

Prevalence and Associated Factors of Intestinal Parasitic Infections Among Secondary School Students in Mbarara City Uganda

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Abstract

Background

Intestinal parasitic infections (IPIs) remain an important public health concern in low- and middle-income countries, disproportionately affecting school-aged children and adolescents. These infections can contribute to malnutrition, anaemia, impaired cognitive development, poor educational outcomes, and increased vulnerability to other infections. Although Uganda has implemented various parasite control interventions, evidence on IPIs among secondary school students remains limited. This study determined the prevalence of and factors associated with IPIs among students attending God's Shepherd Secondary School in Mbarara City, Uganda.

Methods

A school-based cross-sectional study was conducted among 234 students selected through stratified simple random sampling. Information on socio-demographic characteristics, environmental exposures, and hygiene practices was collected using a structured questionnaire. Fresh stool specimens were collected and examined using direct wet-mount microscopy, iodine and eosin preparations, and the formalin–ether concentration technique. Data were analyzed using SPSS version 26. Descriptive statistics were used to summarize participant characteristics and infection prevalence, while bivariate and multivariable logistic regression analyses were performed to assess factors associated with IPIs. Statistical significance was set at $p < 0.05$.

Results

The prevalence of IPIs was 11.1% (95% CI: 7.7–15.9%) among the 234 students. The mean age was 16.21 ± 1.43 years, with most participants being female (74.4%), boarding students (84.6%), and from rural areas (61.5%). Four parasitic species were identified, with *Giardia lamblia* accounting for the largest proportion of infections (58%), followed by hookworm (23%), *Hymenolepis nana* (15%), and *Schistosoma mansoni* (4%). None of the assessed socio-demographic, environmental, or behavioural factors was significantly associated with infection in either bivariate or multivariable analyses ($p > 0.05$). Failure to boil drinking water showed the strongest, although statistically non-significant, association with infection (aOR = 2.45, 95% CI: 0.83–7.24; $p = 0.106$).

Conclusion

IPIs remain a public health concern among secondary school students in this setting, despite the absence of statistically significant associations with the factors assessed. The predominance of *Giardia lamblia* highlights the need for continued attention to parasitic infections among adolescents, a

population that may receive less attention in existing control programs. Strengthening school-based parasite control, access to safe water and sanitation, and hygiene education may help reduce the burden of infection. Larger studies incorporating a broader range of environmental, behavioral, and socioeconomic factors are warranted.

Background

Intestinal parasitic infections (IPIs) remain an important public health concern in tropical and subtropical regions, particularly in low- and middle-income countries. They disproportionately affect children and adolescents and are associated with malnutrition, anaemia, impaired cognitive development, and reduced educational attainment (Garg et al., 2024, George et al., 2023, Carvalho et al., 2025). In sub-Saharan Africa, both helminthic and protozoan infections are common among school-aged children. Soil-transmitted helminths (STHs), including *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms, are among the most widely distributed intestinal parasites globally, affecting an estimated 1.45 billion people (Chelkeba et al., 2020, Archer et al., 2020).

Uganda remains highly endemic for several neglected tropical diseases (NTDs), including STH infections and schistosomiasis. STH transmission has been reported across all districts of the country, while intestinal schistosomiasis remains endemic in many districts (Kabatereine et al., 2011, Tinkitina et al., 2023, Pirzaman et al., 2024). In response, the Uganda Ministry of Health introduced a national school-based deworming program in 2003, with biannual mass drug administration targeting school-aged children (Adriko et al., 2018, Burnim et al., 2017). Although mass drug administration has contributed to reducing the burden of helminth infections, it does not directly address the environmental and behavioural conditions that facilitate transmission. Consequently, reinfection may occur where communities continue to experience inadequate sanitation, poor hygiene practices, and limited access to safe water (Gambhir and Pinsent, 2015, Aiello and Larson, 2002).

Despite these control efforts, adolescents attending secondary schools have received comparatively limited attention in epidemiological research and parasite control programs. Most school-based interventions have historically focused on younger primary school children, potentially leaving older students less adequately represented in surveillance and prevention strategies (Burnim et al., 2017, Bech-Larsen and Kazbare, 2014). Adolescents may have increased exposure to infection because of greater independence in personal hygiene, food choices, and water use. National evidence also suggests that schistosomiasis remains an important concern among adolescents, with notable prevalence among those aged 11–15 years and increasing infection intensity with age (Wiegand et al., 2021).

However, evidence on the burden and determinants of IPIs among secondary school students in specific urban and peri-urban settings in Uganda remains limited. In particular, there are no published data on the prevalence of IPIs among students attending God's Shepherd Secondary School in Mbarara City, Western Uganda, generating school-specific evidence is important for informing targeted health education, sanitation and hygiene interventions, and appropriate parasite control strategies.

Therefore, this study aimed to determine the prevalence of intestinal parasitic infections and identify factors associated with infection among students attending God's Shepherd Secondary School in Mbarara City, Western Uganda.

Methods

Study design and setting

A school-based cross-sectional study was conducted at God's Shepherd Secondary School in Mbarara City, Western Uganda, from March to April 2026. The school provides secondary education from Senior One to Senior Six and accommodates both day and boarding students.

Study population and eligibility

The study population comprised students enrolled in Senior One to Senior Six during the study period. Students were eligible to participate if they were present during data collection, provided written informed consent or assent as appropriate, and submitted an adequate stool specimen for laboratory examination.

Sample size and sampling procedure

A total of 234 students participated in the study. Participants were selected using stratified simple random sampling. Students were stratified by class level (Senior One to Senior Six) and school status (boarding or day) to ensure representation across the different student groups. Eligible students were then randomly selected from the respective strata.

Data collection

Data were collected using a structured and pretested questionnaire. The questionnaire captured information on socio-demographic characteristics, environmental exposures, water and sanitation conditions, hygiene practices, and knowledge related to intestinal parasitic infections. The questionnaire was administered to participating students under conditions that ensured privacy and confidentiality.

Stool specimen collection and laboratory examination

Fresh stool specimens were collected from each participant in clean, labelled, leak-proof specimen containers and transported to the laboratory under appropriate conditions for processing. Specimens were first examined macroscopically for consistency, color, and the presence of visible blood, mucus, or adult worms. Microscopic examination was subsequently performed using direct wet-mount preparations with normal saline and iodine, together with 1% eosin preparation. The formal ether concentration technique was also performed to improve detection of parasite eggs, cysts, and larvae. Parasites were identified based on their characteristic morphological features using standard parasitological procedures.

Data management and statistical analysis

Data were entered, cleaned, and analyzed using SPSS version 26. Descriptive statistics, including frequencies, percentages, and 95% confidence intervals (CIs), were used to summarize participant characteristics and estimate the overall and species-specific prevalence of IPIs.

Simple logistic regression was performed to assess associations between individual independent variables and IPI status. Crude odds ratios (cORs) with corresponding 95% CIs were reported. Variables considered epidemiologically or biologically relevant were included in the multivariable logistic regression model to account for potential confounding. Adjusted odds ratios (aORs) with 95% CIs were reported. Statistical significance was assessed at a two-sided $p < 0.05$.

Ethical considerations.

Ethical approval for the study was obtained from the Department of Medical Laboratory Science and the Faculty Research Committee of Mbarara University of Science and Technology (MUST) number MUST/MLS/023. Administrative permission to conduct the study was obtained from the administration of God's Shepherd Secondary School. Written informed consent was obtained from students aged 18 years and above, while students younger than 18 years provided written assent in accordance with the applicable ethical requirements. Where required, parental or guardian consent was obtained for participants below 18 years of age. This study was not a clinical trial, therefore Clinical trial number: not applicable.

Participation was voluntary, and students were informed of their right to decline participation or withdraw from the study at any stage without any penalty or effect on their education or access to services. Participant confidentiality was maintained throughout the study by assigning unique identification codes rather than recording names on study tools and laboratory specimens. Study data were securely stored and accessed only by authorised members of the research team. Participants were provided with their individual laboratory results, and appropriate guidance or referral was provided where an intestinal parasitic infection was identified.

Results

Participant characteristics.

A total of 234 school-attending students from God's Shepherd Secondary School were enrolled in the study. The mean age of the participants was 16.21 ± 1.43 years. The majority of the students, 183/234 (78.2%), were aged below 18 years, while 51/234 (21.8%) were aged 18 years and above.

Females constituted the largest proportion of the study population, accounting for 174/234 (74.4%) participants, whereas males comprised 60/234 (25.6%). Regarding residence, most of the participants, 144/234 (61.5%), resided in rural areas, while 90/234 (38.5%) were from urban settings.

With respect to educational status, the majority of students were enrolled as boarding students, representing 198/234 (84.6%) of the participants, whereas only 36/234 (15.4%) were day scholars.

Prevalence of intestinal parasitic infections.

Out the 234 participants, 26 were found to have intestinal parasitic infections, giving an overall prevalence of 11.1% (95% CI: 7.7–15.9) as indicated in Fig. 1.

Distribution of identified parasites.

Four parasite species were identified among the infected students. *Giardia lamblia* was the most frequently detected parasite, accounting for 15/26 (58%) of infections, followed by hookworm in 6/26 infections. *Hymenolepis nana* was identified in 4/26 (15%) of infected students, while *Schistosoma mansoni* was the least common, occurring in 1/26 (4%) of infected students. Overall, protozoan infection with *Giardia lamblia* constituted the predominant intestinal parasitic infection among the study participants, Fig. 2.

Factors associated with Intestinal Parasitic Infections.

After adjustment for potential confounding effects (Table 2), none of the assessed factors showed a statistically significant association with intestinal parasitic infections at multivariate analysis (all $p > 0.05$). Variables entered into the multivariate model were selected based on biological and epidemiological relevance from the literature.

Table 2
Factors Associated with intestinal parasitic infections.

Variable	Bivariate		Multivariate	
	cOR(95%CI)	p-value	aOR(95%CI)	p-value
Age (Years)				
<18	1.19(0.43 – 3.34)	0.737	1.45(0.48 – 4.32)	0.508
≥18	1.00		1.00	
Sex				
Male	1.00			
Female	0.93(0.37–2.33)	0.874		
Residence				
Urban	1.00			
Rural	1(0.43–2.31)	1.000		
Education attendance status				
Boarding	0.56(0.21–1.51)	0.254	0.48(0.16–1.44)	0.189
Day	1.00		1.00	
Bushy residence				
Yes	1.67(0.70–3.99)	0.254		
No	1.00			
Residence with stagnant water				
Yes	0.56(0.18–1.70)	0.306	0.46(0.12–1.70)	0.244
No	1.00		1.00	
Awareness level of IPI				
Informed	1.00		1.00	
Not informed	0.81(0.27–2.50)	0.718	0.83(0.23–2.99)	0.777
Access to clean water				
Yes	1.00		1.00	
No	0.75(0.27–2.10)	0.587	0.71(0.18–2.77)	0.625
Source of drinking water				
Borehole	1.46(0.45–4.75)	0.533	1.29(0.35–4.75)	0.705

Variable	Bivariate		Multivariate	
	cOR(95%CI)	p-value	aOR(95%CI)	p-value
Well	0.93(0.25–3.42)	0.914	1.33(0.26–6.70)	0.731
River	1.05(0.28–3.87)	0.945	1.12(0.28–4.82)	0.840
Tap water	1.00		1.00	
Boiling drinking water				
Yes	1.00		1.00	
No	1.43(0.63–3.25)	0.394	2.45(0.83–7.24)	0.106
Source of food				
Cooked by oneself	1.00			
Restaurant	0.55(0.16–1.92)	0.346		
Home hand washing facilities				
Yes	1.00		1.00	
No	1.21(0.54–2.74)	0.643	1.30(0.46–3.65)	0.615
Ever received treatment for IPIs				
Yes	1.00		1.00	
No	1.03(0.39–2.70)	0.957	1.23(0.41–4.01)	0.665
Hand washing after toilet				
No	1.09(0.45–2.64)	0.844	1.13(0.33–3.81)	0.850
Yes	1.00		1.00	
Hand washing before eating				
No	0.90(0.39–2.09)	0.810	1.33(0.34–5.14)	0.683
Yes	1.00		1.00	
How hands are cleaned at school				
With soap and water	1.00			
With water only	1.28(0.54–3.03)	0.573		
Hand sanitizer	9.6(0.56–165.52)	0.119		
Do not wash	1.6(0.17–14.66)	0.677		
Frequency of finger nail trimming				

Variable	Bivariate		Multivariate	
	cOR(95%CI)	p-value	aOR(95%CI)	p-value
Frequently	1.00		1.00	
Rarely	0.96(0.42–2.18)	0.926	0.83(0.26–2.64)	0.753
Finger nail biting habit				
Yes	0.40(0.09–1.76)	0.225	0.28(0.055–1.44)	0.128
No	1.00		1.00	
Walking bare foot out doors				
Yes	0.71(0.30–1.66)	0.427	0.66(0.20–2.13)	0.482
No	1.00		1.00	
IPI associated symptoms				
Yes	1.31(0.58–2.97)	0.518		
No	1.00			

NOTE: cOR= Crude Odds Ratio, aOR= Adjusted Odds Ratio, CI= Confidence Interval

Discussion

Prevalence of intestinal parasitic infections.

The 11.1% prevalence observed in this study confirms that intestinal parasitic infections remain a public health concern among secondary school adolescents in this setting. This finding is lower than the 16.66% reported among secondary school students in Wonji Shoa, Ethiopia (Adugna et al., 2024), and falls below the range of 19.9% to 79% documented in studies from Ethiopia, Iran, and Sudan (Shrestha et al., 2018, Gelaw et al., 2013, Suliman et al., 2019). Lower prevalences were also reported in studies such as a recent study in the Tigray Region of Ethiopia, which found a prevalence of 3.2% among school students (Abrha Yanshet et al., 2026). The lower prevalence in our study may be attributed to several factors, including the school's private status, which may afford students better access to sanitation infrastructure, piped water, and health education compared to public schools in more resource-limited settings. Additionally, variations in behavioural and socio-economic conditions, disparities in the implementation of primary healthcare services and deworming interventions, and differences in levels of community hygiene awareness and practices. In addition, environmental and climatic factors specific to the study area may have contributed to the lower prevalence. Parasite transmission is influenced by temperature, rainfall, humidity, and soil type, all of which affect the survival and development of parasite eggs, cysts, and larvae in the environment. If the climatic conditions during the study period were less

favourable for parasite survival and transmission compared to the settings of other studies, this could partially explain the observed differences.

Types of intestinal parasites identified.

This study reported the dominance of *Giardia lamblia* as the most prevalent species (58%) a prevalence however, that is slightly higher than that reported in a study carried out in Ethiopia with a prevalence of 55% (de Lucio et al., 2016), and in Nsukka Metropolis, Enugu State Nigeria, a prevalence of 38% (Onah et al., 2023). This study finding also is in contrast with other previous studies done in Zambia and Ethiopia which reported infection rates of 29 to 55% of giardiasis among school-going children (Siwila et al., 2011) (de Lucio et al., 2016). The variation in the prevalence noted above can be attributed to inadequate hand hygiene and inadequate water treatment, as seen from the analysis. These factors are well-established risk factors for *Giardia lamblia* transmission. Studies have consistently demonstrated that the parasite is associated with poverty, poor sanitation, lack of clean and safe drinking water supply, and poor personal hygiene (Hajare et al., 2022). Specifically, lack of hand washing before a meal and drinking from non-piped water sources have been found to be significantly associated with *Giardia lamblia* infection (Aliysso et al., 2025).

Hookworm infections were detected in 23% of the infected individuals, a prevalence comparable to findings from other studies such as a study conducted in Bahir Dar and Mecha district, Ethiopia, from March to May 2014, among school-aged children reported a prevalence of 22.3% (95% CI: 21%–24%) (Feleke, 2018). Similarly, a study in Mayuge District, Uganda, reported a hookworm prevalence of 21.8% (95% CI: 19.8–23.9%) (Kim et al., 2024). Our finding of 23% falls within the confidence intervals of both studies, indicating that the prevalence observed in our study is statistically consistent with these previous reports. In contrast to this, a study carried among School Children in Sanja Town Northwest Ethiopia reported a prevalence higher of 37.1% (Worku et al., 2014). This variation can be due drinking unboiled water (oral ingestion) where infective larvae, can lead to infection as its documented route specifically for the *Ancylostoma duodenale* species and due to walking bare foot out doors in contaminated soils.

Hymenolepis nana, accounted for 15% of the infections. This prevalence however, is slightly higher than that reported in other studies in Ethiopia (Gelaw et al., 2013), a prevalence of 13.8% and (Worku et al., 2014), with 8.1% prevalence under *Schistosoma mansoni* dominance. Variations in the prevalence noted above can be attributed to the inadequate hand hygiene since *Hymenolepis nana* is a cestode (tapeworm) transmitted via the fecal-oral route and associated with poor sanitation and hygiene.

Schistosoma mansoni was detected in a single student (4% of infected cases), representing the least common parasite identified a prevalence in agreement to a study carried out among school going children in Babile town in eastern Ethiopia that showed a prevalence of 4.3% (Tulu et al., 2014). In contrast a study carried among School Children in Sanja town, Northwest Ethiopia showed a prevalence of 89.9% (Worku et al., 2014). The reason why the observed infection prevalence varies in this study from other findings might be due to the difference in water contact behavior of the school children (frequency

of contact infested water), ecological distribution of intermediate host(snail), local endemicity of the parasite, and sample size and the difference in altitude and the temperature, which is favourable for the development and survival of snail. Although *Schistosoma mansoni* was the least common, its detection is concerning given that schistosomiasis remains endemic in Uganda and poses a significant health risk to school-aged children (Kabatereine et al., 2014).

Associated factors.

No statistically significant associations were identified between infection status and any assessed socio-demographic, environmental, or behavioral factors. However, not boiling drinking water showed the strongest, although non-significant, trend toward increased infection odds (aOR = 2.45, 95% CI: 0.83–7.24, $p = 0.106$). The small number of positive cases ($n = 26$) substantially constrains the statistical power of the regression analyses, and Type II errors (false negatives) are likely. It is probable that several of the observed trends particularly around water boiling practices and hygiene behaviours represent genuine associations that would attain statistical significance in a larger study. This underlines the need for future research with adequate sample sizes powered specifically for association analyses.

Strengths and Limitations.

The study combined questionnaire-based assessment with laboratory confirmation of infection using concentration techniques, improving diagnostic accuracy. However, reliance on a single stool sample may have underestimated prevalence due to intermittent parasite shedding. Additionally, the study was conducted in a single school, limiting generalizability.

Conclusion

The prevalence of intestinal parasitic infections among the study population was found to be 11.1%, ($n = 26$) with *Giardia lamblia* (58%) and hookworm (23%) being the most common protozoan and helminth, respectively. *Hymenolepis nana* (15%) and *Schistosoma mansoni* (4%) were also detected. These findings indicate that despite the relatively lower prevalence compared to some regional estimates, intestinal parasitic infections remain an active public health concern among secondary school adolescents, a population often overlooked in national programs. Biologically plausible trends were observed, particularly around water treatment practices, consistent with established epidemiological evidence.

Abbreviations

cOR

Crude Odds Ratio

aOR

Adjusted Odds Ratio

CI

Confidence Interval

IPIs

Intestinal Parasitic Infections

MUST

Mbarara University of Science and Technology

SPSS

Statistical Package for the Social Sciences

WASH

Water, Sanitation and Hygiene

MDA

Mass Drug Administration

Declarations

Ethical considerations

Ethical approval for the study was obtained from the Department of Medical Laboratory Science and the Faculty Research Committee of Mbarara University of Science and Technology (MUST) - MUST/MLS/023. The study was conducted in accordance with the ethical principles and guidelines of the approving committees and applicable national ethical requirements for research involving human participants. Administrative permission to conduct the study was obtained from the administration of God's Shepherd Secondary School. Written informed consent was obtained from participants aged 18 years and above. For participants younger than 18 years, written assent was obtained from the participants together with written informed consent from their parents or legal guardians.

Consent to participate.

Written informed consent was sought from all participants aged 18 years and above and written assent for those aged below 18 years before data collection began. Each participant received comprehensive information regarding the study's objectives, their rights, and the voluntary nature of their involvement. They were assured of their right to withdraw from the study at any point without facing any negative consequences. Participants found to have infections during the course of the study were referred to qualified healthcare professionals for appropriate medical care.

Consent for Publication.

Not applicable.

Availability of data and materials.

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Competing interests.

The authors declare that they have no competing interests.

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Authors' contributions.

K.N.D., A.M., L.M., M.D., and M.V. conceptualised the study, formulated the research objectives, coordinated data collection, and contributed to drafting the manuscript. M.V., K.N.D., A.M., L.M., and M.D. developed the study methodology and research protocol. B.C. conducted data cleaning and management, while A.M. performed the laboratory analyses and contributed to manuscript review and editing. M.V. provided overall supervision and oversight of the research process. All authors contributed to the manuscript, critically reviewed the final version, and approved the final manuscript for submission.

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Figures

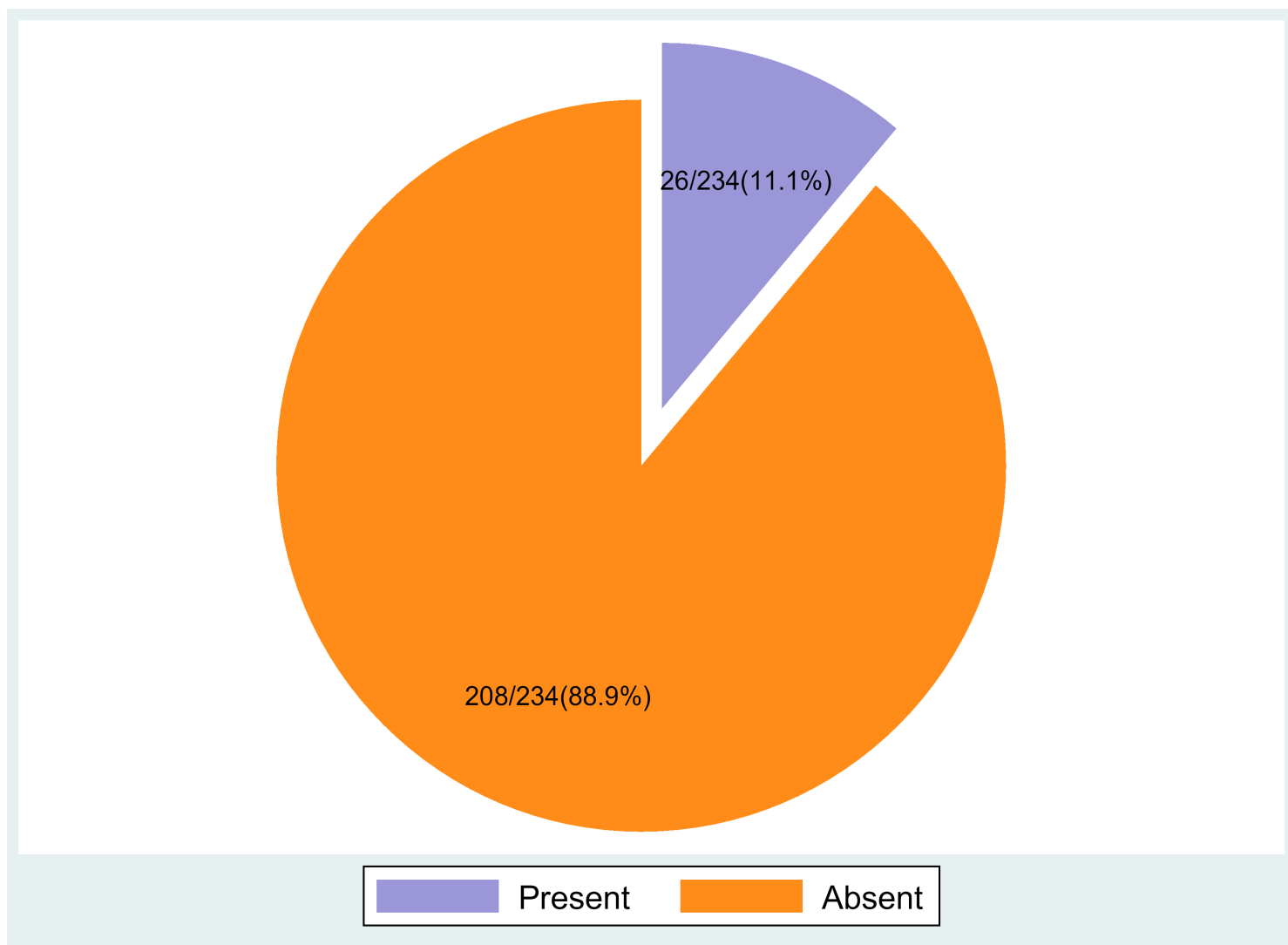


Figure 1

A pie chart showing proportion of the study participants with intestinal parasitic infections.

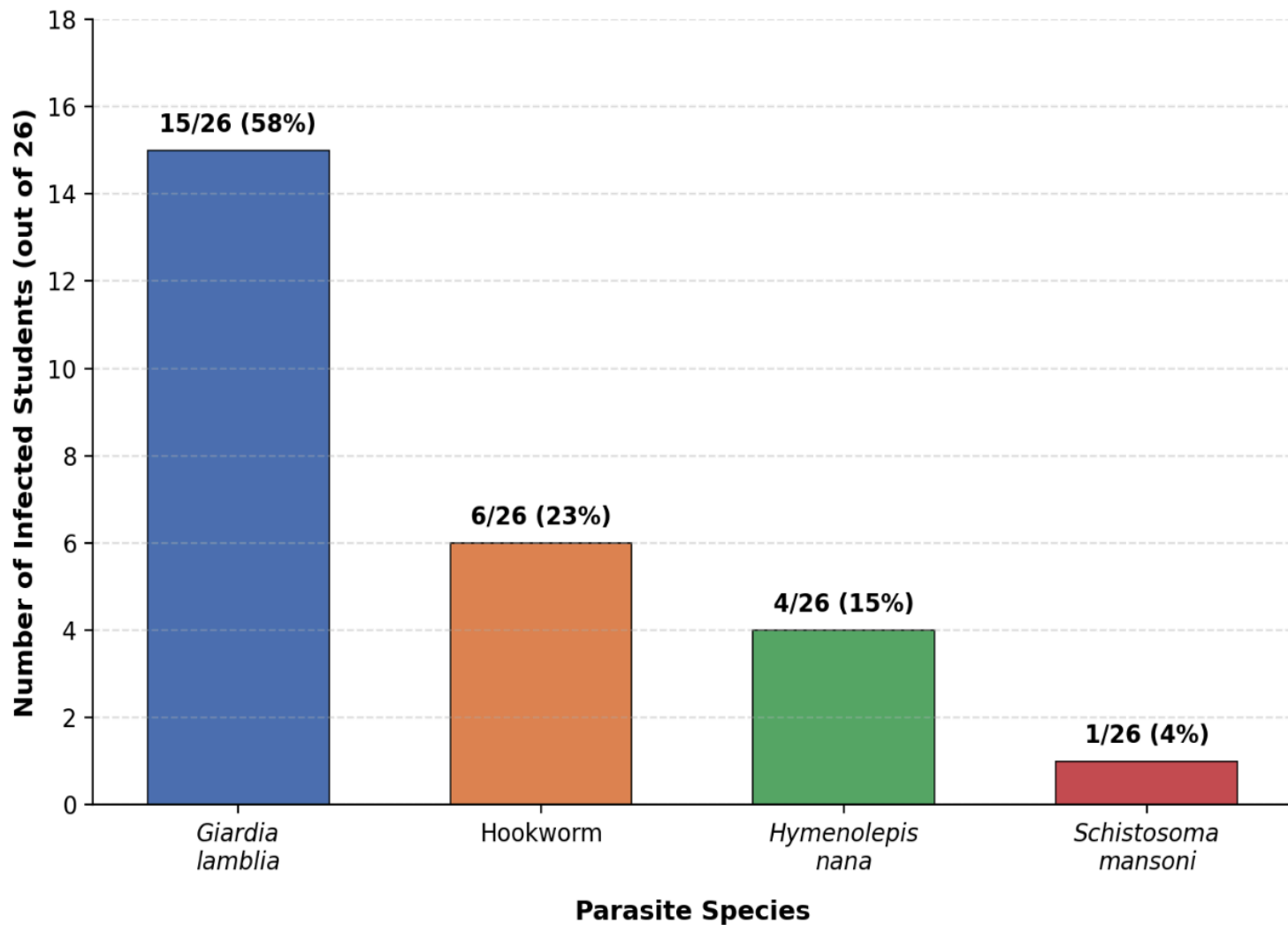


Figure 2

A bar graph showing the types of intestinal parasites identified.