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Prevalence of Intestinal Parasites Among Primary School Children in Sulug Municipality, Libya

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انتشار الطفيليات المعوية بين أطفال المدارس الابتدائية في بلدية سلوق، ليبيا

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Abstract:
Intestinal parasitic infections are serious health problems affecting many regions worldwide, especially in low-income and developing countries. According to the World Health Organization, approximately 3.5 billion people worldwide are infected, with 450 million suffering from severe diseases caused by these parasites. Children represent the most affected group. This study aimed to determine the prevalence of intestinal parasites among primary school students in Sulug Municipality, Libya. The study was conducted on 96 students aged 6 to 12 years, and stool samples were collected and examined using various microscopic methods. The results showed that 30% of the students were infected with intestinal parasites, with a higher infection rate among females (36%) compared to males (25%), although the difference was not statistically significant. Additionally, the older age group (10–12 years) exhibited a higher infection rate (39%) than the younger group (21%). *Enterobius vermicularis* was the most prevalent parasite, accounting for 72% of positive cases, followed by *Ascaris lumbricoides* at 17%. Single cases of *Hymenolepis nana*, *Balantidium coli*, and *Entamoeba histolytica* were also recorded. This study confirms that intestinal parasitic infections remain a health problem in the study area, with potential impacts on children's physical and mental health, which may affect their academic performance and daily activities. Based on these findings, the study recommends intensifying health education efforts, improving school environments, and strengthening parasite control programs within local communities.

Keywords: Intestinal parasitic infections, Schoolchildren, Prevalence, Sulug Municipality.

الملخص
تُعد العدوى بالطفيليات المعوية مشكلة صحية خطيرة تؤثر على العديد من المناطق حول العالم، وخاصة في البلدان منخفضة الدخل والنامية. ووفقًا لمنظمة الصحة العالمية، يُصاب حوالي 3.5 مليار شخص بهذه الطفيليات، يعاني منهم 450 مليون حالة من أمراض شديدة ناجمة عن هذه الطفيليات. ويُعتبر الأطفال الفئة الأكثر تضررًا، هدفت هذه الدراسة إلى تحديد مدى انتشار الطفيليات المعوية بين طلاب المرحلة الابتدائية في بلدية سلوق، ليبيا. أُجريت الدراسة على 96 طالبًا تتراوح أعمارهم بين 6 و12 سنة، وتم جمع عينات براز وفحصها باستخدام طرق مجهرية متعددة. أظهرت النتائج أن 30% من الطلاب كانوا مصابين بالطفيليات المعوية، حيث كانت نسبة الإصابة أعلى بين الإناث (36%) مقارنة بالذكور (25%)، مع العلم أن هذا الاختلاف لم يكن ذا دلالة إحصائية. كما أظهرت *Enterobius* الفئة العمرية الأكبر (10–12 سنة) معدل إصابة أعلى (39%) مقارنة بالفئة الأصغر (21%). وكان الطفيلي بنسبة 17%. كما تم *Ascaris lumbricoides* هو الأكثر شيوعًا، حيث مثّل 72% من الحالات الإيجابية، يليه *vermicularis* تؤكد هذه الدراسة تسجيل حالات منفردة لكل من أن *Hymenolepis nana*، *Balantidium coli* و*Entamoeba histolytica*

العدوى بالطفيليات المعوية ما تزال تشكل مشكلة صحية في منطقة الدراسة، مع تأثير محتمل على الصحة الجسدية والنفسية للأطفال، مما قد يؤثر على تحصيلهم الدراسي ونشاطهم اليومي. وبناءً على هذه النتائج، توصي الدراسة بتكثيف جهود التوعية الصحية، تحسين بيئة المدارس، وتعزيز برامج مكافحة الطفيليات في المجتمعات المحلية.

الكلمات المفتاحية: العدوى بالطفيليات المعوية، تلاميذ المدارس، معدل الانتشار، بلدية سلوق.

Introduction

Intestinal parasitic infections are a serious health problem in many regions of the world, particularly in low-income and developing countries. According to the World Health Organization (WHO), approximately 3.5 billion people worldwide are infected, of whom 450 million suffer from severe, disease-causing infections. The majority of these cases occur in children, and the prevalence of infection varies greatly between different regions. Intestinal parasites are microscopic organisms that live in the digestive tract particularly in the small and large intestines and can infect individuals of all ages. These organisms are classified into two main groups: protozoa (e.g., *Entamoeba histolytica* and *Giardia duodenalis*) and parasitic worms (e.g., *Ascaris lumbricoides*).

Some intestinal parasites cause noticeable health problems, while others may remain in the intestines for extended periods without producing symptoms or requiring treatment. When symptoms do occur, they typically include diarrhea and abdominal pain. In chronic cases, the infection may present with both physical and psychological health issues, potentially leading to learning difficulties, especially during the growth phase. The infection may also cause malnutrition and impaired nutrient absorption due to the attachment of pathogenic parasites to the mucosal surface. This attachment leads to alterations in the intestinal villi, resulting in inflammation and damage to the mucosal cells. Consequently, the small intestine becomes less capable of absorbing essential fat-soluble substances such as carotene, vitamin B_{12}, and folic acid. This impairment also reduces the secretion of digestive enzymes, including disaccharides.

As a result, affected individuals may experience chronic fatigue, irritable bowel syndrome, cognitive impairment, and delayed physical development during childhood. Some intestinal parasites cause noticeable health problems, while others may remain in the intestines for extended periods without producing symptoms or requiring treatment. As a result, parasitic infections have garnered significant attention in recent years. According to the World Health Organization (WHO), more than 270 million preschool-aged children and over 600 million school-aged children living in parasite-endemic areas are infected (Iti, and Farooq. 2018) (Houmsou et al.,2009) (Siddig et al.,2017) (Abd Alslam.,2018) (Ferreira et al.,2020) (Younis.,2021) (Ali.,2021) (Mohammed Elameen et al.,2019).

In addition, transmission is influenced by various factors, including behavioral, environmental, biological, social, economic, and healthcare-related aspects. Household income, educational and employment status, and the availability of urban infrastructure also contribute to the spread of infection and disease. Crowded living conditions, poor environmental sanitation, unsafe drinking water, and unsanitary housing further play a significant role. Moreover, malnutrition, low educational attainment, and poor personal hygiene are among the most prominent risk factors for infection among schoolchildren (Ait Messaad et al., 2014). Climate also plays a crucial role in the high incidence of parasitic infections in tropical and subtropical regions. Similarly, temperate regions show elevated rates of such infections as well (Khan et al.,2024) The school environment is just as important as the home environment, as children spend a significant portion of their day in classrooms, which directly affects their health (Abd Alslam.,2018) (Hamed et al.,2013). A link between international dietary guidelines and malnutrition among preschool children has been observed in many parts of the world, particularly in low-income areas. Overall, millions of preschool- and school-aged children are at risk of infection by parasitic worms and protozoan parasites (Abd Alslam., 2018) (Elmonir et al., 2021) (Bakarman et al., 2019).

Most cases of intestinal parasite infection occur through the ingestion of contaminated food or water, or through contact with contaminated soil. Additionally, infection can occur through skin penetration by certain larval stages. In some cases, transmission also happens via person-to-person contact, especially among schoolchildren (Mahmoud et al., 2022). Controlling parasitic diseases remains one of the greatest health challenges due to the absence of effective vaccines, as none are currently available. Limited data exist on the prevalence of intestinal parasites in this region; therefore, a prospective study was conducted to determine the prevalence of parasitic infections in children under five years of age (Khan et al., 2024).

Several studies have been conducted on intestinal parasitic infections in Libya, focusing on both protozoan parasites and helminthes. These studies took place in various cities, including Benghazi (Younis.,2021) (AlFarisi.,2013)Tripoli (Gashout et al.,2017) Sirte (Hamed et al.,2013) Houn (Abd Alslam.,2018) Misrata(El-Serite and Aljhemi,2020) Zella(Ali.,2021) Brak al-Shati (Mohamed, 2019)

Sabha (ESalem et al.,2017) (Ibrahim and Salem,2020) and Zawiya (Shawesh et al.,2019). Therefore, this infection is considered a significant public health problem, particularly among schoolchildren, due to its negative health consequences that can affect academic achievement and performance. It can also lead to reduced school attendance and productivity. Moreover, the infection can hinder physical development and prevent children from fully benefiting from available formal educational opportunities.

There is currently no study on the prevalence of intestinal parasites among primary school students in the municipality of Sulug. Similarly, no research has yet been conducted on how intestinal parasite infections affect students' activity levels and academic achievement. This study aims to examine the prevalence of intestinal parasites among schoolchildren and to explore their impact on students' activity, concentration, and creativity within the classroom. Additionally, the study seeks to identify the most prevalent types of parasites and determine the age group most affected.

Material and methods

Study area:

This study was conducted in the municipality of Soloug, located 50 km southeast of Benghazi (31°40′07″N, 20°15′01″E) (Figure 1). Sulug experiences a hot desert climate characterized by a long, very hot summer and a short, warm winter, with minimal rainfall throughout the year. According to 2015 statistics, the total population of Sulug is 18,353.

Figure (1): Map of Libya showing Sulug Municipality, Libya.

Study population:

This study was conducted on a sample of primary school children randomly selected from schools in the city of Sulug, Libya, during the period from the first week of May 2024 to the last week of December 2024.

Sample:

A total of 96 random fresh stool samples were collected from primary school children aged 6 to 12 years. Permission was obtained from the Director of Education in Sulug to visit the schools. The samples were collected under the supervision of the teaching staff at the respective schools.

Collecting stool samples:

Sterile containers for sample collection were distributed to the students after a thorough explanation of the sample collection process. The name and age of each student were written on the containers. The following day, the containers were collected, and additional visits were made to retrieve any containers that had not yet been returned. One group of samples was transferred to the laboratories at the Faculty of Science, University of Benghazi, Sulug branch, while the other group was sent to the Dar Al-Hussein laboratory for examination under the supervision of a specialist medical officer.

Laboratory tests:

In the laboratory of the Faculty of Science, Sulug, stool samples were examined using the following methods:

Naked visual examination:

The samples were visually examined to assess their color, consistency, and the presence of any adult parasite worms or larvae.

Direct smear preparation method:

A drop of 0.9% normal saline solution was placed on a clean glass slide, a small amount of stool was added using a plastic loop and mixed well, a cover slide was placed, and the preparation was examined under a microscope at 10X, 40X, and 100X magnification (using an oil immersion lens).

Iodine staining method:

A small sample of stool was placed on a clean glass slide and mixed with 5% Lugol's iodine solution.

The slide was covered and examined under a microscope at 10X, 40X, and 100X magnification.

Statistical analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software. The Chi-square test was used to evaluate any associations between parasitic infections and the studied variables.

Results

A total of 96 stool samples were collected and examined for the presence of intestinal parasites using direct microscopy at the laboratory of the Faculty of Science, University of Benghazi, Sulug branch. Additional analyses were conducted at a local medical laboratory in the city. Of the 96 samples analyzed, 29 (30%) tested positive for cysts and/or other stages of intestinal protozoan parasites

Table 1 shows the distribution of stool samples, which included 51 males and 45 females. The results indicated that 29 students (30%) were infected with intestinal parasites, while 67 students (70%) were not infected. The incidence of infection among males was 13 cases (25%), which was lower than that among females, with 16 cases (36%). However, this difference was not statistically significant ($\chi^2 = 1.149$, $P = 0.284$).

Table (1): Prevalence of intestinal parasites infection among males and females' children from Sulug Municipality, Libya.

Infections	Males (51)	Females (45)	Total
Negative	38 (75%)	29 (64%)	67 (70%)
Positive	13 (25%)	16 (36%)	29 (30%)
Total	51 (53%)	45 (47%)	96

*$P = 0.284$

Table 2 shows the distribution of intestinal parasitic infections by age group. Among the 47 students aged 6–9 years, 10 (21%) were found to be infected. In comparison, 19 out of 49 students aged 10–12 years (39%) tested positive for intestinal parasites. Although the older age group exhibited a higher prevalence of infection, the difference was not statistically significant ($\chi^2 = 3.484$, $P = 0.062$).

Table (2): Prevalence of intestinal parasites infection among children according to age groups.

Age (Year)	Number examined	Number positive	Percentage %
(6-9)	47	10	21%
(10-12)	49	19	39%

*$P = 0.062$

The results presented in Table 3 demonstrate that *Enterobius vermicularis* was the predominant parasite species detected among the study population, identified in 21 cases, accounting for 72% of the positive samples and 22% of the total samples examined. *Ascaris lumbricoides* was the second most common species, detected in five cases, representing 17% of positive cases and 5% of the total samples. Additionally, *Hymenolepis nana*, *Balantidium coli*, and *Entamoeba histolytica* were each detected in a single case, corresponding to 3% of the positive samples and 1% of the total samples per species.

Table (3): Distribution of intestinal parasite species identified among the positive samples collected during this study.

Types of parasites	Positive cases tested (n = 29) (%)	Total number of tested samples (n =96) (%)
Enterobius vermicularis	21 (72%)	21(22%)
Ascaris lumbricoides	5 (17%)	5 (5%)
Hymenolepis nana	1 (3%)	1 (1%)
Balantidium coli	1 (3%)	1 (1%)
Entamoeba histolytica	1 (3%)	1 (1%)

Figure 2 shows two types of parasitic stages that differ in shape and structure. The solid arrow indicates the cystic stage of *Giardia lamblia*, which is the infective and non-motile form typically observed in chronic cases and in severe diarrheal episodes. This stage is characterized by its small, oval shape and thick outer wall, which enables it to survive in the environment for extended periods-up to several months. Distinct internal structures such as nuclei and axonemes are clearly visible. In contrast, the dashed arrows point to the cystic stage of *Entamoeba histolytica*, which is round in shape

and contains four well-defined nuclei, along with a thick external membrane that provides high resistance to harsh environmental conditions. These features enhance the parasite's potential for survival and transmission.

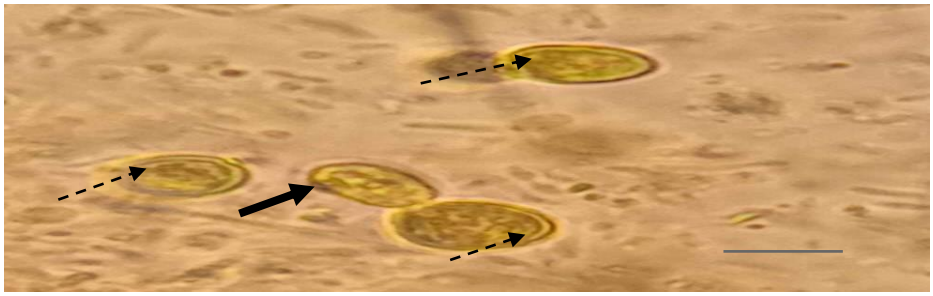

Figure (2): Some of the cystic stages of protozoa.

The black arrow indicates the cystic stage of *Giardia lamblia*. Note the distinctive oval shape of the parasite and the horizontally arranged nuclei. The dashed arrows indicate the cystic stage of *Entamoeba histolytica*. Note the four nuclei and the cyst wall.

Figure 3 illustrates the trophozoite stage of *Entamoeba histolytica*, which represents the pathogenic form responsible for amoebic dysentery. This stage was identified based on its variable morphology during the microscopic examination of a fresh stool sample. The black arrow indicates the pseudopodia, which the parasite utilizes for locomotion and phagocytosis. The white arrows highlight the distinctive spherical nucleus, a key diagnostic feature of this stage. Furthermore, the membrane surrounding the parasite is clearly observed and consists of two distinguishable layers-an inner and an outer, which contribute to the accurate identification of the organism.

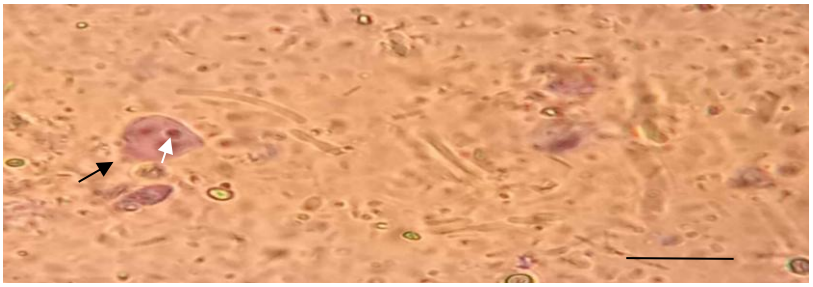

Figure (3): The trophozoite stage of *Entamoeba histolytica*.

Note its variable shape. The black arrows indicate the pseudopodia used in the parasite's locomotion. The white arrow indicates the nucleus.

Figure (4) provides a detailed docum entation of the encysted stage of Balantidium coli, the largest protozoan parasite known to infect humans. It belongs to the phylum Ciliophora. In this stage, the parasite appears with a distinctive oval shape, which represents the typical morphology of the cyst. This stage serves as the infective and resistant form in the life cycle of the parasite and plays a central role in transmission through the fecal-oral route. The black arrow in the image indicates the presence of cilia that uniformly cover the surface of the organism. These cilia are a key morphological feature of *B. coli*, used for motility in the trophozoite stage. While they are inactive in the cystic stage, they remain visibly present under microscopic examination. The dashed black arrow points to the micronucleus, which plays an essential role in sexual reproduction. Despite its small size and occasional difficulty in visualization, it serves as a significant diagnostic marker. In contrast, the dashed white arrow highlights the macronucleus, which is larger, more prominent, and exhibits a characteristic kidney shape. This nucleus is responsible for regulating vital cellular functions, including growth and metabolism.

Although not marked with an arrow, the thick cyst wall surrounding the parasite is clearly visible and constitutes a crucial adaptive structure. It enhances the parasite's ability to survive harsh environmental conditions outside the host, including acidity and chemical disinfectants such as chlorine, thereby increasing its persistence and infectivity.

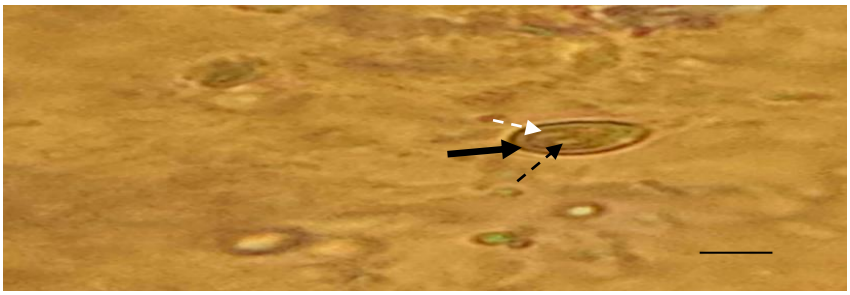

Figure (4): The encysted stage of *Balantidium coli*.

Note its distinctive oval shape. The black arrow indicates the cilia surrounding the entire body of the parasite. The dashed black arrow indicates the micronucleus, and the dashed white arrow indicates the large nucleus with the distinctive kidney shape.

Discussion

In Libya, although several studies have reported the prevalence of intestinal parasites among children (Saleh,2012) (Ibrahim and Salem,2020) (Gashout et al.,2017) (Abd Alslam.,2018) (El-Serite and Aljhemi,2020) (Shawesh et al.,2019) (Younis.,2021) (Ali.,2021) information regarding the association between these infections and socioeconomic factors as potential risk determinants remains limited. Moreover, no recent studies have been conducted to examine the transmission of these infections among the population in the study area. The findings of the present study revealed that 30% of the examined students were infected with intestinal parasitic infections. This represents a relatively high prevalence when compared to some other regions in Libya. For instance, lower infection rates have been reported in Houn (22%) (Abd Alslam., 2018) and Misrata (19.77%) (El-Serite and Aljhemi,2020) whereas higher rates were documented in Zawia (69.6%) (Shawesh et al., 2019) and Sebha, where the infection reached 53.6% among males and 46.4% among females (Ibrahim and Salem,2020). In Sirte, the prevalence was 37.7% (Hamed et al.,2013) while in Tripoli, various protozoan species were detected at different rates: *Entamoeba coli* (10%), *Giardia lamblia* (8.1%), *Entamoeba histolytica/dispar* (5.1%), and *Cryptosporidium parvum* (1%) (Gashout et al., 2017). Such variations in prevalence across Libyan regions may be attributed to several factors, including differences in socioeconomic conditions, the quality of environmental sanitation, access to clean drinking water, hygiene practices, and levels of health awareness. In rural or semi-urban areas, such as the one included in the present study, limited access to safe water sources, poor sewage disposal infrastructure, and inadequate personal hygiene awareness are likely to contribute significantly to the higher prevalence observed.

Comparable findings were reported in a study conducted by Ullah et al., (2014) which highlighted higher infection rates of intestinal helminths compared to protozoan parasites. The highest prevalence was observed for *Ascaris lumbricoides*, particularly in rural areas, where the infection rate reached an alarming 75.18%, in contrast to 18.52% in urban areas. Similarly, *Entamoeba coli* showed a greater prevalence in rural areas (7.80%) than in urban settings (1.23%). These data emphasize the stark contrast in infection rates between rural and urban communities, most likely due to disparities in sanitation infrastructure, availability of clean water, and hygiene practices. The extremely high prevalence of *Ascaris lumbricoides* in rural areas points to widespread environmental contamination, open defecation, and insufficient public health measures. In contrast, lower infection rates in urban areas likely reflect improved living standards, better healthcare access, and more effective hygiene education. Overall, these findings underscore the multifactorial nature of intestinal parasitic infections among schoolchildren and the need for integrated public health interventions that address both environmental and behavioral risk factors Ullah et al., (2014).

Additionally, climatic conditions and population density may also influence the transmission dynamics of intestinal parasites. Areas with warm and humid environments tend to favor the survival and spread of parasite cysts and eggs in the environment, thus increasing the risk of infection. Furthermore, the involvement of asymptomatic carriers, poor food handling practices, and insufficient screening programs in schools may further exacerbate the problem. Although the current study found a slightly higher infection rate among females (36%) compared to males (25%), the difference was not statistically significant (P = 0.284). This may suggest that both genders are exposed to similar environmental and behavioral risk factors in the study area.

In the Brak Al-Shatti area, a study focusing on the prevalence of *Giardia lamblia* among children reported an infection rate of only 1.8%, indicating a significant difference compared to the higher prevalence found in the present study (Mohamed, 2019). Additionally, three previous studies investigated the prevalence of intestinal parasitic infections among children in the city of Benghazi. One of these studies reported an overall infection rate of 21.5% (AlFarisi.,2013), which is notably lower than the 30% prevalence observed in our current study. This disparity may be due to differences in sampling time, population demographics, environmental conditions, or diagnostic methods used across studies. Another study conducted in Benghazi investigated the prevalence of certain helminths, reporting an infection rate of 7.2% for *Enterobius vermicularis* (Younis.,2021), which is notably lower than the rate found in the present study. In contrast, the highest recorded prevalence of intestinal parasitic infections in Libya was reported in the city of Zellah, where the infection rate reached 87%. This rate is significantly higher than that observed in the current study (30%), indicating a substantial regional disparity. Such differences may be attributed to variations in environmental sanitation, access to healthcare services, socioeconomic conditions, and public health awareness across different regions (Ali.,2021).

On the other hand, when comparing the findings of the present study with those from other Arab countries, notable differences in prevalence rates are observed. In the State of Palestine, for example, the overall infection rate among children was 20.6% (Al-Hindi et al.,2019). That study was not limited to protozoan parasites but also included intestinal helminths. The reported protozoan infection rates were *Entamoeba histolytica/dispar* (7.5%), *Giardia lamblia* (4.9%), and *Dientamoeba fragilis* (1.0%). In Morocco, a relatively high prevalence rate of 34.5% was reported among children (Ait Messaad et al.,2014). The infections included both protozoan parasites and helminths, with a higher prevalence observed among females compared to males. This finding is consistent with the results of the present study, which also recorded higher infection rates among females and older children. The high prevalence of intestinal parasitic infections in both settings can be attributed to several contributing factors, including poor personal hygiene, limited parental awareness of parasite transmission and associated health risks, as well as inadequate sanitation and living conditions.

Several studies conducted in different regions of Egypt have reported varying prevalence rates of intestinal parasitic infections. The highest infection rate was recorded in Sohag Governorate, where it reached 63% among males under the age of 10, particularly in families with more than five members. These studies also indicated that monoparasitic infections were more common, with a prevalence of 40%, which was substantially higher than polyparasitic infections at 23.5% (El-Nadi et al.,2017). In contrast, the infection rate in Dakahlia Governorate was considerably lower, at 32.9%. Single, double, and triple infections were documented, with the highest infection rate (54.8%) observed among males aged 6 to 10 years. While these results are consistent with the findings in Sohag Governorate, they differ from the results of the current study (Mahmoud et al.,2022). A study conducted in Tanta Governorate in 2013 reported a relatively low infection rate of 22.43% among children. Although the presence of multiple parasitic infections was not specified, *Entamoeba histolytica* had the highest prevalence at 11.1%, followed by *Enterobius vermicularis* at 7.03%. Differences in infection rates between males and females were observed, which is consistent with the findings of the present study (Ahmed.,2013). In the Kingdom of Saudi Arabia, the prevalence of intestinal parasitic infections was reported to be significantly lower than that found in the present study, with an infection rate of only 5.3% (Bakarman et al.,2019). This stark contrast may be attributed to several contributing factors. Saudi Arabia has made substantial improvements in public health infrastructure, hygiene practices, access to clean water, and regular deworming and awareness programs in schools, all of which help reduce the spread of intestinal parasites. In contrast, the current study recorded a higher infection rate of 30%, with a noticeable predominance among females. These differences may reflect variations in socioeconomic status, environmental conditions, health education, and the availability of sanitation services between the two countries. Additionally, cultural practices and levels of parental supervision regarding children's hygiene habits may play a critical role in influencing infection rates.

In Sana'a, Yemen, a study involving 436 individuals including 222 children reported an overall intestinal parasitic infection rate of 51.8% (Al-Yousofi et al.,2022). The most prevalent protozoan parasite was *Giardia lamblia* (13.8%), followed by *Entamoeba histolytica* (12.8%). Helminthic infections, however, were notably low, with *Hymenolepis nana* at 1.8%, *Enterobius vermicularis* at 1.4%, and minimal infections by *Ascaris lumbricoides* and *Trichuris trichiura*. In contrast, the current study recorded a higher prevalence of helminthic infections compared to protozoan infections. This variation could be attributed to environmental and epidemiological differences between the two regions. The widespread presence of intermediate hosts, poor sanitation, and hygiene habits specific to certain areas may favor the transmission of helminths over protozoa. Additionally, the present study found that monoparasitism (single-parasite infections) was more common than co-infections, a pattern also observed in the Yemeni study, though to a lesser extent.

The gender-based differences in infection rates in the current study further underscore the influence of behavioral and possibly hormonal factors in parasitic susceptibility. The findings from the two Sudanese studies show considerable variability in intestinal parasite prevalence, both between regions and in comparison, with the current study. In Ombda Locality, the overall infection rate was 24.8%, with a slightly higher prevalence among males (29%). This pattern does not align with the results of the present study, where females demonstrated higher infection rates than males. Additionally, the predominance of *Giardia lamblia* (16.6%) and the low occurrence of *Entamoeba histolytica* (0.5%) differ significantly from the current findings, which reported a higher frequency of helminthic infections. In contrast, the study conducted in Khartoum State reported a much higher overall infection rate of 54.2%, with males accounting for 80% of infections an exceptionally high rate compared to both the current and other regional studies. Although females also showed a high prevalence in that study (60%), this finding contradicts the present study's results, where female infection rates, while notable, were lower. Several factors could explain these discrepancies. Differences in geographical location, climate, and access to clean water and sanitation facilities may contribute to regional variations in infection rates (Siddig et al., 2017) (Elameen et al., 2019).

Moreover, cultural practices, dietary habits, health education levels, and diagnostic methodologies could influence the types and frequencies of detected parasites. The strikingly high rates reported in Khartoum, particularly among males, may reflect either a localized outbreak, differing diagnostic criteria, or possibly an increased exposure due to occupational or behavioral factors. These variations underscore the importance of context-specific public health strategies and targeted interventions to reduce intestinal parasitic infections. The school environment is recognized as a significant factor influencing the transmission of intestinal parasitic infections among students. A recent study by Al-Hadheq et al. (2023), conducted in Amran, Yemen, demonstrated a significant association between infection rates and the type of school attended. Specifically, the prevalence of intestinal parasites was notably higher in public schools (57%) compared to private schools (39%). This disparity likely reflects differences in infrastructure, sanitation facilities, and health education programs between the two types of schools. These findings are consistent with those reported by Esiet and Ita, (2017) who also observed a higher prevalence among public school students (36.72%) than their counterparts in private schools (14.45%). In the current study, although the distinction between school types was not explicitly analyzed, the relatively high overall prevalence of intestinal parasitic infections among students suggests that similar environmental and socioeconomic factors could be at play. In addition to school-related factors, family-related determinants such as family size and parental education level also play a crucial role in the transmission of intestinal parasites. Two studies conducted on primary school students in Sharkia Governorate, Egypt, showed that infected children were those whose parents had a low educational level, especially those from large families. These children were more susceptible to parasitic infections, which may negatively affect their academic performance. Taken together, these findings highlight the multifactorial nature of parasitic infection risk among schoolchildren, where both institutional (e.g., school environment) and household-level (e.g., parental education, family size) factors contribute significantly to infection rates (Esiet and Ita, 2017) (Hussein et al., 2021) (Mohammed et al.,2018) (Hadheq et al. (2023).

Three studies conducted in India were cited in this research. One of them, by Khan *et al*., focused on children under the age of six. The highest infection rate was observed among children aged 4-5 years (36.59%), followed by those aged 2-3 years (25.43%), and then 3-4 years (17.78%). These rates are not consistent with the findings of the current study (Khan et al.,2024). In addition, the highest infection rate was associated with *Giardia lamblia* (36.54%), while the lowest was with *Taenia* spp. (3.85%). This also contradicts the findings of our current study, where no infections with such parasites were recorded. In Bijapur, Karnataka, another Indian study was conducted among older age groups. The study, which included 52 students, showed an overall infection rate of 10% among both males and females. The highest infection rate was among the 10-11 years age group (44.2%), while the lowest was in the 8-9 years group (16.7%). These results are comparable to those of the current study. However, the results of Kaur *et al*. do not correspond with those of the current study or with the findings of *Khan et al*, as they reported the highest infection rate among children aged 1–5 years (Iti, and Farooq. 2018) (Kaur et al.,2002). The findings of the present study demonstrate a relatively low prevalence of intestinal parasitic infections compared to those reported in other regions. For instance, Houmsou et al. (Al-Hindi et al.,2019) (Ferreira et al.,2020). reported significantly higher prevalence rates among males, with *Ascaris lumbricoides* reaching 95%, *Trichuris trichiura* 17.6%, *Strongyloides stercoralis* 12%, *Entamoeba histolytica* 15%, and *Giardia lamblia* 8%. Among females, the overall worm infection rate was 35%, with *Taenia* spp. and *Schistosoma mansoni* recorded at 21% and 4%, respectively. These values are substantially higher than those observed in our current study (Houmsou et al.,2009).

Similarly, Philip et al. [2020] conducted a study in Nampula, northern Mozambique, and identified *Giardia duodenalis* as the most prevalent parasite (23.9%), followed by *Strongyloides stercoralis* (4.1%) and *Cryptosporidium* spp. (3.4%). In contrast, our data showed much lower infection rates for these protozoa, suggesting potential differences in exposure risk, environmental conditions, and public health measures between the study regions (Ferreira et al.,2020). The comparison underscores the importance of continuous epidemiological surveillance and highlights the need for region-specific public health strategies. Preventive measures such as deworming programs, health education campaigns, and improvements in water and sanitation infrastructure remain essential in reducing the burden of intestinal parasitic infections.

Conclusion This study highlights the prevalence of intestinal parasitic infections among children in primary schools in Sulug, Libya. The findings emphasize the urgent need to improve public health measures, including upgrading sanitation facilities, ensuring access to clean drinking water, and implementing effective health education programs targeting both parents and children. Early diagnosis and appropriate treatment of parasitic infections are essential to reduce associated health complications. Addressing these factors is a critical step toward improving child health outcomes and alleviating the burden of intestinal parasites in affected communities.

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