the sediment on the clean glass slide, stained with Lugol's iodine using a pipette. This was covered with a cover slip and then examined microscopically using x10 and x 40 objective lenses to identify parasite eggs, larvae and cysts (Cheesbrough, 2004).

Statistical Analysis

Data obtained were analyzed using the Statistical Package for Social Sciences (SPSS) software (Version 22). Pearson's Chi-square test was used to compare the proportion of parasites prevalence rate between species, across seasons, and as well as in relation to sources of water. The p-values < 0.05 were considered statistically significant.

RESULT AND DISCUSSION

A total of 47 water samples were found with parasites (15 in dry season and 32 in rainy season). These include 3 species belonging to the protozoan group (*Entamoeba histolytica, Giardia lamblia* and *Balantidium coli*) and 4 from the nematode group (*Trichuris trichiuria, Ascaris lumbricoides*, *Strongyloides stercoralis* and Hookworm). Table 1 shows the seasonal prevalence of parasites in relation to season in the different water bodies. During the dry season, wells recorded the highest number of parasites 8(53.3%), followed by the stream sample 6(40%), boreholes recorded the lowest number of parasites 1(6.67%). The distribution of the parasites in the early wet season revealed that the well also had the highest number of parasites 16(50%), followed by stream 10 (31.25%), the stored rain water recorded the lowest number of parasites 6(18.75%), water sampled from boreholes recorded no parasite in both seasons, though this disagrees with the work carried out by Pam *et al.* (2018) who reported that stream recorded highest number of parasites.

Table 1: Seasonal prevalence of parasites in relation to season in different water bodies

Parasites	Dry season				Rainy season				
	Wells (n=15)	Borehole (n=10)	Stream (n=5)	Total (n=30)	Well (n=10)	Borehole (n=5)	Stream (n=5)	Stored rain water (n=10)	Total (n=30)
Ascaris lumbricoides	1(6.67%)	0	0	1(3.33%)	2(20.0%)	0	3(60.0%)	2(20.0%)	7(23.33%)
Trichuris trichiura	1(6.67%)	0	2(40.0%)	3(10.0%)	1(10.0%)	0	1(20.0%)	0	2(6.6%)
Strongyloides stercoralis	1(6.67%)	0	1(20.0%)	2(6.67%)	0	0	0	0	0
Entamoeba histolytica	4(26.67%)	1(10.0%)	1(20.0%)	6(20.0%)	9(90.0%)	0	3(60.0%)	4(40.0%)	16(53.3%)
Giardia lamblia	1(6.67%)	0	1(20.0%)	2(6.67%)	2(20.0%)	0	2(40.0%)	0	4(13.33%)

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Parasites	Dry season				Rainy season				
	Wells (n=15)	Borehole (n=10)	Stream (n=5)	Total (n=30)	Well (n=10)	Borehole (n=5)	Stream (n=5)	Stored rain water (n=10)	Total (n=30)
Balantidium coli	0	0	1(20.0%)	1(3.33%)	0	0	0	0	0
Hookworm	0	0	0	0	2(20.0%)	0	1(20.0%)	0	3(10%)
Total	8(53.3%)	1(6.67%)	6(40%)	15(31.92)	16(50%)	0	10(31.25)	6(18.75)	32(68.09)

The prevalence of parasite in relation to species from (Table 2) below showed that *E. histolytica* recorded the highest prevalence rate of (36.67%) followed by *A. lumbricoides* (13.33%), while *G. lamblia, T. Trichuria*, Hookworm, *S. stercoralis* and *B. coli* had 10.00%, 8.33%, 5.00%, 3.33% and 1.67% respectively. Protozoa (48.33%) were more prevalent than helminths (30.00%). Borehole water had the lowest prevalence in both seasons while well water in the rainy season recorded the highest prevalence of *E. histolytica* (90%). *E. histolytica* alone is responsible for more than 1 in 3 of all samples examined and almost half of all parasite occurrences. It is 2.75 times more prevalent than the next species,

A. lumbricoides (36.67% vs 13.33%). This finding disagrees with Adekunle *et al.* (2024) who reported *A. lumbricoides* as the most prevalent, Simon-Oke *et al.* (2020) who reported that *Cryptosporidium parvum* had the highest prevalence of 38.4% in their study and also that of Maikenti *et al*. (2025), where Hookworm was identified as the most prevalent parasite in water sources in Nunkuchu village, Akwanga LGA of Nasarawa State with a prevalence of 15.0%.

Table 2: Overall Prevalence of parasites in relation to species

Species	Group	Total Positive	Species Prevalence
Entamoeba histolytica	Protozoa	22	36.67%
Ascaris lumbricoides	Helminth	8	13.33%
Giardia lamblia	Protozoa	6	10.00%
Trichuris trichuria	Helminth	5	8.33%
Hookworm	Helminth	3	5.00%
Strongyloides stercoralis	Helminth	2	3.33%
Balantidium coli	Protozoa	1	1.67%

The prevalence rate of parasites was higher in the rainy season 32 (68.09%) that the dry season of 15 (31.92%). This finding is in line with the result recorded by Simon Oke *et al.* (2020) and Pam *et al*. (2018) in their research at Akure, Ondo State and Doma local government area of Nasarawa State respectively. Protozoa are the dominant group overall, and significantly more prevalent in rainy season.

Rainy season favours *E. histolytica, A. lumbricoides, G. lamblia* and Hookworm. Dry season favours *T. trichiura, S. stercoralis and B. coli*. The prevalence of *E. histolytica* increased significantly from dry (20.00%) to rainy season (53.33%) ($\chi 2 = 7.18$, $p = 0.007$), while that of *A. lumbricoides* increased significantly from dry (3.33%) to rainy season (23.33%) ($\chi 2 = 5.19$, $p = 0.023$). Other parasites showed no significant differences between both seasons. The distribution across sources did not differ significantly ($\chi 2 = 1.85$, $df = 2$, $P = 0.397$) by season, largely because borehole had almost zero count in both seasons.

Table 3: Prevalence of Parasites by Species and Season

Species	Dry Prevalence	Rainy Prevalence	Change
Entamoeba histolytica	20.00% (6)	*53.33% (16)	+33.33%
Ascaris lumbricoides	3.33% (1)	*23.33% (7)	+20.00%

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Species	Dry Prevalence	Rainy Prevalence	Change
Giardia lamblia	6.67% (2)	13.33% (4)	+6.67%
Hookworm	0.00% (0)	10.00% (3)	+10.00%
Trichuris trichiura	10.00% (3)	6.67% (2)	-3.33%
Strongyloides stercoralis	6.67% (2)	0.00% (0)	-6.67%
Balantidium coli	3.33% (1)	0.00% (0)	-3.33%

A total of fourteen (7) parasites with varying developmental stages (ova, cyst and Larva) were isolated. *Ascaris lumbricoides, Giardia lamblia, Entamoeba histolytica* and *Trichuris trichiura* were isolated in the water samples from both seasons. While *Strongyloides stercoralis and Balantidium coli* were only found in the dry season and Hookworm was isolated only in the rainy season. (Table 2).

Table 2: Parasites stages found in different drinking water sources in dry and rainy seasons

Parasite	Seasons	
	Dry	Rainy
Strongyloides stercoralis	Larvae	-
Ascaris lumbricoides	Larvae	Larvae, Ova
Giardia lamblia	Cyst	Cyst
Balantidium coli	Cyst	-
Entamoeba histolytica	Cyst	Cyst
Trichuris trichiura	Ova	Ova
Hookworm	-	Larvae, Ova

Key: - not present

CONCLUSION

In conclusion, parasitic contamination of drinking and domestic water in Osara is widespread, seasonal, and dominated by *Entamoeba histolytica*. The rainy season significantly increases the risk of infection, particularly from well and stream water. It is therefore recommended that residents should boil, filter or chlorinate water, especially well and stream water, before drinking or domestic use. Wells should be covered and sited away from latrines and refuse dumps; streams should be protected from open defecation and animal grazing. Additionally, government and community health workers should carry out regular water quality monitoring and public health education.

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CONFLICT OF INTEREST

All authors unanimously declare that there is no conflict of interest regarding the publication of this article.

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