Research Article

Prevalence of Intestinal Parasites among Children Attending Assiut University Children's Hospital, Assiut, Egypt

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Abstract | Intestinal parasitic infections in children still remain an important public health problems in developing countries including Egypt. Several environmental and socio-economic factors are responsible for their continued persistence in children. This study was conducted to determine the prevalence of intestinal parasitic infections among children attending Assiut University Children's Hospital, Assiut, Egypt. In this cross-sectional study, a total of 260 stool samples were examined from outpatient children aged 4 months-15 years by direct fecal smear, formal-ether concentration and modified acid-fast staining technique to detect intestinal parasites. The prevalence of intestinal parasites in the children under study was 26.5%. Twelve species of parasites were detected. *Giardia lamblia* (10.4%) *Microsporidia* (5%) and *Cryptosporidium* spp. (2.3%) were the commonest protozoan parasites, while *Hymenolepis nana* (5.8%) and *Capillaria philippinensis* (1.5%) were the commonest helminthic parasites. Mixed infections were observed in 7.3% of the children (n= 19/260). The most common associated clinical manifestations with parasitic infection were bloody stool, pallor mucous membranes, mucous in stool, diarrhea, anorexia, abdominal pain, abdominal distention and flatulence. This study indicated that intestinal parasites prevalent among children aged four months to 15 years in Assiut, Egypt are a significant cause of morbidity in infected children. So, intervention programs, including health education, improved socio-economic conditions and environmental sanitation are required.

Keywords | Intestinal parasites prevalence, Children, Assiut, Egypt

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INTRODUCTION

Intestinal parasitic infections continue to be an important cause of morbidity and mortality in developing countries especially among children (Chhabra and Singla, 2009). It is estimated that 3.5 billion patients are affected and that 450 million of them are ill, the majority being children (WHO, 2000). Among the intestinal protozoan parasites, *Giardia lamblia* and *Entameoba histolytica* have been considered to be two of most commonly causative agents of persistent and acute diarrhea in children and adults (Dib et al., 2008; Ayeh-Kumi et al., 2009). High infection rates of *G. lamblia* were reported in developing countries, especially in children (Minenoa and Avery, 2003), as they usually experience growth retardation (Ahmed et al., 2016). *E. histolytica* can also be found in young children producing profuse bloody diarrhea (Okpala et al., 2014).

More than one dozen different species of soiltransmitted helminths infect humans, especially children in the tropical and subtropical parts of the developing world. They are usually associated with major complications such as intestinal obstruction, anemia, malnutrition, dysentery, fever, dehydration vomiting and colitis (Okpala et al., 2014). Among intestinal helminthes, *Ascaris lumbricoides*, hookworm and *Trichocephalus trichiura* infect an estimated 1.2 billion, 740 million and 795 million people worldwide, respectively, from which thousands of deaths were reported

(WHO, 1997).

Many environmental, social and geographical factors are responsible for sustained persistence and the variation in the incidence and prevalence of intestinal parasites within and across the countries (Rao et al., 2006; Workneh et al., 2014). Some of these factors include poor sanitary conditions, unhygienic practices, absence of clean water, poor housing facilities and poverty (Amuta and Houmsou, 2009). The high prevalence rate occurs due to poor personal and environmental sanitation, poverty and low standard health services (Rashid et al., 2011; Gabbad and Elawad, 2014). These factors are responsible for most of the diseases and deaths in developing countries (Adamu et al., 2006).

Intestinal helminthes infections are most common in school age children (Sehga et al., 2010) and have been related with high risk of anemia, malnutrition, impaired physical developments which will have negative effects on the cognitive function and learning ability (Rashid et al., 2011).

In Egypt, intestinal parasitic infection in children is a common public health problem; in all governorates it was identified among infants, preschool and school children (Mansour et al., 2013). Though the reported prevalence rates in different parts of Egypt vary considerably from one study to another, however, nearly 27% of the children are suffering from intestinal parasites (Ibrahium, 2011). Various prevalence rates of *E. vermicularis, S. haematobium, G. lamblia, H. nana, S. mansoni, A. lumbricoides, E. histolytica* and *A. duodenale* have been reported among children by Zaghlool (2003), Bauomy et al. (2010) in Assuit Governorate, El-Masry et al. (2007) in Sohag Governorate, Ibrahium (2011) in Minia Governorate, Mohammad et al. (2012) in Damietta Governorate, Safar and Eldash (2015) in Al-Fayoum Governorate. For the development of good preventive and control measures, epidemiological studies are important to produce baseline data on the occurrence of parasitic infections. The aim of the study was to determine the prevalence of intestinal parasitic infections among children attending Assiut University Children's Hospital, Assiut, Egypt.

MATERIALS AND METHODS

Study Area

This study was carried out in Assiut City, Capital of Assiut Governorate, located 375 km south of Cairo, Capital of Egypt. Assiut city, geographical position ranges from longitude 30° 45' to 31° 27' east and from latitude 26 °45' to 27 °45' north (Moatamed, 2005). Assiut University Children's Hospital in Assiut is the main hospital in Upper Egypt receiving children referred from other hospitals, health units and clinics of all governments in Upper Egypt.

Study Population and Sample Collection

In a cross-sectional study, 260 outpatient random children aged 4 month to 15 years, 158 were males and 102 were females participated in the study. They were divided into 4 age groups; four month - < 4 years, 4 - < 8 years, 8 - < 12 years and 12 - 15 years. Informed consent was obtained from the parents of each child after a clear explanation. For each child, age, sex, residence, presence/absence of clinical symptomatology were noted. All children were subjected to clinical examination. Fresh stool samples were collected from each child in a clean, covered and labelled plastic container. All the specimens were immediately transferred to Medical Parasitology Department Laboratory, Faculty of Medicine, Assiut University to be examined.

Table 1: Prevalence of intestinal parasites among the 260 children under study

Intestinal parasites	Number infected	Prevalence (%)
Protozoa		
Giardia lamblia	27	10.4
Microsporidia	13	5
Entameoba coli	7	2.7
Cryptosporidium spp.	6	2.3
Entameoba histolytica	4	1.5
Total	**57**	**21.9**
Helminths		
Hymenolepis nana	15	5.8
Capillaria philippinensis	4	1.5
Ancylostoma duodenale	3	1.2
Schistosoma mansoni	3	1.2
Ascaris lumbricoides	2	0.8
Fasciola spp.	2	0.8
Enterobius vermicularis	2	0.8
Total	**31**	**11.9**
Mixed infection	19	7.3
Total	**69**	**26.5**

Examination of the Samples

In order to detect the presence of intestinal parasites, a macroscopic examination of the stool samples was performed for the presence of mucus, blood and any segments or adult worm of helminthes, followed by a microscopic examination for the presence of cysts, eggs, oocysts and larvae. A direct examination of the samples was performed within 12 hours of the collection of sample. Direct examination includes wet mount preparation using saline and iodine, then the concentration method by the formal-ether technique (Cheesbrough, 2009). In addition, modified kinyoun's acid-fast staining (Parija, 2008) using alcohol fixed smear was done to detect parasites like *Cryptosporid-*

ium, *Microsporidia* (Jayarani et al., 2014).

Table 2: Prevalence of mixed intestinal parasites among the 260 children under study

Parasite species	Number infected	Prevalence (%)
Entameoba coli, Microsporidia	4	1.5
Giardia lamblia, Microsporidia	4	1.5
Hymenolepis nana, Giardia lamblia	3	1.2
Hymenolepis nana, Microsporidia	3	1.2
Giardia lamblia, Cryptosporidium spp.	2	0.8
Entameoba coli, Giardia lamblia	1	0.4
Enterobius vermicularis, Giardia lamblia	1	0.4
Microspordia, Cryptosporidum spp.	1	0.4
Total	**19**	**7.3**

Statistical Analysis

The collected data were analyzed by SPSS software (version 16). Prevalence of infection was analyzed using simple percentage. Chi-square test was performed to associate between the prevalence of intestinal parasites and age, sex. P-values less than 0.05(p<0.05) were considered statistically significant.

RESULTS

Out of the 260 children under study, aged between four months and 15 years, 158 were males and102 were females and 69 of them were infected with one or more parasites. Seven intestinal helminthes and five species of protozoan parasites were identified with an overall prevalence of 26.5%. The prevalence of protozoan and helminthic infection were 21.9% and 11.9% while the prevalence of mixed double infection was 7.3%. The most prevalent parasites were *G. lamblia* (10.4%) followed by *H. nana* (5.8%), *Microsporidia* (5%), *E. coli* (2.7%) and *Cryptosporidium* spp. (2.3%) (Table 1).The highest prevalence rate of mixed double infection (1.5%) was detected with *G. lamblia* and *Microsporidia, E.coli* and *Microsporidia* followed by *G. lamblia* and *H. nana, Microsporidia* and *H. nana* (1.2%) (Table 2).

The prevalence of infection was higher among females (29.4%) than among males (24.7%), but the difference was not statistically significant (p>0.05). Both males and females showed a statistically significant higher prevalence rate for single intestinal parasitic infection (21.6% and 17.8%, respectively) than for mixed infection (6.9% and 7.8%, respectively) (p<0.05) (Table 3). *Giardia lamblia* has the highest prevalence of protozoan infection among both sexes (5.8 % for females and 5.6% for males). Among the helminthes, *H. nana* has the highest prevalence among both sexes (12.7% for females and 8.8% for males). *G. lamblia*, *Cryptosporidium* spp., *E. histolytica, H. nana, E. vermicularis* and *C. philippinensis* showed high prevalence in females while *Microsporidia* and *E. coli* showed high prevalence in males with no significant difference (Table 4).The age group 12-15 years had the highest prevalence of intestinal parasites (34.5%) with no detected mixed infection followed by the age group 4 years - <8 years (30.2%) with 8.1% prevalence of mixed infection. The age group 4 month - <4 years (25.2%) had the highest prevalence of mixed infection (10.3%) while the age group 8 years - <12 years had the lowest prevalence of parasites (15.8%) with 0.9% prevalence of mixed infection. The results of the present study showed differences in overall prevalence rates among different age groups, but these differences were statistically insignificant (p>0.05). A significant difference between the single and mixed rates of intestinal parasitic infection was detected in age groups 4 - <8 years and 12-15 years (p< 0.05) (Table 3).

Table 3: Prevalence of single and mixed intestinal parasites in relation to sex and age groups among the 260 children under study

	No examined	Single infection No (%)	Mixed infection No (%)	Total infected No (%)	P. value
Total	260	50(19.2)	19(7.3)	69(26.5)	
Sex					
• Male	158	28(17.8)	11(6.9)	39(24.7)	0.006*
• Female	102	22(21.6)	8(7.8)	30(29.4)	0.010*
Age groups					
4 month - <4years	107	16(15)	11(10.3)	27(25.2)	0.410
4 - <8 years	86	19(22.1)	7(8.1)	26(30.2)	0.019*
8 - <12 years	38	5(13.2)	1(0.9)	6 (15.8)	0.202
12 - 15 years	29	10(34.5)	0(0)	10(34.5)	0.002*

*: Significant difference (p<0.05)

Table 4: Prevalence of different intestinal parasites in relation to sex and age groups among the 260 children under study

Parasite	Sex			Age groups				
	Male No = 158 (%)	Female No = 102 (%)	P. value	4month-4yrs No = 107 (%)	4-<8 yrs No = 86 (%)	8 - <12yrs No = 38 (%)	12– 5yrs No = 29 (%)	P. value
Giardia lamblia	14(8.8)	13(12.7)	0.999	15(14)	5(5.8)	4(10.5)	3(10.3)	0.003*
Microsporidia	9(5.6)	4(3.9)	0.116	9(8.4)	3(3.5)	0(0.0)	1(3.4)	0.018*
Entameoba coli	5(3.1)	2(2.0)	0.285	6(5.6)	1(1.2)	0(0.0)	0(0.0)	0.059
Cryptosporidium spp.	2(1.3)	4(3.9)	0.564	3(2.8)	2(2.3)	0(0.0)	1(3.4)	0.607
Entameoba histolytica	1(0.6)	3(2.9)	0.479	1(0.9)	3(3.5)	0(0.0)	0(0.0)	0.317
Hymenolepis nana	9(5.6)	6(5.9)	0.465	2(1.9)	13(15.1)	0(0.0)	0(0.0)	0.005*
Capillaria philippinensis	2(1.3)	2(2.0)	1.000	0(0.0)	1(1.2)	1(2.6)	2(6.9)	0.779
Ancylostoma duodenale	3(1.9)	0(0.0)	0.102	0(0.0)	2(2.3)	0(0.0)	1(3.4)	0.564
Schistosoma mansoni	3(1.9)	0(0.0)	0.102	1(0.9)	0(0.0)	1(2.6)	1(3.4)	1.00
Ascaris lumbricoides	2(1.3)	0(0.0)	0.317	0(0.0)	1(1.2)	0(0.0)	1(3.4)	1.00
Fasciola spp.	0(0)	2(2.0)	0.317	0(0.0)	1(1.2)	0(0.0)	1(3.4)	1.00
Enterobius vermicularis	1(0.6)	1(1.0)	1.000	1(0.9)	1(1.2)	0(0.0)	0(0.0)	1.00

*: Significant difference (p<0.05)

G. lamblia and Microsporidia showed significant high prevalence in the age group four month - <4 y while *H. nana* showed significant high prevalence in the age group 4 - <8 y (p<0.05) (Table 4). The common clinical features of children with positive parasitic infections were anorexia and abdominal pain (44.9% for each), diarrhea (43.5%), abdominal distention and flatulence (20.3% for each), pallor mucous membrane (17.4%), bloody stool (8.7 %), mucous in stool (5.8%) (Table 5).

Table 5: Prevalence of intestinal parasites in relation to clinical features

Clinical features	No. (%)
Bloody stool	6(8.7)
Diarrhea	30(43.5)
Pallor mucous membrane	12(17.4)
Mucous in stool	4(5.8)
Anorexia, abdominal pain	31(44.9)
Abdominal distention and flatulence	14(20.3)

DISCUSSION

The prevalence of intestinal parasites in the present study was 26.5% (69 out of 260 children), which is nearly comparable with the previous detected prevalence rates in Assuit Governorate (35.8% and 38.5%, respectively) (Zaghlool, 2003; Bauomy et al., 2010). Furthermore, this prevalence is more or less similar to the prevalence rates reported in Egypt. The prevalence among school children in El-Minia Governorate was 29.3% (Ibrahium, 2011) while the prevalence rate was 30.7% in Damietta Governorate (Mohammad et al., 2012), 27% among pre-school children in rural Lower Egypt (Abou El-Soud et al., 2009). However, higher prevalence in preschool children in El-Behera Governorate was detected (51.8%) (Hegazy et al., 2014). The prevalence rate detected in this study may be due to continued poor personal hygiene, an inadequate supply of drinking water and low standard environmental conditions and waste disposal system within the study area. Nevertheless, higher prevalence rates of 41.9 % and 69.3% were detected in Assuit (Kotb et al., 2011). The prevalence of protozoan infection (21.9%) was higher than that of helminthes parasite infection (11.9%). Higher prevalence rates of protozoan infection have been reported in Egypt by many authors (Ibrahium, 2011; Kotb et al., 2011; Mohammad et al., 2012). The high prevalence of protozoan infection in this study suggests contamination of drinking water (Bhat et al., 2013). However, helminthes prevalence was higher in some reports from Egypt (El-Masry et al., 2007; Bauomy et al., 2010).

The rate of mixed double infections was 7.3%, which was much lower than previous reports from Egypt (El-Masry et al., 2007; Bauomy et al., 2010; Kotb et al., 2011). This might be explained by variation in the environmental and geographical conditions of the study localities. 1.5% of double infection cases were infected with a combination of protozoan parasites such as *G. lamblia* and *Microsporidia, E.coli* and *Microsporidia* which indicate water pollution.

A slightly higher prevalence rate among females (29.4 %) compared with males (24.7 %) was observed during this study but with no significant difference. This finding is similar to previous study conducted in Assiut, which reported prevalence rates of 29.4 % in females and 24.7 % in males (Zaghlool, 2003). This higher positive rate among females compared with males could be explained by the smaller sample size of females (n=102) than that of males (n=158) if compared with other studies. It may be associated with some other factors contributing to parasitic infections, particularly personal hygiene (Pooja et al., 2014). However, previous study conducted in Assuit reported higher prevalence rates among males than females (54.9%, 45.1%) (Bauomy et al., 2010) and 60% and 40% (Kotb et al., 2011). Higher prevalence rates were reported among males than females at Minia Governorate (Ibrahium, 2011) and Damietta Governorate (Mohammad et al., 2012).

The results of the present study showed differences in the prevalence rates among different age groups. The highest prevalence rate was found in children aged 12-15 years (34.5%). Another study conducted in Assuit reported high prevalence rates in children aged 6-8years (41.6%), 9-11years (33.5%) and 12-16 years (24.9%) (Bauomy et al., 2010). The high prevalence among older children is due to their higher activities and outdoor existence behaviour, which are favourable to get the infection (El-Masry et al., 2007; Pooja et al., 2014). At the same time, this result was inconsistent with some of the reports, which showed a higher positive rate among younger children in Assuit (Bauomy et al., 2010) and in Minia Governorate (The prevalence rate in children aged 9-12 years was 76.1%) (Ibrahium, 2011).

G. lamblia followed by *Microsporidia* showed the highest protozoan infections in this study. Higher prevalence rates of *G. lamblia* infection (19.2%, 15.2% and 14% respectively) were detected by other authors in Assuit (Hassan and Hany, 2001; Zaghlool, 2003; Bauomy et al., 2010). Even so, lower prevalence rates of infection were reported for other parts of Egypt (Abou El-Soud et al., 2009; Mohammad et al., 2012). Several species of *Microsporidia* have emerged as opportunistic agents in immunocompromised patients and have also been reported in immunocompetent patients (Tremoulet et al., 2004). The detected prevalence rate of *Microsporidia* in this study was nearly equal to previous studies in Assuit (4.2%) (Zaghlool, 2003) and Egypt (4.8%, 5%) (El-Mahallawy et al., 2011; Massoud et al., 2012). During the present study, *E. coli*, *Cryptosporidium* spp. and *E. histolytica* were reported in 2.7%, 2.3% and 1.5%, respectively. Similar and lower prevalence rate of *Cryptosporidium* spp (2.5%, 0.4%0) were reported in Assuit (Shaheen, 1992; Zaghlool, 2003). The prevalence rate of *E. histolytica* detected in the present study was lower than that reported in previous studies in Assuit (10.8%, 5%) (Hassan and Hany, 2001; Zaghlool, 2003) and Egypt (Stauffer et al., 2006; El-Masry et al., 2007; Abou El-Soud et al., 2009; Mohammad et al., 2012). Because all protozoan infections detected in this study spread by direct fecal-oral passage or by food borne or water borne transmission, these differences of prevalence in different locations may be attributed to different levels of sanitation, types of water supply, hygienic measures and food behaviors (Bauomy et al., 2010).

H. nana was the commonest helminthes (5.8%) detected in this study with most of the cases between ages 4 and 8 years. Children between ages 4 and 10 years and those living in bad hygienic conditions which favor spread by autoinfection are the most frequently affected by *H. nana* (Macariola et al., 2002). *C. philippinensis* was the second common helminthic infection detected in this study (1.5%). *C. philippinensis* is an emerging parasite in Egypt. Infection reports in children were scarce. Two sisters aged 8 and 12 years from El-Minia governorate were reported (El-Karaksy et al., 2004) while two boys aged 9 years old were reported from Assiut governorate (Attia et al., 2012). *S. mansoni* and *A. duodenale* showed the same prevalence rate (1.2%) in the present study. The prevalence of *S. mansoni* was low in this study but higher than that reported in other previous studies in Assuit (0.75%) (Hassan and Hany, 2001) and in Damietta (0.9%) (Mohammad et al., 2012). While two other current studies conducted in Assuit did not detect the presence of *S. mansoni* (Bauomy et al., 2010; Kotb et al., 2011). The general decline in schistosomiasis rates Egypt in recent decades is apparently due to the intensive schistosomiasis control, and water supplies programs (Bassey and Umar, 2004). All infected children in the present study were males. Schistosomiasis is usually more prevalent among boys as boys have more frequent and unrestricted access to canal water than girls (El-Khoby et al., 2000).

The same prevalence rate of *A. lumbricoides, Fasciola* spp. (0.8%) was detected during the present study, which is similar to previous study in Assiut (Zaghlool, 2003) but lower than other studies in Egypt (Hassan and Hany, 2001; Abou El-Soud et al., 2009; Mohammad et al., 2012). The prevalence of *E. vermicularis* (0.8%) found in the present study could be underestimated because it was not systematically detected by using the cellophane tape smear method which has higher sensitivity than stool examination(González-Moreno et al., 2011).

Early identification of abdominal symptoms can help us to identify the presence of parasites (Jayarani et al., 2014). The positive association between some clinical manifestations and parasitic infections was detected in this study, including bloody stool, mucous in stool, pallor mucous membrane, diarrhea, anorexia, abdominal pain, abdominal distention and flatulence.

CONCLUSION

Although the prevalence rates of intestinal parasites in this study were nearly comparable with similar studies conducted in other regions in Egypt, the rates of infections are, however, of public health importance. Early identification of some reported clinical manifestations may help in the early detection of parasitic infection and effective treatment. Necessary sanitary strategies, health education, improvements of socio-economic conditions, screening and de-worming of intestinal parasites among children are recommended.

ETHICAL CLEARANCE

This study was approved by the Institutional Ethics Review Board of the Faculty of Medicine, Assiut University, Assiut, Egypt. Oral consent was obtained from the patients before they were recruited into the study.

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CONFLICT OF INTEREST

There are no conflicts of interest.

AUTHORS' CONTRIBUTIONS

Idea by Mahmoud E.M.M. Monib, Mervat M. Khalifa performed the laboratory works and collected data, Rasha A.H. Attia helped with the laboratory analysis of samples, collection of papers, data analysis and writing the manuscript and Mahmoud E.M.M. Monib and Abd Allah A. Hassan revised the manuscript.

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