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Intestinal Parasitic Diarrhea among Children in Baghdad – Iraq

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Abstract. Parasitic diarrhea among children is a significant health problem worldwide. This cross sectional study described the burden of parasitic diarrhea among children. The objectives of this study were to evaluate the impact of risk factors on the parasitic diarrhea, and to determine the parasitic profile among children in Baghdad-Iraq, during the period extending from September 2003 to June 2004. A total number of 2033 cases were included in the study. The estimated prevalence rate of parasitic diarrhea was 22%. We identified the following major diarrhea determinants were large households size, residential location, water source, low socioeconomic status, and low parent education. *Giardia lamblia* was found to be the most prevalent parasite with an infection rate of 45.54% followed by *Entamoeba histolytica* 23.44%, *Enterobius vermicularis* 12.7%, *Hymenolepis nana* 9.82%, *Trichuris trichiura* 5.4%, and *Ascaris lumbricoides* 2.2%. In conclusion, this study demonstrates that poor sanitation, inadequate environmental conditions, and low socioeconomic status are the main determining factors that predispose children to parasitic diarrhea. Mass deworming programs are recommended for school children, as this population is easily accessible.

INTRODUCTION

Parasitic diarrhea (PD) remains one of the leading causes of morbidity and mortality globally, despite ongoing progress in basic understanding of its epidemiology, pathogenesis, and treatment. Over 3.4 million people worldwide die every year due to PD diseases associated with inadequate sanitation and clean water (Conant, 2005). In developing areas, where access to safe drinking water and sewage disposal are often limited or even absent, infectious diarrhea is a major cause of childhood mortality. Infectious PD are transmitted to humans through various means, usually involving water, and can be fatal if left untreated or after multiple reoccurrences. Furthermore, while diarrheal diseases are prevalent in all ages, they are often the most severe and deadly among children due to their small body size, and rapid ability to become dehydrated (Peterson, 2008). Many of the risk factors for contracting diarrheal illnesses are associated with poor socioeconomic conditions, such as lacking access to safe water and sanitation, poor hygiene practices and unsafe human waste disposal (Graf *et al.*, 2008). Low socio-economic status can limit access to health care and education, affect diet, housing conditions and other factors that increase likeliness of exposure to infectious organisms or reduce resistance to infectious diseases. Numerous pathogens can cause PD.

However, their reported frequency may vary depending on the geographic location of the study or the population samples. In addition to viral and bacterial infections that cause diarrheal symptoms, there are numerous parasites present in water sources that often result in diarrhea. Protozoan pathogens originating from animal and human waste have been recorded from water sources throughout the world. More than 325 outbreaks associated with waterborne transmission of protozoan parasitic agents have been reported (Karanis *et al.*, 2007). A number of well documented waterborne protozoa exist, including *Giardia intestinalis*, *Cryptosporidium spp*, *Toxoplasma gondii*, and *Entamoeba histolytica*. There are other potential candidates, including *Cyclospora*, where feco-oral transmission has also been demonstrated (Cotruvo, 2004). Zoonotic helminth infections, including those caused by *Ascaris lumbricoides* and *Trichuris trichuria*, accounted for millions of human cases worldwide. There are also emerging helminthic parasites, some of which may occasionally be transmitted by water from an animal reservoir host. In most parasites, only one host is required for completion of the life cycle, and there is usually strong host specificity (Cotruvo *et al.*, 2006). Increasingly, multiple host susceptibility is being recognized, enhancing the likelihood of zoonotic transmission. In some helminthic parasites, the human host may be only one of several satisfactory hosts. Humans may become only incidentally involved, while animals act as the reservoir for the parasite (Cotruvo *et al.*, 2006). Evidence suggests that *Fasciola hepatica* may have significant transmission through drinking-water in some geographic regions (Cotruvo, 2004). Research interest in the contamination of drinking water by enteric pathogenic protozoa has increased considerably during the past three decades and a number of protozoan parasitic infections of humans are transmitted by the waterborne route (Lallo, 2012). Although the causes of infection are not always known or measureable, the methods of diarrheal disease transmission are largely known and therefore can be prevented through education and proper appropriate technologies. We undertook the present study to provide epidemiological data, describe the association between PD and the socio-demographic characters, and identify the most prevalent parasitic causes. Therefore, the objectives of this study were to evaluate the impact of risk factors on the parasitic diarrhea, and to determine the parasitic profile among children.

MATERIALS AND METHODS

Cross-sectional study was conducted in Baghdad from September 2003 to June 2004. The Research and Ethical Committee in Ministry of Heath-Iraq and at AL-Nahrain University approved the protocols of this study. Informed consent was obtained from all mothers or accompanied person. Three paediatric hospitals were chosen; Al-Kadhimiah Teaching Hospital, AL- Manseur Paediatric Teaching Hospital and Central Pediatric Teaching Hospital. These hospitals were chosen in order to cover Baghdad city, both socially and demographically. Random sample of 2033 children aged 15 years or less with diarrhea were included. Child's mother or accompanied person guardian was interviewed using a well constructed questionnaire that includes socio-demographic information such as (age, sex, residency, parent's education and income). In addition, the information regarding animals contact and source of domestic water were also included. Diarrheal cases among children were confirmed by paediatrician. Following careful clinical examination, fresh stool sample was obtained from each participant using a sterile container, which includes a few drops of 10% formalin to aid preservation. Stool samples were transferred in sealed containers to the Microbiology and Parasitology Laboratory, Nahrain University, Faculty of Medicine. Each stool sample was divided into four portions; one portion used for direct wet mount to detect motile protozoan trophozoites, second portion used for concentration method which enhanced recovery of protozoan cysts or helminths

eggs, while third portion used for detection of *Cryptosporidium* spp by modified Ziehl-Neelsen acid-fast staining (Henriksen & Pohlenz, 1981), and the last portion was used for isolation of nematode larvae by Baermann technique. Intestinal diarrhea caused by bacteria and viruses were confirmed by stool culture and serology methods, and were used only for comparison with cases of PD. Non parasitic diarrhea include all cases of diarrhea due to non parasitic causes. Data was analyzed using SPSS 16.0 (SPSS Inc., Chicago, IL, USA). Chi-square test was used to evaluate the statistical significance between cases and different risk factors. P-value of <0.05 was considered as statistically significant. Low educational status was defined as 10 years or less of basic schooling (Ethelberg *et al.*, 2006).

RESULTS

Intestinal parasitic infection was detected in 448 out of 2033 children after exclusion of other causes of diarrhea including bacteria and viruses, therefore the prevelence of PD was 22%. Male showed higher rate of PD (22.37%) than female (21.56%), however this variation was not significant ($P = 0.66$). No significant association ($P = 0.23$) between PD prevalence and age of the child. The highest rate (23.85%) was detected among age goup of 6-10 years old. Interestingly, prevalence of PD was significantly ($P = 0.02$) increasing steadily (15.35%, 22.07% and 24.52%) with increased family number (3-5, 6-10 and ≥11over) respectively of indexed child. Significantly higher prevalence of PD ($P = 0.005139$) was detected among children residing in rural areas (24.56%) compared to those residing in urban areas (19.42%). Family using tap water as household water source showed that the prevalence of PD was significantly higher (24.0%) than that of the counter group (19.48%) ($P = 0.014$). Children of low income family showed significantly higher (23.56%) prevalence of PD than those of the middle and high income families (19.93% and 25.79% respectively) ($P = 0.0153$). This study showed that childhood PD was significantly more common among children with low parent educational level ($P < 0.0001$). No significant association between PD and contact with animals was detected (Table 1).

Microscopical examination revealed that the most common causes of childhood parasitic diarrhea were *Giardia lamblia* 204 (45.54%), followed by *Entamoeba histolytica* 105 (23.44%), and *Enterobius vermicularis* 57 (12.7%) (Table 2). The non-pathogenic protozoan *Entamoeba coli* was detected in 8.5% of the samples but was omitted from the statistical analysis.

DISCUSSION

Intestinal PD constitute a major health problem in many developing countries, predominantly due to poor sanitation and inadequate personal hygiene. In our study, the prevalence of childhood PD was 22%. Although there is a possibility of seasonal variation, the prevalence of PD was consistent within the average reported rate (19.3% - 40%) in other developing countries such as Iran, Lebanon, Malaysia, and Saudi Arabia (Abdel-Hafez *et al.*, 1986; Norhayati *et al.*, 2003; Hamze *et al.*, 2004; Sayyari *et al.*, 2005). Interestingly, the results of this study showed that the prevalence is much less than those reported in previous studies (40.45% to 53.2% in other provinces of Iraq) (Al-Moussawi, 2004; Mahdi and Ali, 2004; Bushra Al-Naemy *et al.*, 2012). This wide variation among studies could be attributed to the time and period of the study, the age of the study population, variations in habits, different sampling techniques and research methodologies, geographical differences and the inclusion of nonpathogenic intestinal parasites in the analysis.

In agreement with other studies (Sayyari *et al.*, 2005; Genser *et al.*, 2006; Dib *et al.*, 2008), there was no significant association between parasite infection rates with either sex or the age of children. This result most probably showed that the disease is related to enviromental exposure. Our study found that parasitic infections increased significantly with increased family size,

Table 1: Characteristics profile of parasitic diarrhea among children in Baghdad

Child Characteristics	Parasitic diarrhea n=448		Non Parasitic diarrhea n=1585		Total n=2033		x^2	*P* value	OR	95% CI
	No.	(%)	No.	(%)	No.	(%)				
Gender										
Males	266	(22.37)	923	(77.63)	1189	(58.5)	0.187	0.66	0.95	0.945–1.18
Female	182	(21.56)	662	(78.4)	844	(41.5)				
Age (years)										
0-5	36	(20.57)	139	(79.4)	175	(8.6)		0.235		
6-10	207	(23.85)	661	(76.2)	868	(42.7)	2.895			
11-15	205	(20. 70)	785	(79.3)	990	(48.7)				
Household size										
3-5	33	(15.35)	182	(84.7)	215	(10.6)		0.0219		
6-10	275	(22.07)	972	(78)	1247	(61.3)	7.644			
11-over	140	(24.52)	431	(75.5)	571	(28.1)				
Residence									1.351	
Urban	194	(19.42)	805	(80.6)	999	(49.1)	7.83	0.0051		1.09–1.669
Rural	254	(24.56)	780	(75.4)	1034	(50.9)				
Water Source										
Tape water	276	(24.0)	874	(76)	1150	(56.56)	5.942	0.014	0.766	0.618–0.949
Mineral water	172	(19.48)	711	(80.5)	883	(43.44)				
Family income										
High	49	(23.56)	159	(76.4)	208	(10.23)				
Middle	244	(19.93)	980	(80.1)	1224	(60.20)	8.357	0.0153		
Low	155	(25.79)	446	(74.2)	601	(29.56)				
Parent education										
Low level	255	(27.69)	666	(72.3)	921	(45.3)	31.297	<0.0001	0.548	0.44–0.678
High level	193	(17.36)	919	(82.6)	1112	(54.7)				
Contact with animals										
Yes	121	(20.83)	460	(79.2)	581	(28.57)	0.694	0.404	1.105	0.9–1.37
No	327	(22.52)	1125	(77.5)	1452	(71.43)				

Table 2. Common parasitic infection of childhood diarrhea in Baghdad

Type of parasite	No. of cases	(%)
Giardia lamblia	204	45.54
Entamoeba histolytica	105	23.44
Enterobius vermicularis	57	12.7
Hymenolepis nana	44	9.82
Trichuris trichiura	24	5.4
Ascaris lumbricoides	10	2.2
Taenia saginata	2	0.45
Ancylostoma duodenale	2	0.45
Total	448	100

which was similar to previous study (Al-Mekhlafi *et al.*, 2011). This finding supported the notion that infection of any household member might result in the infection of all members of that household (Becker & Dietz, 1995). Other explanation as reported by Bercu *et al.* (2007), suggested that there may be a role of genetic disposition to infection. Geographic location, place of residence in particular has been shown to be another form of disparity, however our findings are consistent with several other studies (Shahatta & Al-Debesh, 2007; Aremu *et al.*,

2011) that PD are more common in rural. People in rural areas living under unsanitary socio environmental conditions were predisposed to parasitic infections, due to the lack of sanitary water supply and the usage of contaminated river water. This is partly due to their lack of formal education as a result of low economical status. In addition, the impact of embargo and the last war in Iraq had resulted in the shortage of health services as well as spoilage of infrastructures, including the safe water supply (Valenciano *et al.*, 2003). This might explain the finding that household water supply other than bottled water was significantly associated with increases in parasitic infection in our study, which is in agreement with Glenn (2005).

In concurrence with several studies (Ethelberg *et al.*, 2006; Genser *et al.*, 2006), we found poor socioeconomic status to be highly associated with PD. The best explanation for this result was that the poor socioeconomic group was those lacking in formal education and knowledge on hygiene, hence the close relationship between hygiene and literacy. Moreover Aremu *et al.* (2011) stated that living in low socio economic deprived condition has been well documented to be associated with less likelihood of seeking medical care. Families with the low educational attainment tend to be with low income, poorest housing, crowded, and worst sanitary facilities. These confounding variables will also promote the transmission of enteric pathogens.

Several literatures showed that parasitic diarrheal rates are highest in householders with the lowest levels of educational attainment (Glenn, 2005; Genser *et al.*, 2006). Interestingly, Aremu *et al.* (2001) found that in almost 2/3 of child diarrhea, their care giver does not possess any formal education. In accordance with studies in Iraq and other countries worldwide (Al-Moussawi, 2004; Bushra Al-Naemy *et al.*, 2012; Shobha *et al.*, 2013), we detected that infection rate with protozoa especially *Giardia lamblia* / *Entamoeba histolytica* was higher compared to helminth infections as their cysts can be transmitted through contaminated food and water, hand to mouth contamination. Moreover protozoan cysts such as *G. lamblia* and *E. histolytica* are highly resistant to chlorine disinfection and their small size (range 1–17 µm) enables them to penetrate water treatment systems and cause waterborne disease even following the consumption of treated drinking-water. In addition, *G. lamblia* has been transmitted most of the time through contaminated water due to lack of appropriate modern toilets within houses and absence of proper drinking sources. The disease is usually spread as a result of fecal-oral contamination and swimming in unhygienic water. Also in the summer season, there is increase in the fly and cockroaches population. This may contribute to increase in giardiasis incidence, which we found in our results (Graczyk *et al.*, 2005).

The non-pathogenic protozoa particularly *E. coli*, *Iodoamoeba bütschlii*, *Trichomonas hominis* were exclduded from the study. Detection of these protozoa in stool sample would suggest ingestion of contaminated water or food and may indicate possible exposure to pathogenic organisms (Yilmaz *et al.*, 1999).

In this study, *Enterobius vermicularis* was the commonest helminthic infection (12.7%) due to the habit of thumb-sucking among children, which is also a probable transmission of this worm within families. Due to its contagious nature, enterobiasis tends to occur more among large families and institutions such as schools. Most infections remain asymptomatic or cause only mild disturbances such as pruritus ani, insomnia, and nocturnal enuresis. However, serious morbidity such as appendicitis, eosinophilic enterocolitis and pelvic inflammatory disease have also been reported as consequences of enterobiasis. (Gunawardena *et al.*, 2013).

The infections with *Hymenolepis nana* was 9.8%. This worm is a rodent parasite, and the life cycle involves various beetles as intermediate hosts, and human can be infected by direct ingestion of infective eggs containing oncospheres or by accidental ingestion of infected beetles (Javier *et al.*, 2011). Lower hygienic status and preventive measures might have a role in endemicity. This study showed low prevalence of

Trichuris trichiura infection (5.4%), suggesting that the eggs of this worm need certain environmental condition such as warm and wet soil and partial darkness.

Low incidence of *Ascaris lumbricoides* was noted (2.2%). This finding was in accordance with studies in other parts of Iraq (Al-Moussawi, 2004; Al-Joudi & Ghazal, 2005; Raza & Sami, 2009). The infection with *Ascaris lumbricoides* is very common in the world. It increases in regions with poor sanitation, particularly where human faeces is used as fertilizer and where children defaecate directly on the ground which are common habits in Iraqi community (Zeibig, 1997).

In conclusion, childhood PD remains an important health concern. Poor socio-economic status was found to be highly associated with diarrhea incidence. Moreover, as our data showed, water source can also act as an effect modifier for some risk factors. The results of this work showed low helminths frequency compared to that for protozoa; the most prevalent pathogenic parasite was *G. lamblia*. We strongly believe that the data collected from this study will form a baseline for future evaluation of measures at reducing the faecal-oral transmission of intestinal parasites by periodic surveillance and treatment of parasites in children. Prevention through continuous health education is one of the solutions to these problems by increasing awareness about food and water contamination proper hygiene within nursing homes and preschool kindergarten students. Also, access to clean drinking water is a crucial concern for the government.

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