A survey of *Giardia* and *Cryptosporidium* spp. in Rural and Urban community in North Delta, Egypt

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Abstract: *Cryptosporidium* spp. and *Giardia duodenalis* are 2 protozoan parasites that affect humans and a wide range of domestic and wild animals. These parasites are a major cause of diarrheal disease in humans and animals worldwide, causing high morbidity in their hosts, in immunocompromised hosts and children, they can lead to death. The purpose of this study was to assess the frequency of *Cryptosporidium* spp. and *Giardia* spp. in the northern part of Delta (Damietta governorate) and the risk of human infection of these protozoa related to personal data, socio-cultural and environmental characteristics, and the presence or absence of symptoms/signs among a rural and urban population. In order to assess the prevalence of these protozoa among population in the northern part of Delta and the risk of human infection, 330 people (175 females and 155 males) with or without symptoms who attended a Health Care Center were parasitological studied. Of the surveyed population (330), 3.6% were infected with *Cryptosporidium* spp. only or 24.2% with *Giardia* spp. and 2.4 % were infected with both protozoa. The frequency of infection according to sex; 2,7% of males were infected and 0.9% of females by *Cryptosporidium* spp, 12.7% and 11.5% by *Giardia* spp. and 1.5% and 0.9% by both parasites, respectively. *Cryptosporidium* spp. and *Giardia* spp. was frequent in children (under 12 year) than adults in both sexes, however, *Cryptosporidum* infections were most frequently diagnosed in children less than 12 years old and prevalence decreased with age. The prevalence of these protozoa in this community are lower than those reported by other studies, which is probably associated with the low density of the studied population. Studies analysis revealed that a male sex, children, loss of weight, impropal waste disposal, diarrhea and abdominal pain were correlated with the presence of these parasites, which indicate the importance of these factors in rural communities.
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1. Introduction

Cryptosporidium spp. and *Giardia duodenalis* are 2 protozoan parasites that affect humans and a wide range of domestic and wild animals (Abaza et al. 1995; Adam 2001; Foyer et al. 2009). These parasites are a major cause of diarrheal disease in humans and animals worldwide, causing high morbidity in their hosts, and in immunecompromised hosts, they can lead to death (Faubert 2000 and Noureldin et al. 1999). The transmission of these 2 parasites is sustained by zoonotic (animal to human) and anthroponotic (human to human) cycles where several species and genotypes are enrolled (Xiao and Caccio 2008). The protozoan flagellate *Giardia lamblia* shares several epidemiologic characteristics with *C. parvum.* (Dillingham et al. 2002).Both organisms are water-borne and this route has been the cause of like *C. parvum, G.lamblia* is a cause of childhood diarrhea (Waikagul et al. 2003) and may be transmitted by close-contact and is often associated with epidemics of diarrhea (Alves et al. 2006). The prevalence of both *G. lamblia* and *C. parvum* is generally higher among very young children and this may be related to more efficient fecal-oral transmission of the infective stages or enhanced susceptibility due to lack of immunity (Almeida et al. 2006). Also has a higher prevalence in tropical regions, reaching infection levels of 20-50%, especially in rural areas (Wilson 1991). While the prevalence of Cryptosporidiosis and Giardiasis is well documented in patients and children with human immunodeficiency virus and AIDS (Matos et al. 2004). Water-borne outbreaks of infections with the parasites have highlighted the fact that morbidity may occur outside of these focus groups in endemic areas (Castro-Hermida et al. 2009). Cysts and oocysts not only remain infective for long periods in environment but are also resistant to the conventional treatment processes of water, representing a serious problem of public health (Fayer 2004; Castro-Hermida et al. 2008;). This problem is also potentiated by the fact that the number of parasites required to induce infection is

small, i.e., infectious dose of 83 -123 oocysts for *Cryptosporidium* spp.and 19-50 cysts for *G. duodenalis* (Hunter and Thompson 2005). Intestinal infections caused by *Cryptosporidium* and *Giardia* spp. are associated to climatic factors, basic sanitary conditions, and sociocultural characteristics (El Mansoury et al. 2006). Environmental conditions (e.g. temperature, humidity, wind, soil) and socio -economic factors are responsible for spreading and for developing infectious forms of *Cryptosporidium* and *Giardia* spp., and for polluting the environment with these agents. Two hundred million are infected with *Giardia* spp. worldwide and 15% of the rural population in Latin America is estimated to be infected with these parasites; with a higher prevalence among children (Atwill and Kemp 1998). In addition, the infection prevalence is lower in the upper strata of the population, and increases in day care centers attended by the children of poorer families (Borda et al. 1996). On the other hand, Infection with *Cryptosporidium* spp. was reported in immunocompromised, as well as immunecompetent (Abaza et al.1995 and Faubert 2000), children and adults (Fernández et al. 2002) and in animals (Alves et al. 2006) The disease occurs in most countries including Arabian countries (El Mansoury et al. 2006), USA (McCuin and Clancy 2003) and Egypt (Abaza et al. 1995; Noureldin et al. 1999; El Mansoury et al. 2004; Mahmoud 2006; El Shazly et al. 2007). The purpose of this study was to assess the frequency of *Giardia* spp. and *Cryptosporidium* in the northern part of Delta and the risk of human infection of these protozoa related to personal data, socio-cultural and environmental characteristics, and the presence of symptoms/signs among a rural and urban population.

2. Subjects, Material and Methods

2.1. Study area

North Delta of Egypt, Damietta Governorate, situated in the north region of Delta, which lies in northeast Egypt some 200 km from the capital city, Cairo. Million five hundred thousand people reside in an area of 589 km^2 (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 (10 km apart from Damietta city).

2.2. Selected population

The study extended from Sept 2009 to Aug 2010, stool samples were referred to Department of parasitology, Faculty of medicine (Damietta), Al-Azhar University, Egypt Total 330 people (175 females and 155 males), with or without symptoms, who attended a Health Care Center were studied. Of these, 191 people lived in an urban area (UA) (57.4%) and 139 in a rural area (RA) (42.6%); 239 were under 12 years old, and 134 lived in the UA. Each individual was surveyed for personal, environmental and socio-cultural data. Personal information - age, sex, and place of residence - was collected, as was socio-cultural and environmental information, garbage disposal (open pit, burning, burying or city garbage collection), water supply (running water, home pump, community pump), tap (inside/outside, public), body waste disposal (sewage, well with a chamber, cesspool, or latrine), overcrowding (presence or absence, presence was defined as more than three people sleeping to a room), and house flooding (never, sometimes, frequent). In addition, subjects were asked about the presence or absence of the following symptoms/signs: anal it ching, abdominal pain, sleeping disorders, diarrhea, vomiting, appetite loss, weakness, and weight lost.

2.4. Parasitic analysis

A serial parasitological analysis was performed, consisting of stool sampling from a daily spontaneous bowel movement, sample were stored in a jar containing 5% formaldehyde. To detect *Giardia* spp. and *cryptosporidium*, the samples were processed and subjected to direct wet smear method and Sheather's sugar flotation and acid-ether sedimentation techniques (Sheather 1923). Processed pellets were stained with lugol and modified Ziehl-Neelsen acid fast stain and observed under a microscope according to (Henriksen et al. 1981 and Casemore et al. 1985).

2.5. Statistical analysis

Significant associations were determined using the chi square test and Fisher's test. 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

Sex, age, and place of residence in the analyzed population are shown in Table 1. In the studied population, 3 % (10/330) of subjects were infected with *Cryptosporidium* spp. only, 22.7% (75/330) with *Giardia* spp. only and 4.5% (15/330) were infected with both protozoa. Regarding *Cryptosporidium* spp. infection, 5.6% (9/158) of males were infected and 1.7% (3/172) of females, similarly for *Giardia* spp., 26.5% (42/158) of males

were infected and 22% (38/172) of females, and 3.1% (5/158) and 2.9% (5/172) were infected with both protozoa. These apparent differences between the sexes were not significant.

Table 1. age, Sex and place of residence of the 330 people studied in North Delta, Damietta.

Areas	Sex	Under 12 year No (%)	Over 12 year No (%)
Urban	Male Female Total	78(23.6) 61(18.5) 139(42.1)	19(5.7) 33(10) 52(15.7)
Rural	Male Female Total	45(13.6.1) 55(16.6) 100(30.3)	16(4.8) 23(6.9) 39(11.8)

The prevalence of *Cryptosporidium* spp. was 3.1% (6/191) in the UA and 4.0% (8/139) in the RA. *Giardia* spp. prevalence was similar in both areas, i.e., 23.5% (45/191) in the UA and 21.5% (30/139) in the RA. Of the 10 people parasitized by both protozoa, 5 (2.6%) lived in the UA and 5 (3.5%) in the RA. Distributions according age, sex, and place of residence are shown in Table 2. Analysis of the age distributions of both parasites in the populations revealed that the frequency of *Cryptosporidium* spp. infection was highest among those aged 2 to 7 years, peaking at 4 years of age. On the other hand, *Giardia* spp. less age dependent and was found to be present in subjects up to 70 years old, peaking between the ages 4 and 12. When the data of both parasite infections were evaluated, ean age for *Cryptosporidium* spp. infection was 7 years and for *Giardia* spp. infection 24 to 35 years.

Table 2. Frequencies of *Cryptosporidium* spp. And *Giardia* spp. infections in the Damietta population, with respect to sex, place of residence and age.

Parasites	Males				Females			
	Under 12 year		Over 12 year		Under 12 year		Over 12 year	
	RA %	UA %	RA %	UA %	RA %	UA %	RA %	UA %
***Cryptosporidium* spp**	3(6.6)	6(7.6)	0(0.0)	0(0.0)	3(5.4)	0(0.0)	0(0.0)	0(0.0)
***Giardia* spp**	11(24.4)	22(28.2)	5(31.2)	4(21)	10(18.1)	16(26.2)	4(17.3)	8(24.2)
Cryptosporidium*+*Giardia	0(0.0)	3(3.8)	1(6.2)	1(5.2)	2(3.6)	0(0.0)	1(4.3)	0(0.0)

Association between clinical manifestation of *Cryptosporidium* and *Giardia lamblia* infection with socio-cultural and environmental data of the study population. When these variables and the presence/absence of symptoms/signs were correlated with parasite frequency are shown in Table 3.

Table 3. Socio-cultural and environmental variables of the 330 study subjects.

Occupation No. (%)		Education No. (%)		Socioeconomic No. (%)		Housing Waste disposal No. (%)		Water supply No. (%)		Clinical symptoms No. (%)	
House wife	95 (28.7)	Illiterate	120 (36.7)	Low	145 (43.9)	Modern building	135 (40.9)	Piped	60 (18.1)	Asympto-matic	198 (60)
Farmer	75 (22.7)	Primary school	95 (22.7)	Moderate	130 (39.3)	Primitive building	195 (59)	River Nile	105 (31.8)	Diarrhea	36 (10. 9)
Manual worker	75 (22.7)	Preparatory school	65 (19.6)	High	55 (16.6)	Overcrowd	235 (71.2)	Shallow wells	92 (27.8)	Weight loss	15 (4.5)
Students	55 (16.6)	Secondary school	35 (10.6)			Sewage disposal	155 (46.9)	Deep wells	70 (21.2)	Abd.Pain	57 (17.2)
Educated (High)	30 (9.0)	Above second	15 (4.5)			Well with chamber disposal	175 (53)	Mineral bottle	13 (3.9)	Nausea & Vomiting	24 (7.2)

4. Discussion

Intestinal parasites are very common in developing countries and *Cryptosporidium* and *Giardia* have been revealed as one of the most common parasites causing acute diarrhea with non-specific signs such as dehydration, fever, anorexia, weakness, and progressive loss of weight may be accompanied. Diarrhea is usually self-limiting in immunocompetent humans; however, it can be life-threatening in children and immunocompromised humans (Atwill and Kemp 1998; Abaza et al. 1995). In Egypt, human cryptosporidiosis been reported by (Abaza et al. 1995; Noureldin et al. 1999; El Mansoury et al. and Mahmoud 2006; El Shazly et al. 2007), but the present study is one of the first to associate the prevalence of *Giardia* spp. and *Cryptosporidium with* socio-cultural and environmental conditions, and estimate the risk of infection by these parasites of a North Delta of Egypt. The overall frequency of *Giardia* spp. infection found in the present study was higher than those reported for similar studies in Italy (3.5%) (Giacometti et al. 2000); but it is lower than those reported in Venezuela (21%) (Miller et al. 2003), Chennai (16%) (Fernández 2002), Pakistan (23.78%) (Siddiqui et al. 2002), and in Brazil (27.4%)(Newman et al. 2001).

Similar results were obtained in studies carried out in Thailand (5.3%) (Waikagul et al. 2002), and Spain (5.05%)(Perez Armengol et al. 1997).Other studies carried out in Argentina have reported higher rates of these parasitizes. Thus, (Gamboa et al. 2003) reported 34% for a shantytown, (Guignard et al. 2000) reported 23% in a population living in temporary homes, while (Borda et al. 1996) reported 29% in shantytown. A compared with previous studies ,our prevalence rates for both parasites are notably lower, this may be due to the rural nature of our study population, and socio-economic, cultural, and demographic (fewer inhabitants per square km) differences, which would be expected reduce infection pressure. Regarding sex, these protozoa were markedly more prevalent among males in the UA group, with an outstanding higher frequency in fewer than 12-year olds. This is probably because the direct transmission of these parasites is related to higher population densities in the urban area, and because of the different hygiene habits of males and females in the same setting, which is reflected by the relatively low/high prevalence observed in the infant population. The category less than 12 years old was a risk factor for this infection. These results agreeded with the development of acquired immunity to both parasites consequent to repeated infections in childhood

(Noureldin et al. 1999; Almeida et al. 2006). Of the socio-cultural and environmental variables studied, frequent flooding, dirt floor inside the home, cardboard/tin homes, and body waste disposal by latrine were associated with the prevalence of these parasites. The refore, the presence of these conditions could be used to estimate the risk of infection by these parasites (El Mansoury et al. 2004; Mahmoud 2006; Gamboa et al. 2003). These data reinforce the existing strong relation between deficient sanitary conditions and intestinal parasitism, Several authors reported a correlation between diarrhea, abdominal pain, flatulence, itching, vomiting, or appetite loss, and the presence of both protozoan infections (Chauret et al. 1997; Miller et al. 2008). We conclude that the low population density of the area studied substantially creates a lower infection pressure, and explains the lower infection prevalence's of the present study. The risk factors for acquiring *Cryptosporidium* and *Giardia* spp in Damietta are apparently similar and this is reflected in their age-prevalence profiles. Alternately, age-related acquisition of immunity to infection or loss of infection may be different for the parasites and this may contribute to the observed patterns that most infections with the parasites were in children, and clinical diagnosis was not an accurate indicator of infection. Factors such as malnutrition as seen in some rural areas may be important in determining the epidemiology of the infections in North Delta. The prevalence of *Giardia*. spp. infections increased with age and this may be reflective of the increasing exposure as children attend schools and day-care facilities. Feeding or infection from untreated water may be more important for transmission of *Cryptosporidium* spp in young children.

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