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The burden and trend of intestinal parasitosis among women at Berekum, Ghana: a 9-year retrospective study

John Gameli Deku[1*], Daniel Ofori Okyere[1,2], Samuel Buabeng[2], Florence Shine Edziah[1], Israel Bedzina[3], Silas Kinanyok[4], Kwabena Obeng Duedu[5,6] and Enoch Aninagyei[5]

Abstract

Background Intestinal parasitic infections (IPIs) are serious global public health issues, especially in low and middle-income countries. These parasites can cause high morbidity and mortality, especially in immunocompromised individuals, and can easily be transmitted by consumption of contaminated food or water or by penetration of skin and mucous membranes.

Methods We retrospectively analyzed all archived data from stool examination reports at the Parasitology Unit of Precise Health Diagnostic Services, Berekum for the prevalence and trends of parasitic infections spanning a period of 9 years (2013–2021). The data was retrieved and exported to IBM SPSS v.26 for statistical analysis. Descriptive data was summarized as proportions and presented in tables and charts. Pearson Chi-Square test (χ^2) or Fisher's exact test was used to test for a statistical association between demographic factors and intestinal parasitic infections. P value was significant at < 0.05.

Results A total of 9,217 records of stool examinations were retrieved. Almost half (48.45%) of the data were from patients aged between 20 and 29 years. An overall prevalence of intestinal parasitic infections of 21.20% was observed in this study. Patients aged 70 to 79 had the highest prevalence of the IPIs (44.44%). The parasites recovered in this study were intestinal flagellates, *Entamoeba coli, Hookworm, Entamoeba histolytica/dispar, Ascaris lumbricoides, Enterobius vermicularis, Strongyloides stercoralis* and *Hymenolepis nana*. The intestinal flagellates had the highest prevalence (98.31%) compared to the other intestinal parasites recovered. Intestinal parasitic infections had the highest prevalence in the year 2020 (28.56%) and lowest in 2018 (11.78%).

Conclusion An overall prevalence of 21.20% of intestinal parasitic infection was found. The majority of the parasites reported were intestinal flagellates (98.31%). The trend analysis revealed that the overall prevalence fluctuated across the entire period from 2013 to 2021.

Keywords Intestinal parasitic infection, Intestinal flagellates, Precise health diagnostic services, Berekum

*Correspondence:
John Gameli Deku
sssdeku@gmail.com
[1]Department of Medical Laboratory Sciences, School of Allied Health Sciences, University of Health and Allied Sciences, PMB 31, Ho, Ghana
[2]Precise Health Diagnostics Services, Berekum, Ghana
[3]Reinbee Medical Laboratory and Wellness Center, Ho, Ghana
[4]Fly Zipline Ghana Limited, Kete-Krachi, Oti Region, Ghana
[5]Department of Biomedical Sciences, School of Basic and Biomedical Sciences, University of Health and Allied Sciences, Ho, Ghana
[6]College of Life Sciences, Faculty of Health, Education and Life Sciences, Birmingham City University, Birmingham, UK

Introduction

Intestinal parasitic infections (IPIs) are serious public health issues in low and middle-income countries. Globally, up to 3.5 billion people have been infected and around 450 million of them fell ill due to the intestinal parasites [1]. Intestinal parasitic infections have been considered one of the major causes of morbidity and mortality, especially in developing countries where public health standards are not as high as those in developed countries [2]. In a systematic review and meta-analysis in Eastern African countries, a pooled prevalence of intestinal parasites among pregnant women was 38.54% [3]. Other studies from Africa reported a prevalence of 33.5% in Ethiopia [4], 33.8% in Nigeria [5] and 76.03% in Benin [6]. In Ghana, various studies have reported the prevalence of intestinal parasites among various groups to be 5.97% [7] and 14.0% [8] among HIV-infected individuals and children under five years respectively.

Intestinal parasitosis is caused by several parasitic agents in different parts of the study country. Predominant etiologic agents reported by various studies carried out in Ghana include *Giardia lamblia* in Bolgatanga Municipality [9], Dodi Papase [7], and Tafo Government Hospital [10]; *Cryptosporidium spp* in Ho Municipality [8] and Komfo Anokye Teaching Hospital [11]; *Ascaris lumbricoides* in Ashanti [12]; intestinal flagellates in Ho Teaching Hospital [13], among others.

Intestinal parasites can be transmitted by direct or indirect means to humans. Direct transmission from animals to humans occurs through the consumption of infested meat, for example, *Taenia solium*, or infested fish in the case of *Diphyllobothrium latum*. Indirect transmission occurs when helminth eggs are voided by man and animals into the environment, which can then be ingested by humans as is the case of *Ascaris lumbricoides*. *Necator americanus* is also transmitted by indirect means through penetration of human skin while *Schistosoma spp* infest gastropod intermediate hosts before transmission to humans [14, 15]. For intestinal protozoans, transmission is through the oral-fecal route following direct or indirect contact with the infectious stages, including human-to-human, zoonotic, waterborne, foodborne, and airborne for *Cryptosporidium* [16]. A high burden of intestinal parasites has been reported among vegetables sold in Ghanaian markets [17]. Intestinal parasitic infections are also associated with climate conditions, poor sanitation, economic variables, lack of access to potable water, consumption of contaminated food, and cultural habits [2].

Intestinal parasitosis results in diarrhea, abdominal pain, nausea, vomiting, bloating, and weight loss [2], anemia, malnutrition, impaired growth, and learning disabilities [18]. Intestinal parasitic infections can also have serious consequences in pregnancy such as anemia, low weight gain, impaired foetal growth, preterm birth, and maternal mortality [19]. It can also lead to malabsorption of important nutrients, allergic reactions, and could be life-threatening for immunocompromised individuals [20].

There are several diagnostic tools available to identify intestinal parasitic infections from stool samples of individuals, however, direct wet mount is commonly used as a reliable diagnostic method in Africa [21, 22]. Different sensitivities of these diagnostic methods have been reported, including 76.0% [21] and 61.4% [23] for the direct saline wet mount method, 81.0% [24] and 97.4% [23] for Kato-Katz technique, and 78.3% [24] and 85.6% [23] for formol-ether concentration technique.

A study conducted by Cobbinah, Addaney [25] highlighted how urbanization has contributed to poor solid waste management in the Berekum Municipality of Ghana. Agyapong [26] also identified solid waste management as a major issue in the Municipality and expected it to deteriorate with time. Residents in the Municipality attributed the issue to insufficient waste bins and the habit of indiscriminate waste disposal which can lead to sanitation issues [26]. Previous studies reported that poor handling and exposure to wastes can lead to increased risks of parasitic infections [27–29] Although there is a mass drug administration and awareness program in Ghana on intestinal parasitic infection, with prevalence data on populations in some areas of the country, there are no published data on the prevalence of IPIs in the Berekum Municipality of Ghana. This study therefore was conducted to determine the prevalence of intestinal parasites over a nine-year period in a Health Diagnostic Laboratory in the Berekum Municipality of Ghana.

Materials and methods

Study site and design

The study was a laboratory-based retrospective analysis of secondary data from the Parasitology Unit of Precise Health Diagnostic Services (PHDS). The data on all stool examinations for the presence of parasitic infections was analysed to ascertain the trend and prevalence of these infections over a period of 9 years (2013–2021). Precise Health Diagnostic Services is a private medical laboratory located at Berekum in the Bono Region of Ghana which has been operating since the year 2000. The Berekum town lies between latitude 7’15 South and 8’00 North and longitude 2’2 East and 2’50 West in the Northwestern corner of the Bono Region of Ghana. The population of Berekum Municipality, according to the 2010 Population and Housing Census, is 129,628 representing 5.6% of the region’s total population, with female population being the majority (53.8%) [30]. The laboratory provides diagnostic services to the people of Berekum township and adjoining communities such as Kato, Domfete, Biadan, among others, as shown in Fig. 1. The PHDS delivers laboratory diagnostic services in Haematology, Parasitology, Serology, among others. The laboratory also serves as a training facility for students on medical laboratory postings.

Inclusion and exclusion criteria

The study analyzed anonymised laboratory data records on individuals whose stools were examined routinely for the presence of parasitic infections over the period under review (2013–2021). Data outside the study period were not retrieved for the study. Eleven archived records with incomplete data such as missing age, gender, and results were also excluded from the study.

Statistical analysis

The data retrieved from laboratory logbooks was entered into a Microsoft Excel 2016 worksheet. The data was exported to IBM-SPSS v.26 for statistical analysis and summarized using frequencies and percentages. The descriptive summary was presented as charts and tables. Pearson Chi-Square (χ^2) test or the Fisher's exact test was used to test for statistical association between

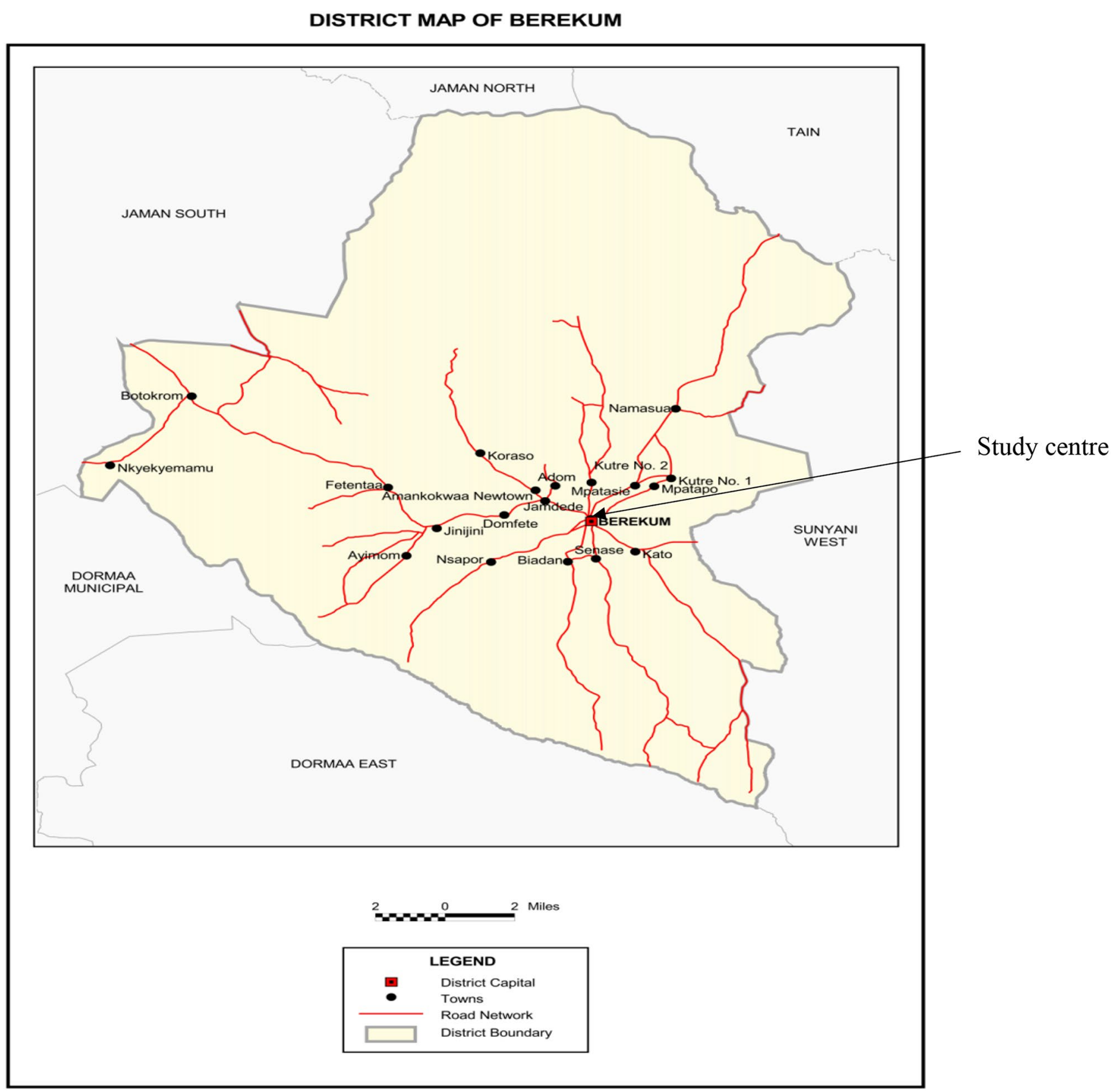

Fig. 1 Map of Berekum Municipality. Source Ghana statistical Service [30]

Table 1 Demographic characteristics of the participants

Parameter	Frequency	Percentage
Age Categories		
≤ 10	41	0.44
11–19	1,306	14.17
20–29	4,466	48.45
30–39	2,849	30.91
40–49	476	5.16
50–59	35	0.38
60–69	25	0.27
70–79	9	0.10
≥ 80	10	0.11
Period		
2013	734	7.96
2014	1,448	15.71
2015	1,295	14.05
2016	1,349	14.64
2017	989	10.73
2018	730	7.92
2019	752	8.16
2020	963	10.45
2021	957	10.38
Total	9,217	100.00

Table 2 Age and stool macroscopic distribution of intestinal parasites

Parameter	Presence of intestinal Parasite		*P*-Value
	Yes, *n* (%)	No, *n* (%)	
Age Categories			
≤ 10	3 (7.32)	38 (92.68)	
11–19	246 (18.84)	1,060 (81.16)	
20–29	976 (21.85)	3,490 (78.15)	
30–39	621(21.80)	2,228 (78.20)	
40–49	97 (20.38)	379 (79.62)	0.010
50–59	5 (14.29)	30 (85.71)	
60–69	1 (4.00)	24 (96.00)	
70–79	4 (44.44)	5 (55.56)	
≥ 80	1 (10.00)	9 (90.00)	
Stool Macroscopy			
Semi-Formed	1,816 (22.15)	6,384 (77.85)	
Formed	86 (9.90)	783 (90.10)	
Loose	46 (39.66)	70 (60.34)	< 0.0001
Bloody	1 (33.33)	2 (66.67)	
Mucoid	5 (17.24)	24 (82.76)	
Total	**1,954(21.20)**	**7,263(78.80)**	

demographic factors and intestinal parasites. P value was significant at < 0.05.

Results

The study analysed 9,217 anonymous data records across the 9 years. Nearly half of the participants (48.45%) were aged 20–29, followed by 30.91% in the 30–39 age group. In contrast, there was minimal representation of children aged 10 or less (0.44%) and older adults over 60 years, thus, less than 1% combined. Most of the participants (15.71%) visited the laboratory in 2014. Table 1.

Age and stool macroscopic distribution of parasitic agents

The prevalence of intestinal parasitic infections among the study population was 21.20%. This prevalence varied significantly across different age groups ($p = 0.010$). The highest prevalence was observed in the 70–79 age group at 44.44%, although there was a relatively small sample size of only 9 individuals in this category. Among the more robustly represented age groups, those aged 20–29 and 30–39 showed the highest prevalent rates at 21.85% and 21.80% respectively. The lowest prevalence was found in the 60–69 age group at 4.00%.

The study also revealed a significant association between stool consistency and the presence of intestinal parasites ($p < 0.0001$). Participants who produced loose and bloody stools exhibited the highest parasite prevalence at 39.66% and 33.33% respectively, while those who produced formed stools had the lowest at 9.90%. Table 2.

Figure 2 depicts the trend of intestinal parasite prevalence across the 9-year study period from 2013 to 2021. The infection rates fluctuated over the 9-year study period. The distribution of infections across the period from 2013 to 2021 showed a meandering trend of infection rates. There were five periods during which the prevalence trended above the mean as against four occasions during which the prevalence was below the mean. The highest and lowest rates were observed in 2020 (28.56%) and 2018 (11.78%) respectively. There was an increase in the infection rate in 2014 (25.14%), with a gradual decrease over the years to its lowest prevalence in 2018 (11.78%). There was a sharp increase from 2019 (15.96%) to 28.56% in 2020.With the mean infection rate at 21.20%, rates for the periods 2014, 2015, 2016, 2020, and 2021 trended significantly above the mean.

Distribution of parasitic agents

A total of eight (8) different intestinal parasites were identified, majority of which were intestinal flagellates (98.31%), with *Hymenolepis nana*, *Ascaris lumbricoides*, *Entamoeba histolytica/dispar and Enterobius vermicularis* being the least parasites (0.05% each) isolated from the fecal samples. The results are presented in Table 3.

Discussion

This study recorded an overall prevalence of intestinal parasitic infections of 21.20%. The overall prevalence observed in this study was higher than the 5.97% recorded by Deku et al. [7], 10.0% observed by Appiah et al. [13] and 10.7% reported by Darko et al. [31] all in other parts of Ghana, as well as 13.8% recorded by Wekesa, Mulambalah [32] in Kenya and the 0.5% observed by Amer et al. [33] in Saudi Arabia. Few studies

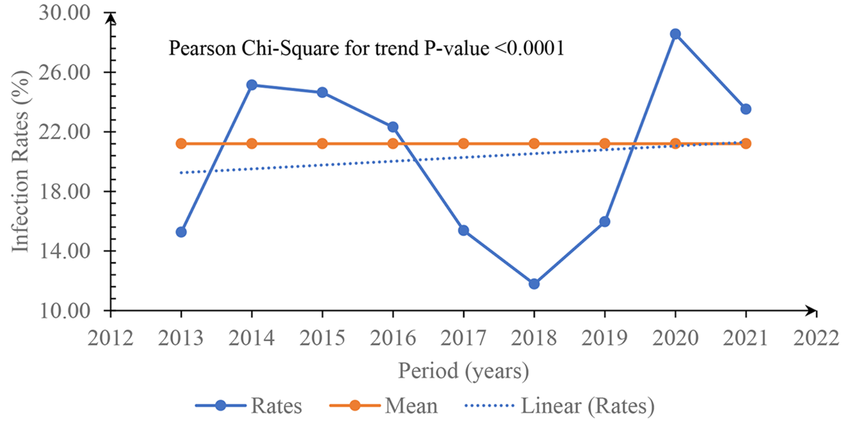

Fig. 2 Trend of parasitic infection rates across the period from 2013 to 2021

Table 3 Frequency of parasites detected at Precise Health Diagnostic Services, Berekum

Parasite	Frequency (%)
Intestinal flagellates	1,921(98.31)
Entamoeba coli	25(1.28)
Strongyloides stercoralis	2(0.10)
Hookworm	2(0.10)
Ascaris lumbricoides	1(0.05)
Entamoeba histolytica/dispar	1(0.05)
Enterobius vermicularis	1(0.05)
Hymenolepis nana	1(0.05)
Total Parasites	**1,954**

have however reported relatively higher prevalent rates of 38.2% [20] and 44.0% [34] from populations in Ghana and 46.88% [35] and 52.9% [36] in Ethiopia. Differences in sociodemographic variables as well as hygienic practices are possible contributing factors to the prevalence of intestinal parasitic infections [37]. In addition, the variation in the prevalence could have been caused by variations in geographical location, season of study, characteristics of the study subjects, diagnostic methodology, sample sizes, the usage of various preventative and control strategies, and socioeconomic status [38]. The study season may be influenced by environmental and behavioral variations in a year. Factors such as temperature, moisture levels, and light are known to affect the development and hatching rates of helminth eggs and the survival of infective larvae [39]. Such environmental factors may have differing effects on the prevalence of parasite species in human populations, depending on the biological characteristics of the parasites, the duration of their life cycles, and transmission dynamics [40].

Individuals aged 70–79 years had the highest prevalence (44.44%) compared to other age categories. This finding is consistent with a report by Aliyo and Geleto [41] that observed an increase in parasitic infections among an aged population in Southern Ethiopia. This observation may be attributed to reduced immunity thus; rendering the aged more prone to acquiring intestinal parasitic infections when compared to other age categories. The prevalence of IPIs is shown to be dependent on the age of the patient in the current study. Therefore, age could be a risk factor for acquiring these infections.

The significant association between stool consistency and the presence of parasites ($p<0.0001$) provides valuable clinical information. Loose stools showed the highest parasite prevalence (39.66%), followed by bloody stools (33.33%). This outcome corroborates reports in Kenya where loose, bloody and mucoid stools were found to be mostly associated with the presence of intestinal parasitosis [42]. This correlation suggests that stool consistency could serve as a useful clinical indicator for healthcare providers to identify potential cases of intestinal parasitosis. However, it is important to note that while formed stools had the lowest prevalence (9.90%), parasites were still present in a notable proportion in these samples, underscoring the importance of regular screening even in the absence of obvious signs and symptoms.

This current study revealed a fluctuating prevalence of intestinal parasitic infections, starting from 2013. There was a sharp increase in the prevalence in 2014 and a gradual decrease in the infection rate until it reached its lowest prevalence in 2018. There was an upward surge in the prevalence from 2018, peaking in 2020. Similar investigations that documented a sigmoid pattern of intestinal parasite infection were reported in Bale-Robe Health Centre, Robe Town, South-Eastern Ethiopia [43] and at Poly Health Centre, Gondar, Northwest Ethiopia [44]. On the contrary, the results of this study were different from a study done in Southern Ethiopia [41], which showed an increasing trend of parasitic infection. The variations in the yearly and overall prevalent rates could be due to several factors including differences in geography, socioeconomic conditions, cultural practices of the population, test methods used [45], low hygienic and sanitation habits, and lack of awareness about intestinal parasitic infections [46].

Parasites predominantly responsible for intestinal infections have been found to vary from one country to another with unique geographical peculiarities [47]. In this study, intestinal flagellates were the most recovered, however, the reporting systems in the diagnostic laboratories in Ghana do not require the naming and identification of these flagellates because the identification to specie level will not change clinical management and treatment of the patient. The high prevalence of intestinal flagellates (98.31%) in this study suggests that there may be a need to kick off discussions to change the reporting systems. In addition to the intestinal flagellates' preponderance, the study also recovered soil-transmitted parasites, such as *Ascaris lumbricoides, Strongyloides stercoralis*, and Hookworm, in lower frequencies. Furthermore, *Entamoeba coli*, a non-pathogenic species, was also identified in this study. A previous study in Ghana reported 90.0% intestinal flagellates [13].The predominance of intestinal protozoa in this study could be due to poor sanitation conditions, lack of water, and poor hygiene conditions. It could also be due to geographical locations, age, climatic conditions, as well as laboratory techniques employed in the identification of the parasites [8].

The species of parasites detected in this study are related by their routes of transmission. All except *Necator americanus* and *S. stercoralis* are transmitted to humans via ingestion from food or water. High prevalence of parasites connected with food and vegetable consumption in Ghana have been reported [17, 48].

Conclusion

An overall prevalence of 21.20% of IPIs was reported in this study. The parasites recovered in this study were intestinal flagellates (98.31%), *Entamoeba coli* (1.28%), Hookworm (0.10%), *Entamoeba histolytica/dispar* (0.05%), *Ascaris lumbricoides* (0.05%), *Enterobius vermicularis* (0.05%), *Strongyloides stercoralis* (0.05%) and *Hymenolepis nana* (0.05%). The intestinal flagellates were the most recovered intestinal parasites (98.31%) in this study. The trend analysis showed that the overall prevalence fluctuated across the entire period from 2013 to 2021.

Strength and limitations of the study

The strength of this study lies in its large sample size taken over a nine-year period which increased its statistical power. The study design also took into consideration any environmental factors that could affect the outcome of this research since the study was done all year long. This notwithstanding, it also has some limitations. The laboratory method employed in examining patients' samples was the routine direct normal saline mount. This method has a low sensitivity of 76.0%, 85.7%, 83.3% and 33.3% in detecting total intestinal helminths, Hookworm, *Ascaris lumbricoides* and *Hymenolepis nana* respectively, according to a study conducted by Mengist, Demeke [21]. The study did not also differentiate the various species of intestinal flagellates which may obscure targeted treatment interventions.

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Author contributions
JGD, FSE and DOO conceptualised the study, JGD and DOO wrote the proposal for the acquisition of ethical clearance, JGD, DOO and SB provided resources, DOO and SB carried out the investigation, JGD supervised the study, DOO and SB curated the data. SK and IB analysed the data, JGD, FSE, EA, IB and SK wrote the original draft of the manuscript, EA and KOD critically reviewed and edited the manuscript. All authors read and approved the final version of the manuscript.

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Data availability
The data used for the study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
Ethical clearance with reference number UHAS-REC A.6 [103] 22–23 was obtained from the Research Ethics Committee of the University of Health and Allied Sciences, Ghana. The study was performed according to the guidelines laid out by the Research Ethics Committee. Written permission was received from Precise Health Diagnostic Services for the use of their data. Confidentiality of the participants' information and data resulted was assured. Informed consent was waived by the Research Ethics Committee of the University of Health and Allied Sciences, Ghana.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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