African Multidisciplinary
Journal of Sciences and Artificial Intelligence

ISSN : 1595-7969

Index: Harvard, Boston, Sydney University, Dimensions, Lens, ResearchGet Scilit, Semantic, Google, Base etc

https://doi.org/10.58578/AMJSAI.v3i3.12060

Prevalence and Risk Factors of Intestinal Protozoan Infections among Secondary School Students in Wukari Metropolis, Taraba State, Nigeria

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Submitted:	Revised:	Accepted:	Published:
Jul 29, 2026	Aug 26, 2026	Sep 7, 2026	Sep 12, 2026

Abstract

Intestinal protozoan infections remain a public health concern among school-aged children in developing regions where access to safe water, sanitation, and appropriate hygiene practices is limited. This study assessed the prevalence of intestinal protozoan infections and potential risk factors among secondary school students in Wukari Metropolis, Taraba State, Nigeria. A cross-sectional study was conducted among 400 students from five public secondary schools. Stool specimens were examined using direct wet-mount and formol–ether concentration techniques, while structured questionnaires were used to collect data on demographic characteristics, hygiene behaviours, sanitation practices, and knowledge. Data were analysed using descriptive statistics and chi-square tests at a 5% significance level. The overall prevalence was 6.75% (95% CI: 4.5–9.0%), comprising *Giardia lamblia* (3.25%) and *Entamoeba histolytica* (3.50%). Maramara Government Day School and Yakasaen Government Day School each recorded a prevalence of 10.0%, whereas Government Day School recorded the lowest prevalence at 2.5%. Prevalence did not differ significantly across schools (χ^2 = 5.864, p = .661), suggesting that exposure conditions may be distributed across the metropolis rather than concentrated in particular schools. Potential behavioural and environmental risk conditions included inconsistent handwashing before meals (38.15%), reliance on unsafe water sources such as streams (9.98%), and open defecation at home (19.95%) and at school (12.22%). Knowledge

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deficits were also evident: 62.84% of students were unaware of intestinal parasites, and 52.12% did not understand their transmission routes. Domestic animal ownership (63.53%), irregular footwear use, and limited deworming history represented additional potential exposure factors. The findings demonstrate an appreciable burden of intestinal protozoan infections associated with modifiable behavioural, environmental, and knowledge-related conditions. Strengthening school-based health education, improving water and sanitation infrastructure, promoting consistent hygiene practices, and implementing routine parasitological screening and appropriate treatment programmes are essential for reducing transmission and improving student health in Wukari Metropolis.

Keywords: Intestinal Protozoa; School-Aged Children; Risk Factors; Sanitation and Hygiene; Wukari Metropolis

INTRODUCTION

Intestinal protozoan infections remain a persistent public health challenge in many developing regions, particularly in sub-Saharan Africa, where poor sanitation, inadequate access to clean water, and low levels of hygiene education continue to sustain high transmission (World Health Organization, 2023). These infections are caused by unicellular organisms such as Giardia lamblia, Entamoeba histolytica, and Cryptosporidium spp., which colonize the gastrointestinal tract and cause diarrhea, abdominal pain, malabsorption, dehydration, and chronic nutritional deficiencies (Haque, 2020). Though often overshadowed by soil-transmitted helminths, protozoan infections contribute significantly to morbidity among children and adolescents, affecting growth, cognition, academic performance, and overall well-being (Hajissa *et al.,* 2022).

Globally, an estimated 280 million people suffer from giardiasis annually, whereas Entamoeba histolytica infects about 50 million people and causes up to 100,000 deaths yearly, making amoebiasis one of the leading parasitic causes of mortality after malaria and schistosomiasis (Stanley, 2022). Transmission is strongly linked to fecal contamination of water, food, hands, and the environment—conditions widespread in low-income settings (Tesfaw *et al.,* 2024). Risk factors such as open defecation, overcrowding, improper waste disposal, poor personal hygiene, and use of unsafe water sources increase susceptibility, especially among school-aged children who frequently engage in high-risk behaviours (Gelaw *et al.,* 2020; Smith & Lee, 2022).

In Nigeria, intestinal protozoan infections remain endemic. Studies from various regions report prevalence ranging from 4% to over 35%, depending on sanitation, water quality, and socioeconomic conditions (Iliyasu *et al.,* 2022; Aribodor *et al.,* 2019). Persistent infrastructural challenges such as poorly maintained sanitation facilities, inadequate access to safe water, and limited hygiene education contribute significantly to transmission. The Nigeria Demographic and Health Survey shows that many households still rely on untreated water from unsafe sources, increasing protozoal infection risk (National Bureau of Statistics, 2023).

School-aged children represent one of the most vulnerable groups because of environmental exposure and behavioural patterns that heighten transmission risk (Hajissa *et al.,* 2022). Socioeconomic limitations may further restrict access to clean water, sanitation, and healthcare. Factors such as low parental education, overcrowded living conditions, limited hygiene awareness, and presence of domestic animals also elevate infection risk (Gobena *et al.,* 2024; Abdoli *et al.,* 2024).

In Wukari Metropolis, environmental sanitation challenges are common, with many communities depending on unprotected water sources and lacking effective waste disposal systems. Schools often face issues of overcrowding, poor water supply, and inadequately maintained toilets conditions conducive for the spread of fecal–oral pathogens (Teshale *et al.,* 2023).

Despite this, there is limited epidemiological data on intestinal protozoal infections among secondary school students in Wukari. Existing studies often focus more on helminths, leaving a gap concerning protozoal diseases. Therefore, this study was conducted to determine the prevalence and associated risk factors of intestinal protozoal infections among secondary school students in Wukari Metropolis. Limitations include potential self-report biases in questionnaires and the sensitivity of single stool sample examinations (approximately 70%).

MATERIALS AND METHODS

Study Area

The study was conducted in Wukari Metropolis, Taraba State, located at latitude 7.85°N and longitude 9.78°E. The area has a mixed population with predominant farming activities, heavy reliance on untreated water sources, and widespread use of pit latrines. Environmental sanitation challenges are common.

Study Design

A cross-sectional descriptive study was carried out among secondary school students in five selected public secondary schools.

Study Population

A total of 400 students from JSS1–JSS3 participated. Inclusion criteria were assent/consent from participants and guardians, no anti-protozoal medication in the preceding two months, and availability during data collection. Exclusion criteria included recent anti-protozoal treatment to minimize false negatives.

Sampling Technique

A multistage sampling method was used: four wards were selected purposively, followed by random selection of one secondary school per ward, and proportional allocation of sample size (80 students per school, n=400 total). The questionnaire response rate was 100%.

Data Collection

Stool Sample Collection and Examination

Stool samples were collected in sterile containers and examined using:

Direct wet mount (normal saline and iodine)

Formol-ether concentration technique

Identification followed standard parasitological protocols (World Health Organization, 2017). A single stool sample per participant was analyzed.

Questionnaire Survey

Validated structured questionnaires (Cronbach's $\alpha = 0.82$) with 25 items captured:

Demographic characteristics (e.g., age, sex, household size)

Hygiene behaviour (e.g., handwashing frequency)

Water and sanitation practices (e.g., toilet type, water source)

Environmental exposures (e.g., animal ownership, footwear use)

Knowledge of intestinal parasites (e.g., awareness of transmission, symptoms)

Data Analysis

Data were analyzed using IBM SPSS Statistics version 25. Descriptive statistics (frequencies, percentages) summarized variables. Chi-square tests assessed associations, with significance at $p < 0.05$. Prevalence confidence intervals (95% CI) were calculated using the Wilson score method.

RESULTS

Prevalence of Intestinal Protozoan Infections

Table 1 presents the prevalence of *Giardia lamblia* and *Entamoeba histolytica* across five secondary schools (n=80 per school).

School	Parasite	Number Positive	Prevalence (%)	χ^2	p-value
Maramara Government Day	Giardia lamblia	3	3.75		
	Entamoeba histolytica	5	6.25		
	Total	8	10.00		
Ladan Junior Secondary School	Giardia lamblia	2	2.50		
	Entamoeba histolytica	3	3.75		
	Total	5	6.25		
Yakasaen Government Day School	Giardia lamblia	4	5.00		
	Entamoeba histolytica	4	5.00	5.864	0.661
	Total	8	10.00		
Central Junior Secondary School	Giardia lamblia	2	2.50		
	Entamoeba histolytica	2	2.50		
	Total	4	5.00		
Government Day School	Giardia lamblia	1	1.25		
	Entamoeba histolytica	1	1.25		
	Total	2	2.50		
Overall	Giardia lamblia	12	3.25		
	Entamoeba histolytica	14	3.50		
	Total	27	6.75		

Maramara Government Day and Yakasaen Government Day Schools exhibited the highest prevalence (10.0% each), while Government Day School had the lowest (2.5%)

Demographic Characteristics

Table 2 summarizes participant profiles

Demographic Characteristics	Category	Frequency	Percentage (%)
Age	10–12 years	192	48.1
	13–15 years	208	51.9
Sex	Male	182	45.5
	Female	218	54.5
Class	JSS1	136	34.0
	JSS2	134	33.5
	JSS3	130	32.5
Household Size	3–5	155	38.8
	6–8	152	38.0
	9+	93	23.2
Living With	Parents	121	30.3
	Guardians	141	35.3
	Other Relatives	138	34.5

Knowledge and Awareness

Table 3 details knowledge levels ($\chi^2 = 12.45$; $p < 0.001$ for overall awareness).

Knowledge and Awareness	Response	Frequency	Percentage (%)
Have you heard of intestinal parasites?	Yes	149	37.2
	No	251	62.8
Do you know how intestinal parasites are transmitted?	Yes	192	48.0
	No	208	52.0
Do you know symptoms of worm infection?	Yes	198	49.5
	No	202	50.5

Hygiene Practices

Table 4 outlines hygiene behaviours ($\chi^2 = 8.72$; $p = 0.013$ for handwashing consistency and infection association).

Hygiene Practices	Response	Frequency	Percentage (%)
How often do you wash hands before eating?	Always	248	62.0
	Sometimes	120	30.0
	Rarely	27	6.8
	Never	5	1.2
How often do you wash hands after toilet?	Always	276	69.0
	Sometimes	94	23.5
	Rarely	23	5.8

Hygiene Practices	Response	Frequency	Percentage (%)
	Never	7	1.8
Do you wash fruits/vegetables before eating?	Yes	345	86.3
	No	55	13.8
What type of water do you drink at home?	Tap water	174	43.5
	Sachet water	108	27.0
	Borehole	79	19.8
	River/stream	39	9.8

Sanitation Facilities

Table 5 reports sanitation access ($\chi^2 = 15.34$; $p < 0.001$ for open defecation and infection risk).

Sanitation Facilities	Response	Frequency	Percentage (%)
Toilet facility at home	Pit latrine	150	37.5
	Flush toilet	170	42.5
	Open defecation	80	20.0
Toilet facility at school	Pit latrine	197	49.3
	Flush toilet	154	38.5
	Open defecation	49	12.3
How often are school toilets cleaned?	Daily	106	26.5
	Weekly	215	53.8
	Rarely	73	18.3
	Never	6	1.5

Personal and Environmental Health Practices

Table 6 summarizes exposures.

Practices	Response	Frequency	Percentage (%)	χ^2	p-value
Do you have domestic animals at home?	Yes	254	63.5		
	No	146	36.5	10.21	0.006
Do you wear shoes outside?	Always	76	19.0		
	Sometimes	258	64.5		
	Rarely	58	14.5		
	Never	8	2.0		
How often do you experience stomach pain/diarrhea?	Frequently	65	16.3		
	Occasionally	168	42.0		
	Rarely	159	39.8		
	Never	8	2.0		
Treated for worm infection in last year?	Yes	180	45.0		
	No	220	55.0		

DISCUSSION

The present study provides an updated epidemiological assessment of intestinal protozoan infections among secondary school students in Wukari Metropolis, Taraba State, and highlights the complex interaction of behavioural, environmental, and socioeconomic factors that sustain transmission in the area. The overall prevalence of 6.75% indicates a moderate burden of protozoan infections among adolescents. Although lower than some values reported in other Nigerian settings such as 11.2% in Kano (Iliyasu *et al.,* 2022) and 14.6% in southeastern communities (Aribodor *et al.,* 2019), the prevalence is comparable to several African studies that documented moderate levels of Giardia and Entamoeba infections among schoolchildren (Hajissa *et al.,* 2022; Mekonnen *et al.,* 2024).

The detection of *Giardia lamblia* (3.25%) and *Entamoeba histolytica* (3.50%) aligns with global disease patterns, where these protozoa are consistently identified as the most prevalent intestinal protozoan parasites affecting children and adolescents (Stanley, 2022). Their almost equal prevalence indicates multiple overlapping transmission routes such as contaminated water sources, inadequate personal hygiene behaviours, and poor food-handling practices. This similarity also suggests that both parasites are endemic in the study area, with environmental contamination sustaining their continuous circulation.

Although variations were observed in prevalence across the five schools surveyed, the differences were not statistically significant ($\chi^2 = 5.864$; $p = 0.661$). The absence of significance implies that risk factors for protozoal infections are uniformly distributed across Wukari Metropolis. This is consistent with findings from Tesfaw *et al., (*2024), who reported that household-level conditions such as water quality, sanitation, and hygiene practices often exert a stronger influence on protozoal transmission than school-level factors alone. Therefore, any effective intervention strategy should target both schools and communities.

Behavioural and environmental determinants played a central role in infection patterns. Inconsistent handwashing before meals remains a significant gap, placing students at heightened risk for fecal–oral transmission. Similar behavioural inconsistencies have been identified in Ethiopia and Ghana (Gelaw *et al.,* 2020; Abdoli *et al.,* 2024). These findings reinforce the need to strengthen practical hygiene education.

The use of unsafe water sources, particularly streams and rivers by 9.98% of participants, is a critical contributor to protozoal transmission (Tesfaw *et al.,* 2024). In Wukari

Metropolis, where treated piped water supply is inconsistent, households often depend on boreholes, wells, and surface water sources, creating multiple points of contamination.

Sanitation-related factors also emerged as major contributors. Nearly 20% of respondents reported open defecation at home, and 12.22% indicated the presence of open defecation practices in schools (Teshale *et al.,* 2023). The infrequent cleaning of school toilets reported by more than half of participants further compounds the problem.

The presence of domestic animals in 63.53% of households introduces zoonotic exposure risks, particularly for Giardia (Mekonnen *et al.,* 2024). In Wukari, where households commonly rear goats, sheep, and poultry within residential compounds, environmental contamination becomes almost unavoidable.

Low levels of knowledge and awareness regarding intestinal parasites were evident, with more than half of the respondents lacking basic understanding (Smith & Lee, 2022). This underscores the urgent need for structured, curriculum-based parasite education programs in secondary schools.

Despite the moderate observed prevalence, the persistence of multiple high-risk behaviors suggests that the infection burden could escalate if left unaddressed. The study area presents a classic epidemiological scenario where low awareness, poor sanitation, limited access to clean water, overcrowded households, and inadequate hygiene practices collectively create a favorable environment for protozoal transmission.

Overall, this study highlights the need for a diverse approach to control intestinal protozoal infections in Wukari Metropolis. Public health interventions should prioritize improving access to safe water, strengthening sanitation infrastructure, enforcing regular toilet cleaning, enhancing hygiene education, promoting behavioural change through school-based programs, and instituting periodic parasitological screening. Longitudinal follow-up studies are recommended to evaluate intervention efficacy. Collaboration between schools, health authorities, and local government agencies will be essential

CONCLUSION

Intestinal protozoal infections among secondary school students in Wukari Metropolis show a moderate yet concerning prevalence of 6.75%. Transmission is strongly associated with risk factors such as inadequate hygiene, unsafe water sources, poor sanitation, and low

awareness. School and community health programs must target these risk behaviours to reduce transmission.

Recommendations

1. Strengthen school-based health education to improve awareness of parasite transmission and prevention.
2. Improve sanitation infrastructure in schools, including regular toilet cleaning and maintenance.
3. Promote regular hand washing through provision of functional hand washing stations.
4. Implement periodic mass deworming and protozoa-targeted treatment for students.
5. Ensure safe water supply by encouraging use of treated tap/borehole water.
6. Engage parents and caregivers in environmental and behavioral hygiene training.

Ethical Considerations

Approval was obtained from relevant educational authorities. Informed consent/assent was received from parents/guardians and students.

Conflict of Interest

The authors declare no conflict of interest.

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