Original Research Article

Distribution and Risk Factors for *Giardia lamblia* among Children at Amran Governorate, Yemen

Abstract

The high prevalence of *Giardiasis* infection is a worldwide public health problem and also predominantly among Yemeni children. Hence, this work was aimed to determine the *Giardialamblia* prevalent infection and risk factors among children admitted to healthcare centers at Amran governorate in Yemen.334 stool samples from infected children were collected between March and July 2019 and parasite identify by light-microscope according to standard parasitology methods. Also, relevant data were obtained using a designed questionnaire. The results were showed that 181(54.2%) cases were infected with *G. lamblia* and 153 (45.8%) were non-infected. Also, 57.5% of infected children were from the urban area while 42.5% of cases from the rural area. The highest frequency of *G. lamblia* was 60.3% reported among males compared to 47.5% among females. Results regarding age and resident, male children aged 8─14 years in both urban and rural areas reported the highest prevalence of *G. lamblia* infection while the lowest was among females aged 1-7 years and 8-14 years, respectively, in the rural and urban area. The high infection of *Giardia* was found among the children who used unsafe water for drinking sources, eating unwashed vegetables and fruits, living in poor housing and living conditions, and didn't wash their hands after defecation. In conclusion, as highlighted in this work, multi-sectoral efforts that include health practices, personal hygiene habits, provision of safe drinking water, and provision of sanitation systems are needed to efficiently reduce this infection from all Yemen governorates.

Keywords: Giardiasis, Amran Governorate, *Giardialamblia*, Prevalence, Yemen.

INTRODUCTION

Giardialamblia, aflagellate intestinal protozoan, is probably among the most common observed gastrointestinal parasites in the world. Globally, it is one of the most frequent that arediarrhea-causing among 200 million cases reported annually particularly in infants, young children, and young adults in developing countries[1,2].

The highest prevalence of *G. lamblia* was recorded in developing countries between 10% and 50% compared between 2 to 5% in developed countries[3,4].

However, *G. lamblia* is transmitted by consumption of contaminated food or water with mature cysts. Also, parasites transmission between community can occur via direct fecal-oralcontact between family members and homosexual men[5,6].Giardiasis prevalence in Yemen is associated with some factors that including inadequate hygienic practices, environmentally contaminated with fecal, absences of health awareness, and the lack of health infrastructure. These factors are resulting from the current war started in March 2015 that destroyed the health system and increased the prevalence of infectious diseases especially among children suffering from severe malnutrition[7].

A few ofprevious studies were reported the prevalence of *G. lamblia* infection among children in different governorates in Yemen; in Ibb governorate (23.6%)[8],in Al-Mahweet governorate (3%)[9],in Hadramowat (19.17%)[10], and in Sana'a (16.7%)[11].

The Amrangovernorate lacks many epidemiological studies focusing on the prevalence and occurrence of intestinal parasitic infections between the residents. Hence, this work was aimed to determine the prevalence of *G. lamblia* infection and related factors among children attending primary healthcare centers at Amran governorate in Yemen.

MATERIALS ANDMETHODS

Study Design and Area

This study is a cross-section study that carried out at the medical laboratory at 22 May hospital in Amran City, Yemen, during the period from March to July 2019. This investigation was applied at Amran governorate in both of urban and rural areas which is far away from north of Sana'a, the capital of Yemen about 50 km.

Data Collection

Prior to specimen collection, the objectives of the study were explained briefly to all infected children. A structured questionnaire that includes the data about the information ofsocio-demographic (i.e., age, gender, parents education, and residence),behavioral habits (i.e., hands washing after defecation and washing fruits and vegetables), and environmental conditions such as type of water supply and presence of absence of toilet was collected from the children's parents or adult guardians via face-to-face interview. The age of participants in this study was categorized into two groups that were between 1-7 years and from 8 to 14 years.

Sample Collection and Examination

A total of three hundreds and thirty-four (334) stool specimens were collected from infected children in clean plastic containers (60 mL) and labeled. The collected samples were directly processed and analyzed by direct smear to identify the presence of *Giardia* parasites (cysts and/or trophozoites) from fresh stool. Also, the wet mount preparation was used after formal-ether sedimentation technique according to Cheesbrough[12].

RESULTS

Three hundred and thirty-four (334) stool specimens were chosen of children from Amran governorate,160(47.9%)specimens were from an urban area and 174(52.8%) specimens from a rural area (Figure 1).

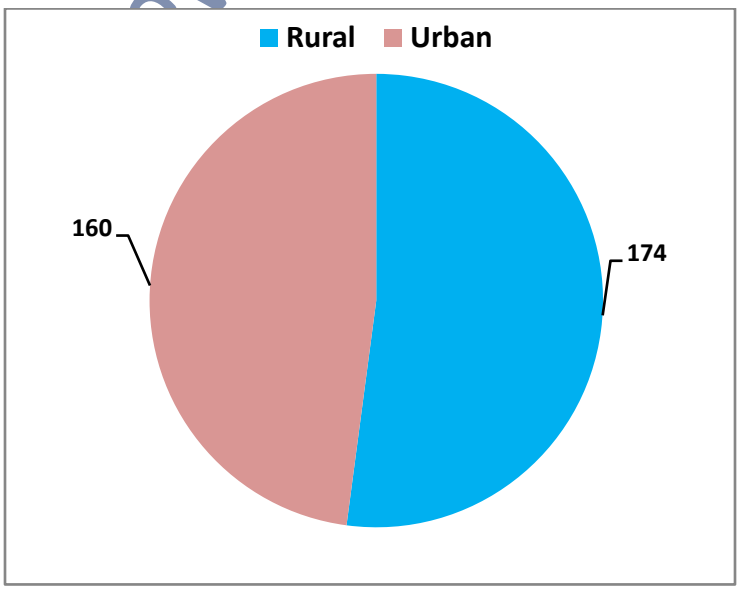

Figure (1): The distribution of specimens among areas

The present results were revealed that 181 (54.2%) cases were infected with *G. lamblia* parasite while153 (45.8%) were negative for *G. lamblia* infection. Meanwhile according to resident high

rates of giardiasis 104(57.5%) were recorded in stool specimens belong the urban area compared to77(42.5%) cases from the rural area are shown in Figure (2).

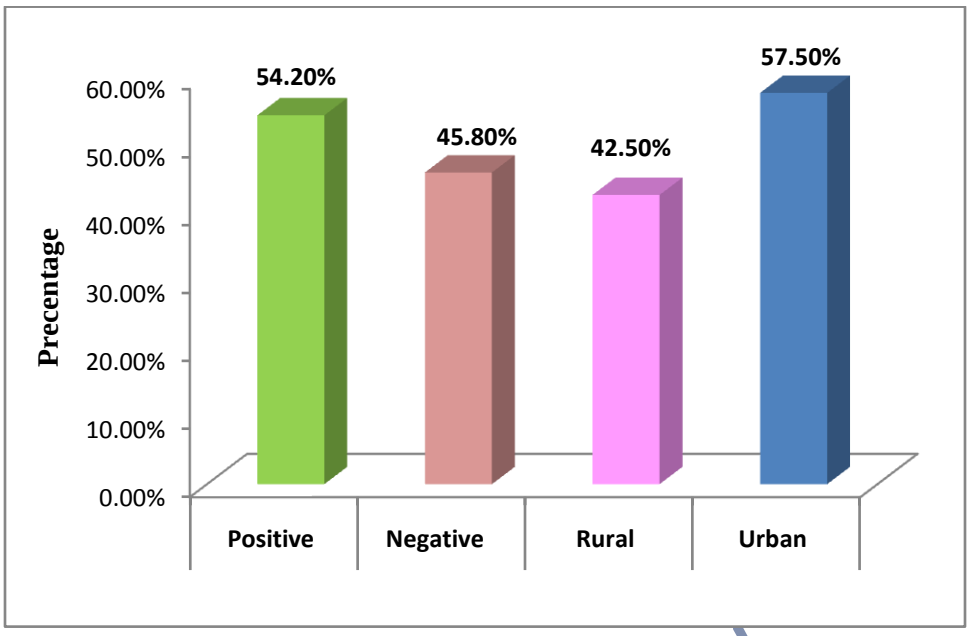

Figure 2: Rateand distribution ofchild infected and non-infected

Table (1) shows that the high frequency of *G. lamblia* infection according to sex was105(60.3%) reported in males when compared to 76 (47.5%) of females were infected with *G. lamblia*.

Table 1: The prevalence of *G. lamblia* infection concerning sex

Resident	Male			Female		
	No. of Samples	Positive (%)	Negative (%)	No. of Samples	Positive (%)	Negative (%)
Urban	85	59 (69.4)	26 (30.6)	79	45 (56.9)	34 (43.1)
Rural	89	46 (51.7)	43 (48.3)	81	31 (38.3)	50 (61.7)
Total	**174**	**105 (60.3)**	**69 (39.7)**	**160**	**76 (47.5)**	**84 (52.5)**

The current results regarding gender and age showed that the highest prevalence of *G. lamblia* infection was reported among the age group of 8 to14 years (81.90%) in males followed by 61.9% was between the age group of 1-7 years in females recorded urban area. Similarly, the highest rate of *G. lamblia* was 55.8% and 40.5%, respectively, observed between each age group of 8 to14 years in males and females in a rural area (Figure 3).

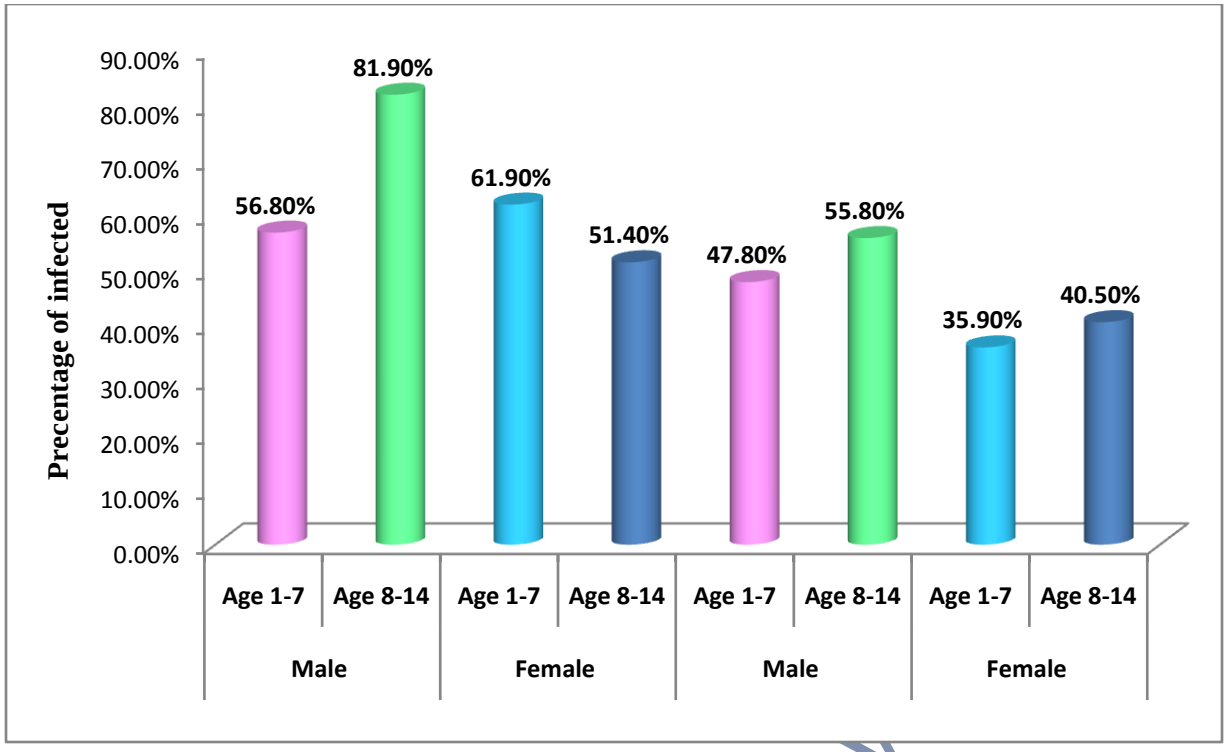

Figure 3: Distribution ofinfected childrenregarding gender and age

The present work showed the associations between the frequency of *G. lamblia* infection and several behavioral and environmental factors. The higher prevalence of *G. lamblia* infection was (73.8%) found between parents of children with the uneducated level of education, used untreated water sources for drinking water (71.9%), eating unwashed vegetables and fruits (69.2%) and (66.4%), respectively. Also, the highest prevalence was (81%) observed between children lived in houses without toilets and those who didn't wash their hands after defecation (74.5%) as summarized in Table (2).

Table (2): Factors associated with *G.lamblia* infection among children

Variables		No. examined	Infected (%)
Parents' educational status	Graduate	56	28(50.0)
	Secondary	79	44(55.7)
	Primary	119	50(42.02)
	Not educated	80	59(73.8)
Source of drinking water	Treated water	100	36(36.0)
	Not treated	204	145(71.9)
Washing vegetables before eating	Yes	242	118(48.8)
	No	91	63(69.2)
Washing fruits before eating	Yes	191	86(45.0)
	No	143	95(66.4)
Presence of toilet in a house	Yes	255	117(45.9)
	No	79	64(81.0)
Hand washing after defecation	Yes	197	79(40.1)
	No	137	102(74.5)

DISCUSSION

A total of 334 specimens of stools,160(47.9%) of an urban area and 174(52.8%) from a rural area,that collected of children were examined for presence *G. lamblia*. The overall rate of *G. lamblia* infection was 54.2% recorded between children and 45.8% of cases were non-infected. This study revealed a higher frequency of *G. lamblia* infection among children than other studies in the governorate in Yemen as it was between 23.6% and 23.94%in Ibb[8,13],3% in Al-Mahweet[9],19.17% in Hadramowat[10], and between 16.7% and 17.7% in Sana'a[11,14].

The high frequency of *Giardia* infection between young children might be due to their lower standards of personal hygienic practices and sanitary behaviors when compared to adults and older children[15,16].

Amran governorate is a developing region in Yemen and the life of most people depended upon agriculture and live with them domestic animals in the same house. Also, it is sufferingfromsevere water reduction and people tend to collect drinking water from unclean water sources such as streams, wells, tanks, rains, and other natural or artificial sources. Moreover, it lacksthe basic constituents in the health and educational systems that contributeto increasing the community awareness about the mode of disease transmission and methods to prevent and control these diseases[17,18].

In current work, the highest prevalence of *G. lamblia* was 57.5% reported in an urban area compared to 42.5% in the rural area. In agreement with the unexpected results, Al-Haddad and Baswaid[10]found that *G. lamblia* infection was (33.57%) more prevalent in the urban area than (32.06%) in the rural area. Furthermore, a study conducted in Taiz cityshowed that the higherprevalence of intestinal parasitic infection was significantly recorded in the urban Inhabitants than those in a rural area[19]. Also, Mekhlafi *et al.*,[7]revealed that *G. lamblia* was 16.1% registered among schoolchildren in rural area of Sana'a between the period of 2013–2015.

It is difficult to explain the higher prevalence of *Guardia* parasite in the urban area than the rural area, but it may be due to some factors such as socio-demographic and socio-economic environmental of Amran city that does not differ in general than natural of habitats life in rural communities. In addition, the Amran city lacks the piped-water supply and sewage disposal as well as its population below than the poverty line are considered as factors that contribute to spreading the intestinal infection.

In the present study, it was revealed the male having a 60.3% higher prevalence of *Giardia* infection than a female with 47.5%.Similarly, the high rate of *Giardia* infection was reported by previous studies between males in Yemen; it was between 17-17.6% in Sana'a[7,11],and 32.1% in Ibb[8]. In contrast, Qasem *et al.*,[13] observed the high prevalence of *G. lamblia* was among a female with 64.4%.

The higher prevalence of the *Giardia* infection among males in this work than females is due to the males in the study area are contributing to some works and they remain for a long time outside the home daily making them more susceptible to Giardia infection than females.

Results from this work revealed that the highest infection rate (81.90%) was between the age group 8 to 14 years in males followed by (61.90%) among the age group of 1-7 years in females in the urban area. Whereas, the highest prevalence of *Giardia* infection was 55.80% among males aged 8─14 years and lowest 35.90% between males aged 1─7 years in a rural area. A similar study was investigated by Mekhlafi *et al.*,[7] showed the high rate of *G. lamblia*. infection was (18.6%) recorded among less than 10 years. Also, Qasem *et al.*,[13] reported that the age group of 9-12 years was 51.1% highly infected by *G. lamblia*.

Findings of the current work showed that the prevalence rates of *Giardia* infection were influenced by the educational level of parents and the type of water sources used for the drink.

The high prevalence of *Giardia* infection was more between children of parents with a low level of education. Also, the children who used the untreated water were more exposed to infection than used treated water. Moreover, children who eating unwashed vegetables and fruits as well as not used the toilet and not washed hands after defecation were found to be highly infected with *Giardia* infection. These results were supported by studies conducted in Yemen found a significant association between *Giardia* infection and type of drinking water, methods of food preparation, and the statue of personal hygiene[9,19].

Most people in the rural area depend totally on dams and surface water such as rivers and springs as a major source of drinking water because this area lacks deep wells. These types of water sources are easy to contaminate by intestinal parasites resulting from the human and animal sources during the rainy season and eventually, the people in the rural area consume these contaminated water[18,19].

However, it was reported that the contaminated hands play an important role in transmitting fecal-oral in developing countries and washing hands after defecation or before eating have been considered as a secondary barrier[20].

CONCLUSIONS

In conclusion, the results show that the prevalence of *Giardia* infection remains high among children and constitutes a major threat that challenges the health system in developing countries. It was frequently observed among children living in poor communities lacking for good water supply, low personal hygienic practices, and poor health sanitary. Therefore, the different control measures are needed for combatting present levels of *Giardia* infection representing on implement the health programs that provide parents of children how to prevent infection among children, adequate personal hygiene, and sufficient of water supply, and good sanitary practices.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

REFERENCES

1. Feng Y, Xiao L. Zoonotic potential and molecular epidemiology of *Giardia* species and giardiasis. ClinMicrobiol Rev 2011; 24: 110–140. DOI: 10.1128/CMR.00033-10.
2. Torgerson PR, *et al*. World health organization estimates of the global and regional disease burden of 11 foodborne parasitic diseases, 2010: A data synthesis. PLoS Med 2015; 12(12): e1001920.DOI: 10.1371/journal.pmed.1001920
3. Daly ER, *et al*. Outbreak of giardiasis associated with a community drinking-water source. Epidemiol Infect 2010; 138: 491–500.
4. Yoder JS, Gargano JW, Wallace RM, Beach MJ. Giardiasis surveillance-United States, 2009-2010. MMWR 2012; 61:13–23.
5. Pakianathan MR, McMillan A. Intestinal protozoa in homosexual men in Edinburgh. Int J STD AIDS 1999; 10: 780–784.
6. Duffy TL, Montenegro-Bethancourt G, Solomons NW, Belosevic M, Clandinin MT. Prevalence of giardiasis in children attending semi-urban daycare centers in Guatemala and comparison of 3 *Giardia* detection tests. J Health PopulNutr 2013; 31: 290–293.doi: 10.3329/jhpn.v31i2.16394
7. 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

8. 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
9. 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.
10. Al-Haddad A, Baswaid S. Frequency of intestinal parasitic infection among children in Hadhramout governorate (Yemen). J Egypt SocParasitol 2010; 40: 479-486.
11. Azazy A, Raja'a Y. Malaria and intestinal parasitosis among children presenting to the pediatric center in Sana'a, Yemen. East Mediterr Health J 2003; 9(5–6): 1048-1053.
12. Cheesbrough M. District laboratory practice in tropical countries. Part 1, 2nd edition, Cambridge, 2010; 200-208.
13. Qasem EA, Edrees WH, Al-Shehari WA, Alshahethi MA. Frequency of intestinal parasitic infections among schoolchildren in Ibb city-Yemen. UJPR 2020; 5(2):42-46. https://doi.org/10.22270/ujpr.v5i2.388.
14. 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
15. Choy SH,*et al*. Prevalence and associated risk factors of *Giardia* infection among indigenous communities in rural Malaysia. Sci Rep 2014; 4: 6909.DOI: 10.1038/srep06909
16. Thompson RC, Ash A. Molecular epidemiology of *Giardia* and *Cryptosporidium* infections. Infect Genet Evol 2016; 40: 315-323.
17. World Health Organisation (WHO). Health system in Yemen close to collapse. Bull World Health Organ 2015; 93: 670-671.
18. Alshahethi AM, Edrees HW, Mogalli MN, Al-Halani AA. Prevalence of *Entamobiahistolytica* among children attending healthcare centers at Amran governorate, Yemen.PSM Biological Research 2020; 5(2):23-28.
19. AL-Harazi T. Prevalence and risk factors associated with intestinal parasitic infection among patients inTaiz City, Yemen. BMRJ 2016; 16(3): 1-7. https://doi.org/10.9734/BMRJ/2016/28317.
20. Anuar TS, *et al*. Prevalence and risk factors associated with *Entamoebahistolytica/dispar/ moshkovskii* infection among three Orang Asli ethnic groups in Malaysia. PLoSOne 2012;7(10):e48165.https://doi.org/10.1371/journal.pone.0048165