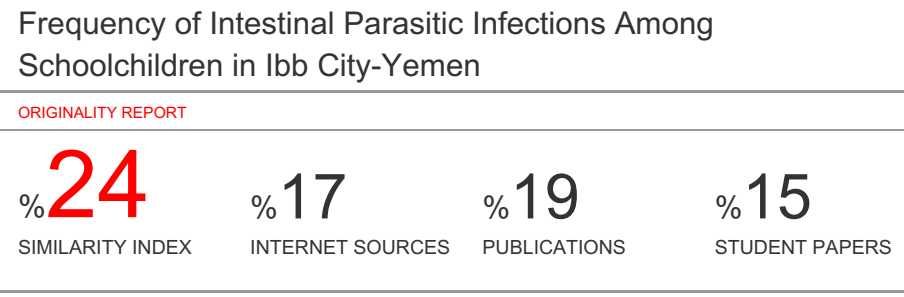
**Reviewer’s Comments**

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**FREQUENCY OF INTESTINAL PARASITIC INFECTIONS AMONG SCHOOLCHILDREN IN IBB CITY-YEMEN**

**ABSTRACT**

Intestinal parasitic infections are widely distributed and remain one of the most health problems in Yemen. This is a cross-sectional study aimed at determining the prevalence of intestinal parasitic infection and factors associated with infection among schoolchildren in Ibb City, Yemen. A total of 300 stool samples were collected from schoolchildren between January to April 2018 and examined by direct smear and formalin ether concentration techniques. The result showed that 62.7% were positive for intestinal parasites, with a higher frequency of single than multiple infections (85.1 *vs*. 14.36%, respectively). Also, 85.64% were infected by protozoa whereas 14.36% infected by helminths. The prevalence of infection was 61.70% for *Entameba histolytica,* 23.94% for *Giardia lamblia*, 7.45% for *Ascaris lumbricoides*, 4.3% for *Hymenolepis nana,* and 2.61% for *Enterobius vermicularis*. Moreover, the highest prevalence of *E. histolytica, G. lamblia,* and *A. lumbricoides* was within group aged 9-12 years. *H. nana* was between age groups of 9-12 and 13-16 years while *E. vermicularis* was found among 5-8 and 9-12 years. In addition, females were 69% infected significantly higher than males 54.55%. Besides, the various signs and symptoms associated with intestinal infections have been documented. High prevalence of intestinal infection was documented among schoolchildren drinking from cistern water, poor hygiene practices, poor food sanitation, non-swimming, and non-previously treated for *Schistosoma* parasite. High frequency of intestinal parasitic infection between schoolchildren in the study area requires more effort to implement the appropriate programmers that warrant to control and prevention the prevalence of intestinal parasitosis.

**Keyword**: Ibb City, Intestinal Parasites*,* Prevalence, School-children, Yemen.

**INTRODUCTION**

Intestinal parasitic infections, caused by both protozoa and helminthes parasites, are one of the biggest health problems globally and responsible to infect up to 3.5 billion people and about 450 million person is ill resulting from intestinal parasites1. The highest prevalence of intestinal parasites is concentrated in developing countries with up to 50%2. Many factors play an important role in developing countries for transmission of the intestinal parasites the representing the unavailability of potable water, reduced hygienic environments, fast population growth, and, low economic status3,4.

Intestinal parasitic infections are the most threats that challenge the healthy living in developing countries primarily affecting school children5. The children’ssusceptibility to heavy infection due to their increased nutritional requirements and less developed immune systems. As a result of morbidity, they are at increased risk for detrimental effects like poor growth, reduced physical activity, impaired cognitive function and learning ability6.It was estimated that about 12% of the global disease burdens caused by intestinal parasites are reported among children aged between 5 to 14 years in developing countries7. Also, up to 270 million pre-school and 600 million schoolchildren are living in an area where the parasites are extensively transmitted8.

In developing countries, the intestinal parasites such as *Entameba histolytica*, *Giardia lamblia*, *Enterobius vermicularis,*and *Hymenolepis nana* are spread more easily and more commonly among children9. Yemen belong to the developing countries that lack the strategies and programs for eradicating or preventing transmission the parasitic infection among the population. There are several reports have been conducted to determine the intestinal parasitic infections between children in Yemeni communities. A study by, in Hadramowat, Al-Haddad and Baswaid10 found that the most infective parasites prevailed in children were *G.lamblia*, *E.histolytica*, *Ascaris lumbricoides*, *Trichuris trichiura*, *H. nana*, *Taenia saginata*, and *Schistosoma mansoni*. However, in Sana’a, Alyousefi *et al*.11 reported that the intestinal parasites between children were *G.duodenalis, E. histolytica/dispar,Cryptosporidium*, *A.lumbricoides*, *S.mansoni*, *H.nana* and *E.vermiculari* recorded in the urban and rural area. Also, it was reported that 75.4% of examined children under 12 years in Taiz districts were infected with *E.histolytica/dispar, G.duodenalis, A.lumbricoides, H. nana, S. mansoni*12.Moreover, Alwabr and Al-Moayed13 recorded that the *E. histolytica*, *S. mansoni*, *T.trichiura,* and *E. vermicularis* were reported between schoolchildren in Al-Mahweet governorate.

One study only was conducted in Ibb city, in 2010,to determine the prevalence of intestinal parasitic infection among children and showed *E.histolytica*, *G.lamblia*, *A.lumbricoides*, *T.trichiura*, *H.nana*, *S.mansoni*, *Ancylostoma duodenale*, *E.vermicularis*, and *Strongyloides stercoralis*14.This study is small and not enough to show the prevalence of intestinal infection among the schoolchildren and related factors. Therefore, the present work was aimed to determine the prevalence of intestinal parasitic infection and related risk factors among schoolchildren in Ibb City, Yemen.

**MATERIALS AND METHODS**

**Study Design and Area**

A cross-sectional study was carried out at the medical laboratory depertement at Ibb University in Ibb city, Yemen, during the period from January to April 2018.Seven districts were selected for this study namely Al-Dehar, Al-Maeen, Al-Mashanh, Al-Sabal, Harathah, Mafrg-Jeblah, and Shabanthat located in Ibb city. From each district, one school was selected randomly.

**Ethical statement**

The study protocol was approved by the Ibb University, Yemen and permission to start data collection were also given by the Education Office belonging to the Ibb city. Before the beginning of data collection, the study objectives and methods were explained to the manger of school and children to consent for inclusion in this study.

**Data Collection**

A designed questionnaire was subjected to each participant such as age, gender, the clinical information like diarrhea, blood in the stool, and abdominal pain as well as environmental factors like; source of drinking water, parents occupation, and swimming etc.

**Sample Collection and Examination**

A total of 300 stool samples were collected from schoolchildren attending governmental schools. The age of the participants was between 5 and 16 years old. A dry, clean, leak proof container (labeled faecal) was given to each child and was instructed on how to introduce specimens (stool) into the bottles and transmitted to a laboratory, as soon as possible, for parasitological examination15. The stool samples were prepared and examined by using three techniques of routine examination of stool: direct examination, saline sedimentation, and formol-ether concentration15.

**RESULTS**

A total of 300 samples were collected from schoolchildren attending seven governmental schoolsin Ibb city. Of these samples, 168(56%) were females and 132 (44%) were males. The distribution of collected samples according to age was listed in Table 1.

**Table 1:The distribution of collected specimens according to gender and age**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Gender** | **Age groups (years) N(%)** | | | **Total** |
| **5-8** | **9-12** | **13-16** |
| **Female** | 52 (17.3%) | 68 (22.7%) | 48(16%) | 168 (56%) |
| **Male** | 47 (15.7%) | 45 (15%) | 40 (13.3%) | 132 (44%) |
| **Total** | **99 (33%)** | **113 (37.7%)** | **88(29.3)** | **300 (100%)** |

The distribution of collected samples according to districts was figured in Figure 1.It was collected 48 (16%) samples from Al-Dehar, 43 (14.3%) samples from Al-Maeen, 39 (13%) samples from Al-Mashanh, 37(12.3%) samples fromAl-Sabal, 44(14.67%) samples from Harathah, 47 (15.67%), and samples from Mafrg-Jeblah, and 42 (14%) samples from Shaban.

**Figure 1: The collected samples according to districts**

Out of 300 schoolchildren samples, 188 (62.7%) were recorded positive for parasites infection while 112 (37.3%) samples were reported negative for parasitic infection as shown in Figure 2.

**Figure 2:Positive and negative for parasitic infection**

Furthermore, multiple infections were obviously identiﬁed. The results were documented that 160(85.1%) of the positive samples were infected with one type of parasite, whereas 28 (14.9%) were infected with two types of parasites (Table 2).

**Table 2: Multiplicity of parasitic infections among schoolchildren**

|  |  |  |
| --- | --- | --- |
| **Infections multiplicity** | **Number of samples** | **Rate %** |
| **One parasite** | 160 | 85.1% |
| **Two parasite** | 28 | 14.9% |
| **Total** | **188** | **100%** |

Figure 3 shows that the 161 (85.64%) of the positive samples were infected by intestinal protozoa (cyst)while 27 (14.36%) of the positive samples were infected by intestinal helminthes (eggs).

**Figure 3: Type of intestinal infection among schoolchildren**

The present results revealed that the most predominate of intestinal parasitic infection was *E.histolytica* with 116 (61.70%) followed by *G.lamblia* 45(23.94%), *A.lumbricoides*14(7.45%), *H. nana* 8(4.3%), and*E.vermicularis*5(2.61%) as listed in Table (3).

**Table 3: Prevalence of intestinal parasites among schoolchildren**

|  |  |  |
| --- | --- | --- |
| **Parasite types** | **Frequency** | **Percent %** |
| *E. histolytica* | 116 | 61.70% |
| *G.lamblia* | 45 | 23.94% |
| *A.lumbricoides* | 14 | 7.45% |
| *H. nana* | 8 | 4.3% |
| *E.vermicularis* | 5 | 2.61% |
| **Total** | **188** | **100%** |

The prevalence of intestinal parasitic infection in relation to age highest prevalence of *E. histolytica*was reported among the age group of 9-12 years (41.4%) followed by the age of13-16 years (37.9%). The high rate infections were 51.1% and 57.1% recorded between 9-12 years by *G. lamblia* and *A. lumbricoides*, respectively. Also, the similar results of *H. nana* infection were (50%) reported between groups aged 9-12 and 13-16 years while infection *E. vermicularis* infection was found among 5-8 years and 9-12 years as listed in Table 4.Moreover, the overall rates of intestinal parasitic infection were recorded69.1% and 54.55%, respectively, in females and males as summarized in Table 4.

**Table 4: Distribution of intestinal parasitic infections in relation to age and gender**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | | **Identified parasites N(%)** | | | | | **Total**  **(%)** |
| ***E. histolytica*** | ***G. lamblia*** | ***A.***  ***lumbricoides*** | ***H. nana*** | ***E. vermicularis*** |
| **Age (years)** | **5-8** | 24 (20.7%) | 12(26.7%) | 2(14.3%) | 0 | 2(40%) | 40 (40.40) |
| **9-12** | 48 (41.4) | 23(51.1%) | 8(57.1%) | 4(50%) | 2(40%) | 85(75.22) |
| **13-16** | 44 (37.9%) | 10(22.2%) | 4(28.6%) | 4(50%) | 1(20%) | 63(71.6) |
| **Gender** | **Male** | 42 (36.2%) | 16 (35.6%) | 6(42.9%) | 4(50%) | 4(80%) | 72(54.55) |
| **Female** | 74 (63.8%) | 29(64.4%) | 8(57.1%) | 4(50%) | 1(20%) | 116(69.1) |

Table 5 summarizes the common signs and symptoms among infected schoolchildren. It was revealed that the high rate was 49.3% recorded with an abdominal pain followed by 46.7% for diarrhea. While the low rate was with 8% with bloody in the stool.

**Table5: Clinical signs and symptoms among infected schoolchildren**

|  |  |  |
| --- | --- | --- |
| **Signs andsymptoms** | **Responding to question** | |
| **Yes (%)** | **No (%)** |
| **Bloody in stool** | 24 (8%) | 164 (54.7%) |
| **Fever** | 72 (24%) | 116 (38.7%) |
| **Cough** | 80 (26.7%) | 108 (36%) |
| **Muscles pain** | 44 (14.7)% | 144 (48%) |
| **Diarrhea** | 140 (46.7%) | 48 (16%) |
| **Itch skin** | 68 (22.7%) | 120 (40%) |
| **Abdominal pain** | 148 (49.3%) | 40 (13.3%) |
| **Weight loss** | 88 (29.3%) | 100 (33.3%) |

The results in relation to factors were showed that the prevalence of intestinal parasitic infection among schoolchildren drinking from the cistern with 76.6%, poor hygiene with 76.1%, poor food sanitation with 57.4%, no swimming practice 68.1%, not previously treated for *Schistosoma*68.1%as listed in Table 6.

**Table 6:Factors associated with intestinal parasitic infection among schoolchildren**

|  |  |  |
| --- | --- | --- |
| **Frequency (%)** | **Variables** | |
| 44 (23.4) | **Piped** | **Source of water** |
| 144 (76.6) | **Cistern** |
| 45 (23.9) | **Good** | **Personal hygiene** |
| 143 (76.1) | **Poor** |
| 80 (42.6) | **Good** | **Food sanitation** |
| 108 (57.4) | **Poor** |
| 44 (23.4) | **Agriculture** | **Parents occupation** |
| 144 (76.6) | **Others** |
| 60 (31.9) | **Yes** | **Swimming** |
| 128 (68.1) | **No** |
| 60 (31.9) | **Yes** | **Previous Schistosoma treatment** |
| 128 (68.1) | **No** |

**DISCUSSION**

The high prevalence of intestinal parasites among children in Yemen is well-known. The major factors associated with the prevalence of intestinal parasitic infections are the low hygienic practices, environment contamination with fecal, lack of safe water, and health education resulting from the high level of poverty13.

The present study was revealed that 300 samples (168 females and 132 males) were collected from schoolchildren from Ibb city. It was observed that 62.7%of samples were reported positive for intestinal parasitic infection while 37.3% were reported negative. Similar studies reported from different regions of Yemen including Hadramowat governorate (58.7%)10, Ibb (57.4%)14,and Sana’a (54.8%)16. However, the low prevalence was reported in Yemen; in Taiz 38.2%12,in Sana’a city 40.3%11, while the higher prevalence was in Al-Mahweet governorate with 90%13.The current work showed that the multiple infectionsat 14.9% with two types of parasites. Similarity, the previous studies were reported the multiple infections in Yemen; in Sahar district 3%17, in Sana’a city 11.7%11, and in Sana’a governorate 8.5%16, in Al-Mahweet 75.5%13.

In the present study, it was found that the intestinal protozoa were (85.64%) the most predominant infections among schoolchildren, while the intestinal helminthes infections were (14.36%). A similar result was reported by Al-Mekhlafi*et al*.16found thatprotozoa and helminthic infections were 37.6% and 17.2%, respectively, recorded among rural schoolchildren in Sana’a.

In this result showed that the *E.histolytica* was the most prevailed of intestinal parasitic infection with 116 (61.70%) followed by *G. lamblia* 45(23.94%), *A. lumbricoides* 14(7.45%), *H. nana* 8 (4.3%), and *E. vermicularis* 5(2.61%). This finding is similar to previous studies conducted in Yemen. A study by Alsubaie*et al*.14 documented that the high prevalence of intestinal parasitic was *E. histolytica* (33.7%), *G. lamblia* (23.6%), *A. lumbricoides* (14.3%), *T. trichiura* (9.3%), *H.nana* (6.2%), *S.mansoni* (3.1%), *A.duodenale* (1.2%), *E.vermicularis* (0.8%), and *S.stercoralis* (0.8%).

However, a study by Alwabr and Al-Moayed13 recorded that the most common intestinal parasites prevalence were *E. histolytica* (64%) followed by *S. mansoni* (36.5%), *Trichuris trichiura* (18%), and *E. vermicularis* (13%).Another study by AL-Harazi12 reported that the 75.4% of examined children were infected with *E. histolytica/dispar* (20.6%)*, G. duodenalis* (12.4%)*, A. lumbricoides* (3%)*, H. nana* (0.9%), and *S. mansoni* (0.9%) in an urban and rural area. In contrast, Alyousefi*et al.*11observed that the *G.duodenalis* had the highest infection rate (17.7%) followed by *E.histolytica*/*dispar* (17.1%), *A.lumbricoides* (2.4%), *H. nana* (1.4%), *E.vermicularis* (0.4%) and *S.mansoni* (0.3%). Also, Al-Haddad and Baswaid10found that the most parasites prevailed in children were *G.lamblia* (19.17%), *E. histolytica* (16.83%), *A.lumbricoides* (15.83%), *T.trichiura* (2.33%), *H. nana* (2.33%), *T.saginata* (1.50%), and *S.mansoni* (0.67%).

Among the protozoan parasite, *E. histolytica* and *G.lamblia* are the most prevailing cause of intestinal morbidity in children. *E. histolytica* infects annually about 500 million cases and causes around 50 million of amoebic dysentery and invasive amebiasis diseases and kills about 100 thousand persons18,19. *G. lamblia* responsible for about 200 million cases every year20. Also, *A. lumbricoides* and *T. trichiura*are responsible for about 1.2 billion and 795 million, respectively, infections globally21.

The occurrence of chronic and heavy intestinal parasitic infection lead to intestinal bleeding, mal-absorption of nutrients, nutritional deficiency, cells and tissues damage. In eventually these results generally effect in retardation of growth, slow height-weight development, reduced mental development, school absenteeism, low academic performance, predisposed to malnutrition and infection22.

In current work, the higher prevalence of *E. histolytica, G. lamblia,* and *A. lumbricoides* infection was recorded among the age group of 9-12 years. While the age groups of 9-12 and 13-16 years were 50% infected by *H. nana.* The *E. vermicularis* infection was found among 5-8 years and 9-12 years. Theseresults are in agreement with Alwabr and Al-Moayed13 who observed that the high prevalence of intestinal parasitic infection was (43%) recorded in the age group 10-12 years

This could be explained by the extreme movement of children at this age and they may become more susceptibility to infected water while swimming/playing or fetching water for domestic purposes or helping in agriculture activities23.

In the current study, the prevalence of intestinal parasitic infection in females with 69% was significantly higher than males (54.55%). Conversely, the previous study by Alwabr and Al-Moayed13reported that the infection rates between males (46.5%) were higher than females (43.5%).

The present result showed that the majority of clinical signs and symptoms sufferings are associated with the main parasites in Yemen such as *E. histolytica* and *Giardia*. Also, the bloody in stool, cough, muscle pain, itch skin, and weight loss are shared with all parasitic infections and another disease. This result was supported by Al-Haddad and Baswaid10 who found that different symptoms as diarrhea, abdominal pain, abdominal distention, constipation, nausea and vomiting, and fever were presented between participated.

The effect of intestinal parasites on children weight was investigated in Yemen. Alwabr and Al-Moayed13showed that more than 67% of the infected schoolchildren were found to be underweight and 22% stunting. High prevalence of intestinal infection in this work was recorded among schoolchildren drinking from cistern water, poor hygiene practices, poor food sanitation, non-swimming, and non-previously treated for *Schistosoma* parasite. The environmental and behavioral factors could be attributable to the high prevalence of intestinal parasitic infections in the study area.

**CONCLUSIONS**

It can be concluded that the high prevalence of protozoa and helminthes infections reported in the present investigation indicated poor hygiene and environmental contamination as a problem of public health among schoolchildren in the area. Therefore, there are more efforts to implement the appropriate programmers that warrant to control and prevention the prevalence of intestinal parasitosis among schoolchildren.

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**CONFLICT OF INTEREST**

**REFERENCES**

1. Okyay P, Ertug S, Gultekin B, Onen O, Beser E. Intestinal parasites prevalence and related factors in school children, a western city sample-Turkey. BMC Public Health. 2004:4(64).
2. Chacon-Cruz E, Mitchell D. Intestinal protozoal diseases. Medicine Journal. 2003; 3(5):1–11.
3. Sayyari AA, Imanzadeh F, *et al*. Prevalence of intestinal parasitic infections in the Islamic Republic of Iran. Eastern Mediterranean Health Journal.2005; 11(3): 377-383.
4. Mohammed K, Abdullah M, Omar J. Intestinal parasitic infection and assessment of risk factors in North-western. Nigeria: A Community Based Study IJPMBS. 2015;4(2):141–145.
5. Kia EB, Hossein M, *et al*. Study of intestinal protozoan parasites in rural inhabitants of Mazandaran province, northern Iran. Iranian Journal of Parasitology. 2008; 3:22–25.
6. Sackev M-E. Intestinal factors and parasite infections: prevalence, risk factors and consequences for child growth, Iron status and development in rural Ecuador. Msc. Thesis; Virginia Polytechnic and State University; Ecuador; 2001.
7. Awasthi S, Bundy D, Savioli L. Helminthic infections. BMJ. 2003;323:431-433.
8. World Health Organization. Soil-transmitted helminth infections. Geneva: WHO; 2016.
9. World Health Organization. Soil-transmitted helminthiases. In: Eliminating soil-transmitted helminthiases as a public health problem in children: Progress report 2001–2010 and strategic plan 2011–2020. WHO, Geneva. 2012; 18-85.
10. Al-Haddad A, Baswaid S. Frequency of intestinal parasitic infection among children in Hadhramout governorate (Yemen). J Egypt Soc. Parasitol.2010; 40: 479-486.
11. Alyousefi NA, Mahdy MK, Mahmud R, Lim YL. Factors associated with high prevalence of intestinal protozoan infections among patients in Sana’a City, Yemen. PLoS ONE. 2011; 6(7): e22044.doi:10.1371/journal.pone.0022044
12. AL-Harazi T. Prevalence and risk factors associated with intestinal parasitic infection among patients inTaiz City, Yemen. BMRJ. 2016; 16(3): 1-7.
13. Alwabr AG, Al-Moayed E. Prevalence of intestinal parasitic infections among school children of Al-Mahweet Governorate, Yemen. Eur J Biol R, 2016; 6(2): 64-73.
14. Alsubaie AR, Azazy AA, Omer EO, Al-Shibani LA, Al-Mekhlafi AQ, Al-Khawlani FA. Pattern of parasitic infections as public health problem among school children: A comparative study between rural and urban areas. JTUSC.2016; 11(1):13–18.<http://dx.doi.org/10.1016/j.jtumed.2015.10.006>
15. Cheesbrough M. District laboratory practice in tropical countries. Part 1, 2nd ed. Cambridge, 2010; 200-208.
16. Al-Mekhlafi AM, Abdul-Ghani R, Al-Eryani SM, Saif-Ali R, Mahdy MA. School-based prevalence of intestinal parasitic infections and associated risk factors in rural communities of Sana'a, Yemen.Acta Trop. 2016; 163: 135-141. <http://dx.doi.org/10.1016/j.apjtm.2017.09.011>
17. Raja’a YA, Mubarak JS. Intestinal parasitosis and nutritional status in school children of Sahar district, Yemen. Eastern Mediterranean Health J. 2006; 12: 189-194.
18. BaxtLA, Singh U. New insights into *Entamoebahistolytica* pathogenesis. CurrOpin Infect Dis. 2008; 21: 489–494.
19. World Health Organization. *Entamoeba* taxonomy. Bull. World Health Organ.1997; 75: 291–294.
20. Feng Y, Xiao L. Zoonotic potential and molecular epidemiology of *Giardia* species and giardiasis. ClinMicrobiol Rev. 2011; 24: 110–140.
21. Alum A, Rubino J, Ljaz M. The global war against intestinal parasites -should we use a holistic approach? IJID. 2010;14:732–738.
22. BrookerS. Estimating the global distribution and disease burden of intestinal nematode infections: adding up the numbers: A review. Int J Parasito. 2010; 40(10):1137–1144.
23. Sady H, Al-Mekhlafi HM, Mahdy MAK, Lim YAL, Mahmud R, Surin J. Prevalence and associated factors of schistosomiasis among children in Yemen: implications for an effective control programme. PLoSNegl Trop Dis.2013; 7(8): e2377. doi:10.1371/journal.pntd.000237.