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RESEARCH ARTICLE

PREVALENCE OF INTESTINAL PROTOZOA, HELMINTHES, AND COCCIDIAN INFECTIONS AMONG PRIMARY SCHOOL CHILDREN IN THALA'A DISTRICT AT AMRAN GOVERNORATE, YEMEN

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Abstract

Background and objectives: The prevalence of intestinal parasite infection, which can range between 18% and 90%, is one of the most frequently reported diseases in Yemen and poses a serious health issue for schoolchildren. In Thala'a District, Amran Governorate, Yemen, the study's main goal was to ascertain the prevalence of intestinal parasite infection among primary school students.
Subjects and methods: A cross-sectional survey was conducted from January to April 2022 among 400 schoolchildren, in the age groups 7-12 years. All the children were residents of the city of Thala'a. A pre-tested structured questionnaire was used to collect data. Stool samples were examined for intestinal parasites according to standard laboratory methods.
Results: The children's ages ranged from 7 to 12 years, with a mean±SD of 9.52±2.9 years. The results showed that 136/400 (34%) of the tested children were positive for intestinal parasite infection with a higher prevalence of specific intestinal worms (50.4%) than protozoa (33.3%) and coccidian infection (16.3%). The rate of infection alone was also higher than that of multiple parasitic infections (19.3% vs. 14.8%). A higher rate was also recorded in older children (41%) with an odds ratio of 1.6 (p=0.03).
Conclusion: There is a high prevalence of intestinal parasites among school children in Thala'a city, and various control measures are required to control and prevent intestinal parasites among school children.
Keywords: Intestinal parasitic infections, prevalence, schoolchildren, Thala'a district, Yemen.

INTRODUCTION

One of the world's major health issues is the intestinal parasitic diseases, which can be brought on by both the protozoa and helminthes parasites. These infections can affect up to 3.5 billion people worldwide, with 450 million of those cases being directly attributable to intestinal parasites[1]. According to estimates of up to 50%, parasite infection is highly prevalent in impoverished nations[2-5]. In developing nations, a number of conditions, including a lack of drinkable water, poor environmental hygiene, rapid population increase, and low economic status, have a significant influence in the transmission of intestinal parasites[6,7]. Intestinal parasite infection poses the greatest risk to the children in underprivileged areas.

The poor development of the immune system and high susceptibility of youngsters to serious infection caused by their increasing nutritional needs. They are more likely to suffer from negative consequences such stunted growth, decreased physical activity, impaired cognitive function, and poor learning ability[8,9]. According to estimates, children between the ages of 5 and 14 in underdeveloped nations account for roughly

12% of the world's illness burdens brought on by intestinal parasites[10]. Additionally, according to the World Health Organization (WHO)[11], as many as 270 million and 600 million preschoolers and schoolchildren, respectively, reside in regions with widespread parasite transmission. *E. histolytica*, *Giardia lamblia*, *Hymenolepis nana*, and *Enterobius vermicularis* are among the intestinal parasites that are disseminated more readily and more frequently among children in underdeveloped nations[12]. *Coccidian* is an essential microscopic parasite that infects the intestinal tract of most human and animal organisms. These organisms are a major concern for the clinicians, especially with the increasing rate of HIV infection and immuno-compromised cases. *Coccidian* parasites (*Cryptosporidium* spp., *Isospora belli*, and *Cyclospora* spp.) are the most common intestinal parasites in immunocompromised patients that can usually lead to fatal acute diarrhea while causing mild and limited gastrointestinal disturbances in individuals with a normal immune system[13-16]. The above-mentioned variables contribute to the under-estimating of the significance of this illness because it is consistently viewed as a parasite that is neglected and there aren't enough investigations, particularly in Yemen[17]. Globally and in Yemen, a number of risk factors for coccidian parasites have been documented, including the use of tainted drinking water, contact with animals, a lack of sanitation, and poverty. Children are also at risk for contracting this infection[18]. Yemen is a developing country that lacks programming strategies to eliminate or control the transmission of parasitic infections in the population. The prevalence of intestinal parasitic infection among children in different regions of Yemen has been recorded in several reports and at a high rate[3-5,19]. Also in Yemen, the spread of coccidian parasites has not been studied, among immunocompromised patients as well as children with diarrhea or malnutrition, as the rate of malnutrition among children has increased in Yemen due to the war that has been going on for 8 years and has not ended until now[19].

Thus the study's main goal was to determine the prevalence of intestinal parasite infections among primary school students.

SUBJECTS AND METHODS

Study design: Cross sectional study was carried out among primary schoolchildren.

Place and duration of study: The research was carried out at Sana'a University in Sana'a, Yemen, at the Faculty of Medicine and Health Sciences, Medical Microbiology and Parasitology departments. Total 400 fecal samples from 400 randomly chosen schoolchildren in Thala'a city, Amran governorate, aged 7 to 12, and were tested between January and February 2022.

Analysis of samples: Following receipt of the samples in the lab, wet-mount preparations with saline and iodine were made and screened within two hours of sample collection to look for motile Trophozoites, larvae, eggs, and cysts. Fecal samples were also treated with a formalin-ether concentration technique and re-examined with wet saline-iodine preparations as well as stained with a modified acid-fast dye[15] to look for *Cryptosporidium*, *Cyclospora* and *Isospora oocysts*. Each wet form and stained fecal swabs were examined by a clinical microbiologist and researcher (Prof. AMA) independently and the results verified.

Collection and analysis of Data: Demographic data were collected in a standard questionnaire, and the results of intestinal parasites, helminthes, and *coccidian* parasites were analyzed and their association with demographic data were studied.

Ethical approval: The Medical Ethics Committee of the Faculty of Medicine and Health Sciences of Sana'a University gave its official permission on January 1, 2022, with reference number 2022-11.

Ethical consideration: Consents were taken from all the participants and their families and the participants were informed that participation is voluntary and that they can refuse without giving any reason.

RESULTS

The study findings are represented in three tables. The children's ages ranged from 7 to 12 years, with a mean SD of 9.52 (2.9 years) (Table 1). The results showed that 136/400 (34%) of the tested children were positive for intestinal parasite infection, with a higher prevalence of specific intestinal worms (50.4%, n=133) than protozoa (33.3%, n=88) and coccidian infection (16.3%, n=43). The rate of infection alone was also higher than that of multiple parasitic infections (19.3% vs. 14.8%).

Table 1: Age and sex distribution of schoolchildren who were tested for intestinal parasitic infection.

Characters	Total (n=400)
	No. (%)
Sex	
Male	189 (47.25)
Female	211 (52.75)
Age groups	
7- 8 years	122 (30.5)
9-10 years	139 (34.75)
11-12 years	139 (34.75)
Mean Age	9.52 years
SD	2.9 years
Min	7 years
Max	12 years

The highest number of intestinal parasites were 12.5% (n=50) for *A. lumbricoides* and 12.25% (n=49) for *E. histolytica*, followed by 9.8% (n=39) for *G. lamblia*, 11.5% (n=46) for *E. vermicularis*, 6.5% (n=26) for *Cryptosporidium* species, 6.5% (n=26) for *Hymenolepis nana*, 2% (n=8) for *S. mansoni*, and 0.8% (n=3) for *T. trichiura* (Table 2). Considering the associated factors, boys had a higher infection rate than girls (50% vs. 24.2%), with an *OR* of 2.6 and a *CI* of 1.7–3.9 (p=0.05). A higher rate was also recorded in older children (41%, n=57), with an odds ratio of 1.6 (p=0.05) (Table 3).

Table 2: The prevalence of intestinal parasite among schoolchildren.

Parasites	Frequency Number (%)
Protozoa	
E. histolytica	49/400 (12.3)
G. lamblia	39/400 (9.8)
Total identified protozoa	88/264 (33.3)
***Coccidian* parasites**	
Cryptosporidium species	26/400 (6.5)
Cyclospora species	14/400 (3.5)
Isospora belli	3/400 (0.8)
Total identified coccidian	43/264 (16.3)
Helminthes	
A. lumbricoides	50/400 (12.5)
E. vermicularis	46/400 (11.5)
H. nana	26/400 (6.5)
S. mansoni	8/400 (2)
T. trichura	3/400 (0.8)
Total identified helminthes	133/264 (50.4)
One parasite	77/400 (19.3)
Multiple parasites	59/400 (14.8)
Total infected children	136/400 (34)
Total identified parasites	264

DISCUSSION AND RECOMMENDATIONS

The current study showed that 34% of the children were infected with intestinal parasites. This score is lower than that previously reported in different regions of Yemen, including Hadramout (58.7%)[20], Ibb (62.7 %)[21], Hajjah (58.8%)[8], and Sana'a (54.8%)[22], and is well below 90% among schoolchildren in Al-Mahweet Governorate[23]. The results of the current study revealed that intestinal worms were found in 50.4% of the patients, whereas intestinal protozoa were present in 33.3% of the cases. This data conflicts with that of Qasem *et al*.,[21] who discovered that schoolchildren had protozoa and helminthes infections at rates of 85.64% and 14.36%, respectively. *A. lumbricoides* (12.5%) and *E. histolytica* (12.25%) were found to be the most prevalent intestinal *protozoa*, followed by *Giardia lamblia* (9.8%) and *E. vermicularis* (11.5%), according to the findings of the current study (Table 2). These results are in line with earlier studies conducted in Yemen, including one by Qasem *et al*.[21], which discovered that *E. histolytica*, *G. lamblia*, and *A. lumbricoides* were the most prevalent intestinal parasites. Additionally, Alshahethi *et al*.,[24,25] found that *G. lamblia* and *E. histolytica* were the most common intestinal parasites among schoolchildren in the Amran governorate. Boys had a greater infection rate than girls in the current study (50% vs. 24.2%), with an odds ratio of 2.6 and a confidence interval of 1.7–3.9 (p=0.001) when parasitism-related factors were taken into account. This result conflicts with research by Qasem *et al*., where it was shown that girls have a substantially greater infection rate than boys. Current findings, however, are consistent with those made public by Moghalli *et al*.,[8] in Hajjah, where boys were more likely to contract the infection than girls. This could be explained by the excessive movement of boys and more exposure to eating habits outside the home and/or poor personal hygiene behavior compared to girls. The infection rate alone was also higher than the rate of multiple parasitic infections (19.3% vs. 14.8%), and multiple parasitic infections may lead to gastrointestinal bleeding, malabsorption of nutrients, nutritional deficiencies, and cell and tissue damage. Ultimately, these outcomes generally result in growth retardation, slow weight growth, decreased mental development, truancy, reduced academic performance and a predisposition to malnutrition and infection by other micro-organisms[23,26,27]. *Cryptosporidium*, *Isospora* and *Cyclospora* are becoming increasingly prevalent in immunocompromised patients as well as in humans with normal immunity.

Table 3: The age and sex association with positive parasitic infections among schoolchildren.

	Positive (n=136) No. (%)	*OR*	*CI*	χ^2	*Pv*
Sex					
Male n=189	85 (50)	2.6	1.7-3.9	19.2	<0.0001
Female n=211	51 (24.2)	0.39	0.25-0.59	19.2	<0.0001
Age groups					
7- 8 years, n=122	30 (24.6)	0.52	0.32-0.85	6.9	<0.0001
9-10 years, n=139	49 (35.3)	1.1	0.7-1.6	0.14	0.69
11-12 years, n=139	57 (41)	1.6	1.04-2.4	4.7	0.03
Total n=400	136				

OR- odds ratio = > 1 (risk), *CI- Confidence intervals* 1 to more than 1, X^2*- Chi-square* = > 3.9 (significant), *p*- probability value = < 0.05 (significant)

Humans can become infected with *coccidiosis* through the fecal-oral route, through direct person-to-person or animal-to-person contact as well as consumption of contaminated water or food[27] while an animal reservoir for human *Isospora* has not yet been identified[28]. In the current study, the prevalence of *Cryptosporidium* spp was 6.5%, while *Cyclospora* spp was the second most common spherical pathogen (3.5%). The results of this study are lower than those reported among schoolchildren in Al-Turbah city, Taiz governorate, by Shamsan *et al*.,[16] as the prevalence of *Cryptosporidium* spp, *Cyclospora* spp, and *Isospora belli* parasites reached 75.9%, 45.6%, and 1.75%, respectively[18]. However, the results of this study are similar to those reported in the general population of developing and developed countries where *Cryptosporidium oocysts* rate of less than 6%, was recorded[29]. Also, the current study rate of *Cryptosporidium* spp (6.5%) was lower than the prevalence rates of *Cryptosporidiosis* among HIV/AIDS diarrheal patients which ranged from about

10% to 33%[29,30] but approximately similar to that among diarrheic children with normal immunity[31].

In order of the present findings, however, many research-based interventions have mostly taken place in disadvantaged nations and regions, where sanitation is a key concern for disease prevalence[8,16]. Methods of preventing intestinal parasites are not isolated to certain geographic areas. Using correct hand washing techniques, using restrooms that are built properly and have enough ventilation, having a piped water source, and wearing shoes are some of the current best practices for preventing intestinal parasites[32,33]. Currently, up to 80% of the population does not have access to washing facilities in some areas of Yemen where the disease is most widespread. Even though this number is large, 93% of people have access to latrines, but only 29.2% of them are built properly to prevent parasite infection[8,16,34].

Behavioral interventions focused on encouraging washing, sometimes with soap, in the context of education in schools and childcare facilities[35]. In recent studies, the best interventions take a multidisciplinary approach by: increasing environmental sanitation to promote hand-washing and shoe-wearing habits, and teaching children from an early age at school and at home. However, all that was mentioned has no effect in Yemen, and schools have become recruitment centers for children. Yemen also need particular evidence-based interventions, such as those in schools that concentrate on creating better restrooms with better ventilation, offering clean drinking water, and teaching kids about good hygiene[36]. A SAFE (Surgery, antibiotics, face hygiene, environmental sanitation) approach is used to treat trachoma, with a focus on environmental sanitation and face hygiene[37]. Cutting nails and washing hands with soap at key periods can both help to lower re-infection rates, but additional research is required before developing and implementing these interventions on a wide scale. Programs that incorporate anthelmintic medication administration with measures to improve environmental cleanliness (such minimizing fecal pollution) also can be applicable in Yemen[38].

Limitations of the study

This study has flaws since the samples were only analyzed using basic techniques, and modern genetic methods were not used to examine the samples. This is one of the things that may lower the accuracy and validity of the results.

CONCLUSIONS

The healthcare sector continues to have serious concerns about the high prevalence of intestinal parasite infections in youngsters. Intestinal parasite illnesses are common in low-income settings where environmental hygiene is poor and personal hygiene practices are lacking. Therefore, a variety of control strategies are needed to reduce and eventually eliminate the incidence of intestinal parasitosis among students. The report also emphasizes how common *coccidian* parasites are among Yemen's immuno-competent schoolchildren. *Coccidian* parasites, even in immunocompetent children, can cause childhood diarrhea, therefore Yemeni doctors need to be aware of this.

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AUTHOR'S CONTRIBUTIONS

AL-Mekhlafi AM: writing original draft, methodology, investigation. **Al-Moyed KA:** editing, review. **Al-Shamahy HA:** formal analysis, supervision. **Al-Haddad AM:** methodology, data curation. **Al-Ankoshy AAM:** review, editing, data curation. **Al-Shamahi EH:** review and editing, data curation. All the authors approved the finished version of the manuscript.

DATA AVAILABILITY

The data and material are available from the corresponding author on reasonable request.

CONFLICT OF INTEREST

No conflict of interest associated with this work.

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