The prevalence and associated risk factors of intestinal parasitic infections among school children living in rural and urban communities in Damietta Governorate, Egypt

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Abstract: Parasitic infection is still a serious public health problem in the world, especially in developing countries, and represents a major cause of morbidity and mortality in childhood and among high-risk groups in most parts of the world. These parasitic infections are the result of multiple factors, such as, socioeconomic, cultural, historical, and political conditions. The purpose of this study to determine the prevalence and associated local risk factors of different types of parasitic infections among rural and urban school students who represent high-risk groups in Damietta Governorate, Egypt. Across-sectional study involving A total of 560 schoolchildren were invited to participate and 530 (94.6%) provided proper stool samples and complete information. Among these, 275 (51.9%) were males and 255 (48.1%) females. The age of the children was 4-19 years, 330 (62.3%) *living* in the rural area and 200 (37.7%) living in the urban area. All the students were interviewed examined clinically and laboratory techniques were conducted between October 2011 and January 2012. Stool specimens were examined using direct wet mount and the formal ether concentration technique. The cellophane tape adhered to a glass slide was used to children to investigate the infection status of *Enterobius vermicularis*. Data were analyzed done using the SPSS statistical software. Seven species of intestinal helminthes were identified with an overall prevalence of 30.7% (163 of 530 children). The predominant parasites involved were *Entamoeba coli, Entaemoeba histolytica, Enterobius vermicularis*, *Giardia lamblia, Hymenolepiasis nana, Ascaris lumbricoides* and *Schistosoma mansoni* with the percentages, 8.8%, 5.6%, 5.2%, 4.3%, 3.2%, 2.6% and 0.9% respectively, with varying percentages between male and female pupils and a highly statistical association between pupils sex and type of parasites ($p<0.001$). The infection rate was higher among boys 64%, (93/275) than in girls 54.9%, 70/255). The prevalences of *Enterobius vermicularis*, *Giardia lamblia, Hymenolepiasis nana* and *Ascaris lumbricoides* in the urban centre were similar ($P > 0.05$) to those in the rural communities. The prevalence of *Ascaris lumbricoides* and *Entaemoeba histolytica* increased significantly with age ($P < 0.001$). The commonest double infections were *Entaemoeba histolytica* and *Enterobius vermicularis* while the commonest triple infections were *Entamoeba coli, Entaemoeba histolytica* and *Hymenolepiasis*. Anemia and hepatomegally was present among 50%, 3.2% of infected students respectively. Poor personal hygiene, low socioeconomic level, male children, previous parasitic infections and no early consultation for therapy were important risk factors which indicate the importance of these factors in rural communities. The prevalence of these parasites in this community is lower than those reported by other studies which are probably associated with the low density of the studied population. The study demonstrates the need for intervention programmes against intestinal helminthiases in the study area.

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1. Introduction

Intestinal parasitic infections still constitute one of the major causes of public health problems in the world, particularly in developing countries (Ekpenyong, 2008 and Jamaiah *et al*., 2008). Parasitic infections, particularly intestinal helminthes, cause hundreds of thousands of avoidable deaths each year, and are among the world's most common infectious diseases. Intestinal helminthes are more prevalent throughout the tropics, especially among poor communities. Records show increasing trends in helminthiasis infections, particularly in developing nations (Lang, 2005 and Bdir *et al*., 2008). Reports on intestinal parasites in Egypt have shown prevalence rates of 27%. Prevalence of

these parasites varies from one country to another. There are many reasons for the difference in prevalence of infections in these countries such as geographic and socioeconomic factors, climate, poverty, malnutrition, personal and community hygiene, population density, unavailability of drinking water and poor sanitary facilities. School age children are one of the groups at high-risk for intestinal parasitic infections. The adverse effects of intestinal parasites among children are diverse and alarming. Intestinal parasitic infections have detrimental effects on the survival, appetite, growth and physical fitness (Sharma *et al.,* 2004), school attendance, (Nematian *et al.,* 2008) and cognitive performance of school age children (WHO, 2006). About 400 million school-age children around the world are infected with roundworm, whipworm and hookworm (Lang, 2005). Intestinal parasitic infections are endemic and have been described as the greatest single worldwide cause of illness and disease. Worm infestation is a major problem in children from developing countries. Intestinal parasitic infections are most common among school age children and tend to be of high intensity in school-age children (Sharma *et al*., 2004 and Ekpenyong, 2008). The highest infection rate and worm burden were found among school children aged 4-16 years and were attributed to poor sanitation and hygiene. These infections can affect child development, educational achievement, reproductive health, a Nowadays, despite biomedical advances; parasite infections remain and continue to be an example of the parasite-host interaction complex. Nevertheless, the eradication of helminthiasis is still very difficult, due to many factors that determine this prevalence (Nematian *et al*., 2008). The improvement of environmental conditions together with personal hygiene, direct care, and participating research would be capable of decreasing the rate of enteroparasitosis incidence in the world (Yassin *et al.,* 1999). Although several reports on intestinal helminthiases and schistosomiasis in Egypt include those of Ibrahium (2011), El-Masry *et al.* (2007), Hesham *et al.* (2000) and Ismail *et al.* (2007). Yet, to the best of our knowledge, there is none on the epidemiology of intestinal helminthiasis from Damietta Government and North Delta Area of Egypt. The present study aimed to figure out the epidemiological picture of intestinal helminthiases, to determine the prevalence of intestinal helminthic infections, and to identify associated risk factors of school children in some rural and urban communities of Damietta governorate.

2. Materials and Methods

The study area consisted of students who attended a primary and secondary Health Care Center of new Damietta city and Kafr Saad villages. Both Areas found in Damietta state which situated in the north region of Delta, lies in northeast Egypt some 200 km from the capital city, Cairo. Million five hundred thousand people reside in an area of 589 km2 (991, 687 inhab rural areas). The town has a commercial downtown or "urban region", surrounded by a rural area. Damietta city representing urban area and Kafr Saad villages representing rural area where many of the inhabitants are farmers (10km apart from Damietta city). Each of the communities has a public primary, secondary, preschool and a health care centers. In all the communities included in this study, potable water supply is infrequent, therefore, the inhabitants usually depend on streams (particularly in the rural communities), wells, bore-holes, harvested rain water (in rainy season) and mobile water tankers for their domestic water needs. Fecal disposal facilities used by the inhabitants of all the communities include water closet, pit latrines (commonest, especially in the rural areas) and open defecation. Prior to the commencement of the study, permission was obtained from the local education authority of each of new Damietta city and Kafr Saad. The head teacher and teachers of each selected school were contacted, and the parents and pupils were adequately enlightened on the purpose of the study. All the public schools in new Damietta city and 10 randomly-selected public schools in Kafr Saad were included in the study. The examined population size was 530 (275 males, 255 females) and the age range was 4-19 years. A total of 330 and 200 subjects were examined in the rural communities and the urban center, respectively. The study was performed between October 2011 and January 2012.

For each participating school child, a questionnaire was administered to obtain information, such as age, sex, source of water for drinking, and other purposes, toilet facilities, and hygiene practices. Labeled sample bottles were distributed to the school children for a little portion of their early morning feces. In the laboratory, each collected sample was examined using direct wet mount and the formal ether concentration technique. The cellophane tape adhered to a glass slide was used to children to investigate the infection status of *Enterobius*

vermicularis. All microscopic observations were done with 10x objective and, when required, 40x objective lenses. Egg counts were recorded as no. of eggs/g of feces. The chi-square (χ^2) test was used to compare data and to determine the significance of differences between prevalences. Socio-cultural and environmental characteristics, symptoms, age, and sex were used as (independent) explanatory variables. SPSS software, version 11.5 was used throughout.

3. Results

The overall percentage of parasitic infections among the studied school children (Table 1) was 30.7%. By species, the rate for *Entamoeba coli* was 8.8%, *Giardia lamblia* 5.6%, *Enterobius vermicularis* 5.2%, *Entaemoeba histolytica* 4.3%, *Hymenolepiasis nana* 3.2%, *Ascaris lumbricoides* 2.6% and *Schistosoma mansoni* 0.9%. Mixed infections constituted 5.6%. The double helminthic infection rate was formed to be 6.4% (34 out of the 530 children), 19.7% of which were infected with a combination of *Entaemoeba histolytica* and *Enterobius vermicularis*. Fiveteen of the 530 children (2.8%) of the whole had triple infections of *Entamoeba coli, Entaemoeba histolytica* and *Hymenolepiasis*. The prevalence of *Entamoeba coli* was the highest, compared with other parasite species ($P < 0.001$). compares the prevalences of the helminths among the urban center and the rural communities in the study area (Table 2), the prevalences of *Enterobius vermicularis*, *Giardia lamblia*, *Hymenolepiasis nana* and *Ascaris lumbricoides* in the urban centre were similar ($P > 0.05$) to those in the rural communities. The prevalence of *Schistosoma mansoni* in the rural communities was statistically higher than that in the urban community ($P < 0.01$). The prevalence of *Ascaris lumbricoides* decreased with age while *Entaemoeba histolytica* and *Entamoeba coli* increased significantly with age ($P < 0.001$). Among males and females, *Entamoeba coli* revealed the highest prevalence ($P < 0.001$). Each of the recorded helminths had statistically similar prevalences among both genders ($P > 0.05$). The age-related prevalence of the helminths in the study area is shown in table (3). *Giardia lamblia* and *Hymenolepiasis nana* showed the highest prevalence in all the age groups except 19 years ($P < 0.05$). The 19 years subjects had the statistically highest prevalence of *Entaemoeba histolytica*, *Entaemoeba coli* and *Ascaris lumbricoides* ($P < 0.001$). For *Enterobius vermicularis*, 12-14 years age group had statistically highest prevalence ($P < 0.05$). The remaining helminths recorded had similar prevalences among the infected age groups ($P > 0.05$). *Ascaris lumbricoides* had fertile and infertile eggs ratio of 10: 1 and 4.6: 1 in the urban centre and rural areas, respectively. Among the infected school children, 53 (32.8%), 6 (3.6%), and 1(0.6%) had double, triple and quadruple infections, respectively. The prevalences of double infections among males (51.8%) and females (53.6%) were statistically similar ($P > 0.05$). Socio-cultural and environmental risk factors summarized in table (4). As regard sociodemographic risk factors, the low level of paternal education (illiterate and read & write), low level of paternal occupation and low social class were significant risk factors for parasitic infections. As regard health care behavior risk factors, the improper hygienic food handling, poor personal hygiene, delayed consultation for treatment and incompliance with therapy were risk factors. As regard of personal characteristics risk factors, small age groups 6-8 years, male sex and the last birth child were risk factors. As regard the clinical characteristics and impacts of parasitic infections, 60.3%, 52.4%, 51.9%, 45.4%, 34.3%, 32.7%, 28.4%, 26.5%, 21.4% and 2.4% of the students with positive parasitic infections suffered from headache, fatigue, pallor, loss of appetite, abdominal pain/colic, polyphagia, pruritus ani, fever, diarrhea and hematuria, respectively. Anemic students with positive parasitic infections (52.4%). Lastly, hepatomegaly was detected clinically in 3.2% of positive parasitic infections.

Table 1. Prevalence of intestinal helminthes among studied school children of Damietta governorate

Parasite species	**Males** n=275 No (%)	**Females** n=255 No (%)	**Both** sex n=530 No (%)
Entamoeba coli	27(9.8)	20(7.8)	47 (8.8)
Giardia lamblia	16(5.8)	14(5.4)	30(5.6)
Enterobius vermicularis	15(5.4)	12(4.7)	27(5.2)
Entaemoeba histolytica	10(3.9)	13(4.7)	23(4.3)
Hymenolepiasis nana	10(3.6)	7(2.7)	17(3.2)
Ascaris lumbricoides	8(2.9)	6(2.3)	14(2.6)
Schistosoma mansoni	4(1.4)	1(.3)	5(.9)
Mixed infection	23(8.3)	7(2.7)	30(5.6)
Overall prevalence	93(64)	70(54.9)	163(30.7)

Table 2. Prevalence of parasitic helminthes in the urban center and rural communities surveyed in Damietta governorate

Parasites species	**Urban** n=200 (62.3%)	**Rural** n=330 (37.7%)	**Total** n=530 (100%)
Entamoeba coli	31(15.5)	16(4.8)	47(8.8)
Entaemoeba histolytica	7(3.5)	16(4.8)	23(4.3)
Enterobius vermicularis	10(5)	17(5.1)	27(5.2)
Giardia lamblia	11(5.5)	19(5.7)	30(5.6)
Hymenolepiasis nana	6(3)	11(3.3)	17(3.2)
Ascaris lumbricoides	5(2.5)	9(2.7)	14(2.6)
Schistosoma mansoni	0(00.0)	5(1.5)	5(.9)
Mixed infection	9(4.5)	21(6.3)	30(5.6)

Table 3. Prevalence of parasitic helminthes in relation to age groups of studied population in Damietta governorate

Parasite species	**4-6 y** No=15 (%)	**6-8 y** No=50 (%)	**9-11 y** No=203 (%)	**12-14 y** No=152 (%)	**15-17 y** No=85 (%)	**18-19 y** No=25 (%)
Entamoeba coli	0(00.0)	4(8.0)	19(9.3)	9(5.9)	11(12.9)	4 (16.0)
Entaemoeba histolytica	0(00.0)	0(00.0)	4(1.9)	7(4.6)	8(9.4)	4(16.0)
Enterobius vermicularis	1(6.6)	2(4.0)	8(3.9)	10(6.5)	5(5.8)	1(4.0)
Giardia lamblia	1(6.6)	4(8.0)	15(7.3)	7(4.6)	3(3.5)	0(00.0)
Hymenolepiasis nana	1(6.6)	3(6.0)	13(6.4)	0(00.0)	0(00.0)	0(00.0)
Ascaris lumbricoides	0(00.0)	1(2.0)	4(1.9)	6(3.9)	3(3.5)	0(00.0)
Schistosoma mansoni	0(00.0)	0(00.0)	0(00.0)	3(1.9)	1(1.1)	1(4.0)
Mixed infection	0(00.0)	0(00.0)	6(2.9)	13(8.5)	9(10.5)	2(8.0)

Table 4. Prevalence of positive and negative parasitic infections among students according to Socio-cultural and environmental risk factors in Damietta governorate

Sociodemographic No. (%)		**Socioeconomic and health care behavior No. (%)**		**Housing & Waste disposal No. (%)**		**Water supply & water contact No. (%)**		**Clinical symptoms No. (%)**	
Illiterate	10 (1.8)	Low	209 (78.9)	Modern building	85 (16.9)	Piped	60 (18.1)	Anemia	138 (52.4)
Read and write	15 (2.8)	Moderate	157 (59.3)	Primitiv building	130 (24.5)	River nile	95 (28.7)	Hepatomegally	6 (2.2)
Primary school	295 (55.6)	High	43 (16.6)	Overcrod	235 (44.2)	Shallow wells	105 (31.8)	Abdominal pain/colic	90 (34.3)
preparatry school	135 (25.4)	Early consultat -ion for treatment	161 (60.8)	Sewage disposal	455 (85.8)	Deep wells	70 (21.2)	Headache, fever, fatigue, pallor & Weight loss	159 (60.3) 131 (49.7)
Secondary school	75 (14.1)	Complia- nce with therapy	174 (65.7)	Well with chamber disposal	75 (14.2)	Other	20 (3.7)	Diarrhea pruritu ani	56 (21.4) 75 (28.4)

4. Discussion

As regard distribution of parasitic infections among the studied school children, the overall percentage of parasitic infections was 30.7%. This was similar to Ibrahium *et al*. (2011) who reported that the prevalence of parasitic infection among Egyptian school children in El-Minia governorate village in upper Egypt was 29.3%. However, our result was less than that reported in lower Egypt by El-Gammal *et al*. (1995) and El-Masry *et al*. (2007) who reported that the prevalence of parasitic infections among Egyptian school children in Tamouh and rural school students in Sohag governorate villages were 60.2% and 88.5%, respectively. The high prevalence of parasitic helminthes among school children in this study suggests a generally low standard of living and poor environmental sanitation in the study area (Ukoli, 1984; Smyth, 1996). The high prevalence of *Giardia lamblia, Enterobius vermicularis* and *Entaemoeba histolytica* among the children in the study area is corroborated by the relatively high occurrence of unhygienic habits among them. The similar prevalence of *Enterobius vermicularis*, *Giardia lamblia*, *Hymenolepiasis nana* and *Ascaris lumbricoides* in the urban centre and rural communities possibly shows no difference among the communities in environmental sanitation and personal hygiene of the school children. The unhygienic practices among food vendors in the study area might have contributed to the occurrence of *Ascaris lumbricoides* and some other helminthes among the school children (Idowu and Rowland, 2006). Also, our results are in accordance with and Gamboa *et al*. (1998) and Umar (2007) who cleared that intestinal parasites are transmitted directly through the contaminated water, soil and food by feces, or indirectly through unsanitary living conditions. An estimated 10.0% of the world's population is infected with *Entaemoeba histolytica;* the highest prevalence is in developing countries with the lowest levels of sanitation. *Giardia lamblia* is the most commonly isolated intestinal parasite throughout the world. Rates of 20.0-40.0% are reported in developing countries, especially in children (Chacon-Cruz and Mitchell, 2007). In this study *Entamoeba coli*, *Giardia lamblia,* and *Entaemoeba histolytica* were reported in 8.8%, 5.6 % and5.2% respectively and no evidence of other protozoa. Agreeded with El-Gammal *et al*. (1995) who reported 5.4% and 8.9% prevalence of *Entaemoeba histolytica* and *Giardia lamblia*, respectively. The prevalences of *Enterobius vermicularis* and *Schistosoma mansoni* were low in the study area. This might have been due to the diagnostic methods used in this study; particularly for *Enterobius vermicularis* which is best diagnosed using cellophane tape smear methods (Shoup, 2001). *Enterobius vermicularis* is a nematode and has the broadest geographic range of any helminthes. Since the first evidence of pin worm infection from Roman-occupied Egypt (Horne, 2002), it has been known to be the most common intestinal parasite seen in the primary care setting (Petro *et al.,* 2005). *Hymenolepiasis nana* is the smallest tape worm that infects humans. This parasite has worldwide distribution (Ismail *et al*., 2007). Children between the ages of 4 and 10 years are the most frequently affected (Macariola *et al*., 2002). Both *Enterobius vermicularis* (5.2%) and *Hymenolepiasis nana* (3.2%) represented the highest prevalence of nematode and cestode infections, respectively in this study. In school children in rural areas of Qalubia, Kandeel (1998) found that prevalence of *Enterobius vermicularis* and *Hymenolepiasis nana* were 3.5% and 5.8%, respectively. *Ascaris lumbricoides* (round worm), Infection is caused by ingestion of eggs from contaminated soil (Crompton and Savioli, 2006). In this study, the rate for *Ascaris lumbricoides* was 2.6%. Ibrahium *et al.* (2011) found that prevalence of *Ascaris lumbricoides* was 3.2%. Schistosomiasis is an endemic disease in Egypt (El-Khoby *et al*., 2000) and it constitutes a major health problem (Abdel-Wahab and Mahmoud, 1987). In the present study the prevalence of *Schistosoma mansoni* infection as determined by ova in the stool was 0.9%. Similar results were reported by recent studies in many governorates in Egypt. Our result supported that of Hammam *et al.* (2000b) and suggested that the prevalence has continued to decrease to about half of the 2000 level denoting the success of National Bilharzia Control Program in Egypt. The general decline in schistosomiasis rates in Egypt in recent decades is in contrast to the situation in most other African countries where rates have increased, apparently due to the intensive schistosomiasis control and water supply programs (Bassey and Umar 2007). The presence of schistosomiasis is no surprise since many of the school children had caused to frequent streams for drinking water, laundry, and other domestic purposes). Ascariasis decreased gradually in prevalence as the age of the school children increased versus *Entamoeba coli*

and *Entaemoeba histolytica* which increased with age. However, the high prevalence in virtually all age groups indicates general ignorance and/or deliberate neglect of basic rules of hygiene among the children. The observation of relatively higher prevalences of *Entamoeba coli*, *Entaemoeba histolytica* and *Enterobius vermicularis* in age groups 12-17 years may be an indication of their higher level of involvement in farming activities than others. The absence of *Schistosoma mansoni* among 4-6 years age group may be because they make infrequent (if any) contact with natural water bodies. The seeming restriction of *Enterobius vermicularis* to certain age groups is attributable to their low prevalences in this study. In this study, mixed infection constitutes 5.6%. The most common double infection was *Entaemoeba histolytica* and *Enterobius vermicularis* while the commonest triple infections were *Entamoeba coli, Entaemoeba histolytica* and *Hymenolepiasis*. As regard sociodemographic risk factors, showed that the low level of paternal education, low level of paternal occupation and low social class were significant risk factors for parasitic infections. These were in accordance with El-Gammal *et al*. (1995) who reported that 43.0% of their students were belonging to low socioeconomic standard in Lower Egypt. Also, parasitic infections were more common in rural areas and among lower socioeconomic. According to personal characteristics risk factors, we noticed that small age groups 5-9 and 9-13 years were risk factors. This was in agreement with Mahmoud (1983) and Ibrahium *et al*. (2011). As regard health care behavior risk factors, we cleared that the improper hygienic measures in food handling, poor personal hygiene, water contact activities delayed consultation for treatment, incompliance with therapy and no sibling's referral for treatment were risk factors. Children playing or swimming in canals had significant rate of infection and morbidity by *Schistosoma mansoni* (Hammam *et al.,* 2000b) who cleared that schistosomiasis was more common among boys; this might be due to more contact with polluted water. While, Oluwafemi (2003) showed that some parasitic infections as *Entaemoeba histolytica* was higher in girls than boys, and some parasitic infections as *Ascaris* was higher in boys than girls. As regard the clinical characteristics, intestinal invasion may be asymptomatic (small number) or presented by various symptoms as abdominal pain (usually vague), abdominal cramps/colic, diarrhea, vomiting (rarely) and constipation (occasionally). However, the most common symptom in pin worm infection is nocturnal perianal pruritus (Hökelek and Lutwick, 2006). Most of the parasitic infections causing acute or chronic diarrhea with malabsorption (Mahmoud, 1983 and Alberton *et al*., 1995). The most frequent associating symptoms were diarrhea and distension (Mahmoud, 1983& Current and Garcia, 1991). However, chronic symptoms such as dyspepsia, epigastric pain, nausea and anorexia may be present (Mahmoud, 1983; Addis *et al*., 1992 and Fayad *et al*., 1992). El-Hawy *et al.* (1992) and Markel *et al.* (1999) cleared that, through effect on the intestinal flora, children infected with enteric parasites may suffer from colitis that lead to vague, non-specific abdominal symptoms. So, they usually lose their food interest to prevent these symptoms. WHO (1998) and WHO (2002) cleared that parasitic infections were commonly associated with anemia. WHO (2006) stated that no doubt that poor iron status and iron-deficiency anemia are closely linked to diminished educational performance. Hepatomegaly was detected clinically and by ultrasonography in 3.2% of positive parasitic infections However, no case of splenomegaly, urinary bladder wall lesions or obstructive uropathy was detected. These may be attributed to the absence of *Schistosoma hematobium* infection and more or less early infections of young students. This study has shown a general similarity in the epidemiological pictures of parasitic helminthes in the urban centre and the rural communities in the study area. This corroborates the opinion of Gillespie (2001) that urbanisation and population growth often combine to increase total burden of diseases in developing countries. It necessarily implies that there is an urgent need for concerted efforts towards ensuring adequate control of intestinal helminthiasis in Damietta State. We recommend improving personal and environmental hygienic measures, regular screening and treatment for parasitic infections and more studies on big number of students in rural and urban areas of Egypt.

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