Research Journal of Parasitology

ISSN 1816-4943

Academic Journals Inc.

www.academicjournals.com

Research Journal of Parasitology 10 (1): 31-41, 2015
ISSN 1816-4943 / DOI: 10.3923/jp.2015.31.41

Assessment the Prevalence of Intestinal Parasites and Associated Risk Factors among Preschool Children in Riyadh, Saudi Arabia

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ABSTRACT

Intestinal parasite infections are major public health problems of children. The study aimed to assess the prevalence of intestinal parasites and associated risk factors among preschool children in Riyadh city. Samples were obtained from 255 preschool children (157 girls and 98 boys), a single stool sample was collected and examined microscopically for the presence of intestinal parasites using a formalin-ether sedimentation technique. The overall prevalence of parasites was 45 (17.7%), the most of them had diarrhea 40 (15.7%) was a significant difference, ($p<0.05$). The prevalence rate of infection in boys and girls were (20.4%, 15.9%), respectively. In all preschool children, the highest infection rate was (23.3%) among the age group ranged between 3-5 years. The study detected about seven types of intestinal parasites among preschool children, the most common parasites were *Giardia lamblia* (37.8%). In this study the relationships were observed between intestinal parasitic infection and some of socio-demographic factors. Concerning the parents educational level was highly significant difference ($p<0.001$). Working mothers, presence of house maid, attending day care centers and poor hygienic measures and moderate socioeconomic standards were played role as predisposing factors for transmission of infection. The prevalence of infection with intestinal parasites between two different area in Riyadh was no significant. The study indicated that parasitic infections are important public health problems. Thus, infection control measures and the development of awareness strategies to improve sanitation and health education should be considered.

Key words: Intestinal parasites, preschool children, risk factor, riyadh

INTRODUCTION

Parasitic infections specially intestinal parasites which caused by helminths and protozoa are a major cause of inveterate infection in humans worldwide with appraise show that fully one quarter of the world's population is infected (WHO., 1999). Intestinal parasites appear an important public health problem, particularly in developing countries where the climates is suitable for spread the intestinal parasites (Arani *et al*., 2008). The most countries of the tropical region which has more than 80% of all deaths annually are because of infectious and parasitic disease accounting for over 3 million deaths. Protozoan and helminthic intestinal infections were estimated to 3.5 billion people world wild, mostly children, present clinical symptoms (Keiser and Utzinger, 2010; Brooker *et al*., 2009).

Parasitic infection or infestation can occur in children of all ages. Infants, toddlers and very young children in day care settings are at risk for the parasitic disease called giardiasis that causes diarrhea and it spread through contaminated feces (CDC., 2014).

Incidence of parasitic disease is generally associated with an unhygienic environment, importation of infection from other countries and unsanitary habits of the people. Furthermore, most intestinal parasites have been associated with ill health particularly in children in some countries. Even though the overall advancement in sanitation, overall number of people with special indication to children infected with parasites worldwide is thought to be growing (Curtis *et al*., 2000; Azazy and Raja'a, 2003; Nissapatorn *et al*., 2005).

According to WHO (2010), Soil-Transmitted Helminths are the second leading cause of mortality in children of age less than six years who live in Africa. Around 1.45 billion persons in the world were infected with Soil-Transmitted Helminths (STHs) in addition, 5.19 million indicate associated morbidity in 2010 (Pullan *et al*., 2014; Hotez *et al*., 2014). The disease burden due to schistosomiasis was estimated 3.31 million during 2010. Out of 1.45 billion infections because of STHs, 438.9 were infected with hookworm, 819.0 million with *A. lumbricoides* and 464.6 million with *T. trichiura* (Pullan *et al*., 2014).

In the recent years, worldwide some countries demonstrated high incidence rates of intestinal parasites infection among children, the percentage were 38.7 in Oman (Patel and Khandekar, 2006), 19.8% in Nepal (Mukhiya *et al*., 2012), 84% in Colombia (Salcedo-Cifuentes *et al*., 2012), 27.5% in Brazil (Nobre *et al*., 2013), 18.4-28.8% in Iran (Nematian *et al*., 2004; Masoumeh *et al*., 2012), 89.6% in Argentina (Gamboa *et al*., 2014), 93% in Nicaragua (Munoz-Antoli *et al*., 2014) and 32.3% in Malaysia (Sinniah *et al*., 2014).

In Kingdom of Saudi Arabia there are various reports have been published indicates the presence of a prevalence rate on parasitic diseases in children, as reported by Bolbol *et al*. (1989) who found in his study that prevalence was 20.8% in Riyadh. Moreover in the study at Al-Baha region, the percentage were 21.1% (Al-Eissa *et al*., 1995) and the percentage was 33.8% in Jeddah (Al-Braiken, 2008).

As reported by Ramakrishnan *et al*. (2007) who found that intestinal parasites are frequently transmitted by low level of environmental and personal hygiene, contamination of food and drinking water and poor sanitary conditions in developing countries. Proper investigation of the parasitic etiology of diarrhea leading to prompt and effective management can help in decreasing the morbidity and mortality in such patients.

Intestinal parasitic infections are globally endemic and have been described as constituting the greatest single worldwide cause of illness and disease among preschool children. Parasitic infections are linked to poor health, contributing to economic instability and social marginalization.

This study aimed to assess the prevalence of intestinal parasites and associated risk factors among preschool children and identify the associated risk factors of intestinal parasitic infections among preschool children.

MATERIALS AND METHODS

Design: A quasi experimental design was used to conduct the study.

Setting: The study was conducted in two central areas (North and South) Riyadh city, Kingdom of Saudi Arabia.

Sample: A total of 255 under-five preschool children (157 girls and 98 boys) were participated in the study. The sample were collected from several health centers in Riyadh city Kingdom of Saudi Arabia. During the period from May 2013 to September 2013.

Tools of data collection

A pre-designed questionnaire: It designed by the researcher to elicit data on socio-demographic and risk environmental factors that leads to the infection.

A single stool sample: Data was collected from each child in labeled sterile plastic containers and transported to the laboratory. A stool specimen of each preschool child was examined microscopically for the presence of the type of intestinal parasites.

Specimens were fixed and tested with 10% formalin for 30 min (2-3 g fecal-1) and then concentrated by a formalin-ether sedimentation technique. Samples were examined as wet saline mounts and in iodine preparation for detection of protozoan oocysts, cysts, helminthic eggs and larvae (Chessbrough, 1998). Permanent stained smears were performed for intestinal coccidian parasites by the modified Ziehl-Neelsen technique according to Garcia *et al.* (1983) and modified trichrome stain according to Ryan *et al.* (1993).

Ethical clearance: The ethical considerations were addressed by treating positive individuals using standard drugs under the supervision of a doctor and nurse working at the centres. The objective of the study was explained to children parents and oral consent was sought from parents or guardians of the selected children during stool sample collection.

Statistical analysis: Chi-Square test was used to compare the difference in the prevalence of intestinal parasites among children presenting with diarrhea. Attention to children age and sex differences and risk factors were considered significant if p was less than 0.05 (Greenwood and Nikulin, 1996).

RESULTS

Of 255 examined stool samples of preschool children 45 (17.7%) revealed presences about seven types of intestinal parasites.

Table 1 illustrates that the majority of the positive samples were children their age ranged from 3-5 years (23.3%). There was no significant difference in the prevalence of parasites between boys and girls, although the number of positive girls is higher than the number yielded positive parasites in boys. Concerning the parents' educational level, it was found that the majority (61.1%) of them graduated from primary school were highly significant ($p<0.001$). On the other hand the table showed that (20.8%) working mothers were a significant difference ($p<0.01$). Furthermore, it was clear that the majority (22.3%) had house maid and (42.1%) of the mothers were poor with significant ($p<0.01$).

Table 2 clarified that prevalence of intestinal parasites among girls more than boys. It was found that *Giardia lamblia* and *Blastocystis hominis* percentage (6.12%) was more common among preschool boys but *Giardia lamblia* (7.01%) was the most common among preschool girls and there was no statistical significant difference between the both sex in all Overall type of infection.

As shown in Table 3 the overall infection was ($p<0.05$) significant difference in association between the presence of intestinal parasites species and diarrhea among the preschool children. On the other hand, it was observed that *Giardia lamblia* was the most common cause of diarrhea ($p<0.05$).

Table 1: Socio-demographic distribution of preschool children

		Positive		Negative		
Factors	N = 255	No. 45	17.7%	No. 210	82.3%	Statistical analysis
Age						
0-1	32	3	9.4	29	90.6	$\chi^2 = 3.87$ p>0.05
1-2	77	12	15.6	65	84.4	
2-3	56	9	16.1	47	83.9	
3-5	90	21	23.3	69	76.7	
Sex						
Boys	98	20	20.4	78	79.6	$\chi^2 = 0.83$ p>0.05
Girls	157	25	15.9	132	84.1	
Parents educational level						
Illiterate	2	1	50.0	1	50.0	$\chi^2 = 43.6$ *p<0.001
Read and write	22	9	40.9	13	59.1	
Primary	18	11	61.1	7	38.9	
Intermediate	39	9	23.1	30	76.9	
Secondary	70	6	8.6	64	91.4	
University	100	8	8.0	92	92.0	
Others	4	1	25.0	3	75.0	
Occupation						
House wife	72	7	9.7	65	90.3	$\chi^2 = 4.34$ *p<0.01
Working	183	38	20.8	145	79.2	
Presence of house maid						
Yes	188	42	22.3	146	77.7	$\chi^2 = 10.8$ *p<0.01
No	67	3	4.5	64	95.5	
Attending day care centers						
Yes	162	33	20.4	129	79.6	$\chi^2 = 2.28$ p>0.05
No	93	12	12.9	81	87.1	
Socioeconomic standard						
Rich	37	2	5.4	35	94.6	$\chi^2 = 11.36$ *p<0.01
Moderate	199	35	17.6	164	82.4	
Poor	19	8	42.1	11	57.9	

*Significant difference

Table 2: Prevalence of intestinal parasites among preschool children between boys and girls

	Sex						
	Boys n = 98		Girls n = 157		Total n = 255		
Parasite species	No.	%	No.	%	No.	%	Statistical analysis
Protozoa	18	18.40	25	15.90	43	19.90	-
Giardia lamblia	6	6.12	11	7.01	17	37.80	$\chi^2 = 0.07$ p>0.05
Entamoeba histolytica	5	5.10	6	3.80	11	24.40	$\chi^2 = 0.25$ p>0.05
Blastocystis hominis	6	6.12	3	1.90	9	20.00	$\chi^2 = 3.1$ p>0.05
Cryptosporidium parvum	1	1.02	3	1.90	4	8.90	$\chi^2 = 0.28$ p>0.05
Cyclospora cayetanensis	0	0.00	2	1.30	2	4.40	$\chi^2 = 1.34$ p>0.05
Helminths	2	2.04	0	0.00	2	2.04	-
Ascaris lumbricoides	1	1.02	0	0.00	1	2.20	$\chi^2 = 1.51$ p>0.05
Hymenolepis nana	1	1.02	0	0.00	1	2.20	$\chi^2 = 1.51$ p>0.05
Overall infection	20	20.40	25	15.90	45	17.70	$\chi^2 = 0.83$ p>0.05

Table 3: Association between the presence of intestinal parasites and diarrhea among the preschool children

	Diarrhea n = 193		Non diarrheic n = 62		Total n = 255		
Parasite species	No.	%	No.	%	No.	%	Statistical analysis
Protozoa	40	20.7	3	4.80	43	19.90	$\chi^2 = 8.55$ *p<0.01
Giardia lamblia	17	100.0	0	0.00	17	37.80	$\chi^2 = 5.78$ *p<0.05
Entamoeba histolytica	10	90.9	1	9.10	11	24.40	$\chi^2 = 1.49$ p>0.05
Blastocystis hominis	7	77.8	2	22.20	9	20.00	$\chi^2 = 0.03$ p>0.05
Cryptosporidium parvum	4	100.0	0	0.00	4	8.90	$\chi^2 = 1.36$ p>0.05
Cyclospora cayetanensis	2	100.0	0	0.00	2	4.40	$\chi^2 = 0.67$ p>0. 05
Helminths	0	0.0	2	2.04	2	2.04	-
Ascaris lumbricoides	0	0.0	1	100.00	1	2.20	$\chi^2 = 1.01$ p>0.05
Hymenolepis nana	0	0.0	1	100.00	1	2.20	$\chi^2 = 1.01$ p>0.05
Overall infection	40	15.7	5	2.00	45	17.70	$\chi^2 = 5.12$ *p<0.05

*Significant difference

Table 4: Prevalence of intestinal parasites among preschool children in two different area in Riyadh

	Area						
	South n = 168		North n = 87		Total n = 255		
Parasite species	No.	%	No.	%	No.	%	Statistical analysis
Protozoa	30	17.8	13	14.9	43	16.90	-
Giardia lamblia	11	6.5	6	6.9	17	37.80	$\chi^2 = 0.1$ p>0.05
Entamoeba histolytica	8	4.8	3	3.4	11	24.40	$\chi^2 = 0.27$ p>0.05
Blastocystis hominis	6	3.6	3	3.4	9	20.00	$\chi^2 = 0.005$ p>0.05
Cryptosporidium parvum	3	1.8	1	1.2	4	8.90	$\chi^2 = 0.17$ p>0.05
Cyclospora cayetanensis	2	1.2	0	0.0	2	4.40	$\chi^2 = 1.09$ p>0.05
Helminths	2	1.2	0	0.0	2	0.78	-
Ascaris lumbricoides	1	0.6	0	0.0	1	2.20	$\chi^2 = 0.43$ p>0.05
Hymenolepis nana	1	0.6	0	0.0	1	2.20	$\chi^2 = 0.43$ p>0.05
Overall infection	32	19.1	13	14.9	45	17.70	$\chi^2 = 0.5$ p>0.05

Table 4 shed light on the difference between the two regions (South and North) of Riyadh in relation to the prevalence of infection, it is clear that the percentage of infection species were more common in South Riyadh (19.1%) but there was no statistical significant difference between South and North region. However, the infection by *Giardia lamblia* was common in both regions.

DISCUSSION

In the present study, the prevalence of intestinal parasites among preschoolers was 17.7%. They had at least one parasite in their stools which is lower than that reported in children under five years age by Mbae *et al.* (2013) in Kenya (25.6%) and by Canete *et al.* (2012) in Cuba, the prevalence rate in his study was (71.1%). The present study as a recent prevalence was in agreement with some previous report from Saudi Arabia in Riyadh (20.8%) (Bolbol *et al.*, 1989) and in Al-Baha (21.1%) (Al-Eissa *et al.*, 1995). However, it is lower than that found in Jeddah (33.8%) (Al-Braiken, 2008) but it is higher than that recorded in Eastern province (9.3%) by Qadri *et al.* (1995). Also, it is in agreement with previous studies in other countries, in Iran (18.4%) (Nematian *et al.*, 2004) and in Nepal (19.8%) (Mukhiya *et al.*, 2012). On the opposite side, it is

lower than that reported in Oman (38.7%) (Patel and Khandekar, 2006), in Iran (28.8%) (Masoumeh *et al*., 2012), in Brazil (27.5%) (Nobre *et al*., 2013), in Ethiopia (24.3%) (Yirgalem *et al*., 2014) and in Malaysia (24.6%) (Sinniah *et al*., 2014). However, it is more lower than that found in Yamoussoukro (47.4%) (Koffi *et al*., 2014), Morocco (51%) (El Fatni *et al*., 2014), Colombia (84%) (Salcedo-Cifuentes *et al*., 2012), Argentina (89.6%) (Gamboa *et al*., 2014) and Nicaragua (93%) (Munoz-Antoli *et al*., 2014). Furthermore, giving an overall prevalence of diarrhea as shown Table 3 in 40 of the sufferers (15.7%) is significant ($p<0.05$), this in agreement with (Yilmaz *et al*., 2008; Dogan *et al*., 2012; Hegazi *et al*., 2013; Koffi *et al*., 2014). On the other hand, this result incompatible with Bolbol *et al*. (1989) who said that diarrhea is not a major sign of parasitic infestation in 0.6-6 years old.

As shown in Table 3 the most common intestinal parasites identified among preschool children were *Giardia lamblia* 17 (37.8%), *Entamoeba histolytica* 11 (24.4%), *Blastocystis hominis* 9 (20%), *Cryptosporidium parvum* 4 (8.9%), *Cyclospora cayetanensis* 2 (4.4%), *Ascaris lumbricoides* 1 (2.2%) and *Hymenolepis nana* 1 (2.2%). The most of these parasites were recorded in children in other studies in Saudi Arabia (Al-Eissa *et al*., 1995; Qadri *et al*., 1995; Bolbol *et al*., 1989; Al-Braiken, 2008). In addition, it was reported in several studies around the world in children (Sayyari *et al*., 2005; Sharif *et al*., 2010; Mukhiya *et al*., 2012; Vahedi *et al*., 2012; Manganelli *et al*., 2012) specially in children under five years age (Canete *et al*., 2012; Mbae *et al*., 2013).

In this study, *Giardia lamblia* was the most common parasites detected in preschool children (37.8%) this result is in agreement with the study which was reported by Alkhalife (2006) in Riyadh, Zakai (2004) in Jeddah and Al-Eissa *et al*. (1995) in Al-Baha. In the Middle East, several studies were carried out to determine the prevalence of *G. lamblia* infection, indicating it to be a most common protozoan in children (Sharif *et al*., 2010; Ashtiani *et al*., 2011; Vahedi *et al*., 2012; Canete *et al*., 2012; Masoumeh *et al*., 2012). However, the prevalence rate detected in this study was higher than that previously reported for this parasite in Jeddah by Al-Braiken (2008). Moreover, there is a significant association between infection and diarrhea ($p<0.05$) (Al-Tukhi *et al*., 1993).

The second common parasite in this study was *Entamoeba histolytica* (24.4%) between infected children which in agreement with the findings of Al-Eissa *et al*. (1995) in Al-Baha, Al-Braiken (2008) in Jeddah, Patel and Khandekar (2006) in Oman. On the other hand, it was lower than that found in Taif, western Saudi Arabia (48%) (Al-Malki, 2014) and Yamoussoukro (22.55%) (Koffi *et al*., 2014).

The most common parasites found is *Giardia lamblia* and the next most common is *Entamoeba histolytica* which is similar that reported by Qadri *et al*. (1995) and Al-Eissa *et al*. (1995) in eastern province and Al-Baha, respectively.

In addition, *Blastocystis hominis* was also common infections in the study which found in (20%) but less than *G. lamblia* and *E. histolytica*. Some studies were carried out to determine the prevalence of *B. hominis* infection with percentage close to that recorded in this study (Al-Braiken, 2008; Sharif *et al*., 2010; Manganelli *et al*., 2012; Dogan *et al*., 2012).

The prevalence of *Cryptosporidium parvum* was (8.9%), this was in accordance with several studies (Yilmaz *et al*., 2008; Dogan *et al*., 2012; Vahedi *et al*., 2012). However, the prevalence of the infection is lower than that observed in a study of the same area which reported a prevalence of *Cryptosporidium* infection among immunosuppressed children less than 2 years (69.7%) (Sanad and Al-Malki, 2007) and in children in Jeddah, symptomatic (32%) and asymptomatic (4.7%) (Al-Braiken *et al*., 2003).

Infection with *Cyclospora cayetanensis* was (4.4%) which is similar that recorded by El Fatni *et al.* (2014) but it is slightly lower than that recorded in the previous studies from the same area (Al-Megrin, 2009, 2010) and in Jeddah (Al-Braiken *et al.*, 2003).

On the other hand, Infection with *Ascaris lumbricoides* and *Hymenolepis nana* which found in the lowest prevalence-one case for each, this was in contract with other studies which found it with low rate (Patel and Khandekar, 2006; Al-Braiken, 2008; Al-Megrin, 2010; Sharif *et al.*, 2010). However, it was found in a higher prevalence in Nicaragua (Munoz-Antoli *et al.*, 2014) and in Malaysia (Sinniah *et al.*, 2014).

Parasitic infection was related to protozoa in (95.6%) and intestinal worms in (4.4%) which in completely deal with Ashtiani *et al.* (2011) who found parasitic infection in Iran was (95.33 and 4.87%) by protozoa and helminths respectively and infection with protozoa parasitic is highly significant with diarrhea ($p<0.01$). On the other hand, it was in disagreement with Gelaw *et al.* (2013) who reported infection (13.2%, 26.9%) with protozoa and helminths, respectively.

Regarding the prevalence of intestinal parasites among preschool children and the association between the presence of parasites with diarrhea, Table 3 showed that there was a highly significant difference between the presence of intestinal parasites species and diarrhea among the preschool children especially *G. lamblia* ($p<0.01$).

As shown in Table 2 the prevalence of infection with intestinal parasites among boys and girls preschool children were 20.4 and 15.9%, respectively indicating that both genders are equally susceptible to infection ($p>0.05$). This result in agreement with many studies founded as in Thiland, the prevalence was (18.5%, 16.1%) (Wongstitwilairoong *et al.*, 2007), in Italy (17.1%, 12.7%) (Manganelli *et al.*, 2012), in Kenya (51.6%, 48.4%) (Mbae *et al.*, 2013), in Wonji, Ethiopia (25.1%, 23.5%) (Yirgalem *et al.*, 2014) and in Morocco (63.5%, 60.4%) (El Fatni *et al.*, 2014) in boys and girls respectively. However, it was in disagreement with the study that founded in Nepal where the prevalence was (16.9%, 22%) (Mukhiya *et al.*, 2012) in Brazil (26.1%, 30.3%) (Nobre *et al.*, 2013), in northwest and southern Ethiopia (32.1%, 35.9%) (Gelaw *et al.*, 2013), (80.6%, 81.4%) (Abossie and Sied, 2014) in boys and girls respectively. However, it was founded that no significant ($p>0.05$) concerning association between sexes and species of intestinal parasites.

This study report that the group of age between 3-5 years had the highest proportion of intestinal parasites infection (23.3%) as compared with the other age groups in cases ($p>0.05$) which was in agreement with Yirgalem *et al.* (2014) who recorded the highest infection between 3 and 4 years. On the other side, it was in difference with (Wongstitwilairoong *et al.*, 2007) who found that the highest infection was between children age ranged from 2 and 3 years.

In this study relationships were observed between intestinal parasitic infection and some of socio-demographic factors. Concerning the parents educational level, it is found that the majority parents who have low level of education had risk of their children to acquire the intestinal parasitic infection than other household heads who had higher education level with high statistically significant difference ($p<0.001$). This is in agreement with Abossie and Sied (2014). Moreover, it was found that the majority of infected children with intestinal parasites who had working mothers (20.8%) with statistically significant difference ($p<0.01$), it is in approvement with (Nobre *et al.*, 2013) and (22.3%) of them had house maid with statistically significant difference ($p<0.01$). In Saudi Arabia economic growth speedy and increasing in rate of women who are working out home which lead to importation of housekeepers, with a potential also for importation of disease. However, importation of these workers may also increase the importation of the intestinal parasites commonly found in their countries. Female housekeepers arriving in Saudi Arabia emanated

mainly from tropical countries such as Indonesia, Sri Lanka, Bangladesh, Philippines, India and some of these workers have infection with various types of parasites and other diseases indigenous to their home countries. The spread of infection with one or more parasites in Asian female housekeepers was 46.5% of in Abha region (Al-Madani and Mahfouz, 1995). The community should be interested in safety of these workers which the nature of their work required being in close contact with family members specially children. In addition, it noted that the infection with intestinal parasites is common in preschool children attending day care centers but statistically no significant difference ($p>0.05$) (Lander *et al*., 2012; Pedraza *et al*., 2014). Regarding socioeconomic standards, of those who had intestinal parasites (42.1%) had poor family than other who had good and high income ($p<0.01$), the low per capita income family was strongly associated with an increased risk for an infection (Nobre *et al*., 2013).

As shown in Table 4 the prevalence of infection with intestinal parasites between two different area in Riyadh was show a high rate of infection especially in south of Riyadh where the infection was (19.1%) as compared with north of Riyadh (14.9%) with no significant association between infection rate and the area. It could be due to, people living close to animals. This result indicate that the educated and the economic level is an effective factor on infection with intestinal parasites (Masoumeh *et al*., 2012).

CONCLUSION

The high prevalence of intestinal parasitic infections among the preschool children indicated that parasitic infections are important public health problems. Thus, infection control measures and the development of awareness strategies to improve sanitation and health education should be considered.

ACKNOWLEDGMENTS

We would like to thank the nurses who helped in the collection of samples and information, specially pediatric nurses. Also, we thank all health care centers and the parents that participated in this study for their cooperation.

REFERENCES

Abossie, A. and M. Seid, 2014. Assessment of the prevalence of intestinal parasitosis and associated risk factors among primary school children in Chencha town, Southern Ethiopia. BMC Public Health, Vol. 14. 10.1186/1471-2458-14-166

Al-Braiken, F.A., 2008. Is intestinal parasitic infection still a public health concern among Saudi children? Saudi Med. J., 29: 1630-1635.

Al-Braiken, F.A., A. Amin, N.J. Beeching, M. Hommel and C.A. Hart, 2003. Detection of *Cryptosporidium* amongst diarrhoeic and asymptomatic children in Jeddah, Saudi Arabia. Ann. Trop. Med. Parasitol., 97: 505-510.

Al-Eissa, Y.A., S.A. Assuhaimi, A.M. Abdullah, A.M. AboBakr, M.A. Al-Husain, M.N. Al-Nasser and M.K. Al Borno, 1995. Prevalence of intestinal parasites in Saudi children: A community-based study. J. Trop. Pediatr., 41: 47-49.

Al-Madani, A.A. and A.A. Mahfouz, 1995. Prevalence of intestinal parasitic infections among Asian female house keepers in Abha District, Saudi Arabia. S. Asian J. Trop. Med. Public Health, 26: 135-137.

Al-Malki, J.A., 2014. Factors associated with high prevalence of *Entamaeba Histolyticaldispar* Infection among Children in Jeddah, KSA. Am-Eurasian J. Agric. Environ. Sci., 14: 50-56.

Al-Megrin, W.A.I., 2009. *Cyclospora cayetanensis* infections among diarrheal patients in Riyadh, Saudi Arabia. J. Egypt. Ger. Soc. Zool., 95: 35-41.

Al-Megrin, W.A.I., 2010. Intestinal parasites infection among immunocompromised patients in Riyadh, Saudi Arabia. Pak. J. Biol. Sci., 13: 390-394.

Al-Tukhi, M.H., J.P. Ackers, M.N. Al-Ahdal, M.A. Taha and W. Peters, 1993. ELISA for detection of anti-Giardia specific IgM: Response in serum. J. Trop. Med. Hyg., 96: 333-336.

Alkhalife, I.S., 2006. Retrospective analysis of intestinal parasitic infections diagnosed at a University Hospital in Central, Saudi Arabia. Saudi Med. J., 27: 1714-1718.

Arani, A.S., R. Alaghehbandan, L. Akhlaghi, M. Shahi and A.R. Lari, 2008. Prevalence of intestinal parasites in a population in South of Tehran, Iran. Rev. Inst. Med. Trop., 50: 145-149.

Ashtiani, M.T.H., M. Monajemzadeh, B. Saghi, S. Shams and S.H. Mortazavi *et al*., 2011. Prevalence of intestinal parasites among children referred to Children's Medical Center during 18 years (1991-2008), Tehran, Iran. Ann. Trop. Med. Parasitol., 105: 507-513.

Azazy, A.A. and Y.A. Raja'a, 2003. Malaria and intestinal parasitosis among children presenting to the Paediatric Centre in Sana'a, Yemen. Eastern Mediterr. Health J., 9: 1048-1053.

Bolbol, A.S., S.D. Mostafa, M. Al-Sekait and A.A. Al-Nasser, 1989. Pattern of intestinal parasitic infection in preschool children in Riyadh, Saudi Arabia. J. Hyg. Epidemiol. Microbiol. Immunol., 33: 253-259.

Brooker, S., N.B. Kabatereine, J.L. Smith, D. Mupfasoni and M.T. Mwanje *et al*., 2009. An updated atlas of human helminth infections: The example of East Africa. Int. J. Health Geogr., Vol. 8. 10.1186/1476-072X-8-42

CDC., 2014. Centers for disease control and prevention. http://www.cdc.gov/parasites/children.html.

Canete, R., M.M. Diaz, R.A. Garcia, P.M.L. Martinez and F.M. Ponce, 2012. Intestinal parasites in children from a day care centre in Matanzas City, Cuba. PLoS One, Vol. 7. 10.1371/journal.pone.0051394

Chessbrough, M., 1998. Parasitological Tests. In: District Laboratory Practice in Tropical Countries, Chessbrough, M. (Ed.). Tropical Health Technology, World Health Organization, Geneva, Switzerland, pp: 184-235.

Curtis, V., S. Cairncross and R. Yonli, 2000. Review: Domestic hygiene and diarrhea-pinpointing the problem. Trop. Med. Int. Health, 5: 22-32.

Dogan, N., Y. Oz, N.U. Kocman and A.F. Nursal, 2012. [Comparison of individual differences in the direct microscopic examination in the diagnosis of intestinal parasites]. Turkiye Parazitolojii Dergisi, 36: 211-214, (In Turkish).

El Fatni, C., F. Olmo, H. El Fatni, D. Romero and M.J. Rosales, 2014. First genotyping of *Giardia duodenalis* and prevalence of enteroparasites in children from Tetouan (Morocco). Parasite, Vol. 21. 10.1051/parasite/2014049

Gamboa, M.I., L.A. Giambelluca and G.T. Navone, 2014. Spatial distribution of intestinal parasites in the City of La Plata, Argentina. Medicina, 74: 363-370.

Garcia, L.S., D.A. Bruckner, T.C. Brewer and R.Y. Shimizu, 1983. Techniques for the recovery and identification of *Cryptosporidium* oocysts from stool specimens. J. Clin. Microbiol., 18: 185-190.

Gelaw, A., B. Anagaw, B. Nigussie, B. Silesh and A. Yirga *et al*., 2013. Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School, Northwest Ethiopia: A cross-sectional study. BMC Public Health, Vol. 13. 10.1186/1471-2458-13-304

Greenwood, P.E. and M.S. Nikulin, 1996. A Guide to Chi-Squared Testing. John Wiley and Sons, New York, ISBN-13: 9780471557791, Pages: 280.

Hegazi, M.A., T.A. Patel and B.S. El-Deek, 2013. Prevalence and characters of *Entamoeba histolytica* infection in Saudi infants and children admitted with diarrhea at 2 main hospitals at south Jeddah: A re-emerging serious infection with unusual presentation. Brazil. J. Infect. Dis., 17: 32-40.

Hotez, P.J., M. Alvarado, M.G. Basanez, I. Bolliger and R. Bourne *et al*., 2014. The global burden of disease study 2010: Interpretation and implications for the neglected tropical diseases. PLoS Neglected Trop. Dis., Vol. 8. 10.1371/journal.pntd.0002865

Keiser, J. and J. Utzinger, 2010. The drugs we have and the drugs we need against major helminth infections. Adv. Parasitol., 73: 197-230.

Koffi, M., M. N'Djeti, T. Konan and Y. Dje, 2014. Molecular characterization of intestinal protozoan parasites from children facing diarrheal disease and associated risk factors in Yamoussoukro, Cote d'Ivoire. Afr. J. Environ. Sci. Technol., 8: 178-184.

Lander, R.L., A.G. Lander, L. Houghton, S.M. Williams and H. Costa-Ribeiro *et al*., 2012. Factors influencing growth and intestinal parasitic infections in preschoolers attending philanthropic day care centers in Salvador, Northeast Region of Brazil. Cadernos Saude Publica, 28: 2177-2188.

Manganelli, L., F. Berrilli, D. Di Cave, L. Ercoli, G. Capelli, D. Otranto and A. Giangaspero, 2012. Intestinal parasite infections in immigrant children in the city of Rome, related risk factors and possible impact on nutritional status. Parasites Vectors, Vol. 5. 10.1186/1756-3305-5-265

Masoumeh, R., T. Farideh, S. Mitra and T. Heshmatollah, 2012. Intestinal parasitic infection among school children in Golestan province, Iran. Pak. J. Biol. Sci., 15: 1119-1125.

Mbae, C.K., D.J. Nokes, E. Mulinge, J. Nyambura, A. Waruru and S. Kariuki, 2013. Intestinal parasitic infections in children presenting with diarrhoea in outpatient and inpatient settings in an informal settlement of Nairobi, Kenya. BMC Infect. Dis., Vol. 13. 10.1186/1471-2334-13-243

Mukhiya, R.K., S.K. Rai, A.B. Karki and A. Prajapati, 2012. Intestinal protozoan parasitic infection among school children. J. Nepal Health Res. Council, 10: 204-207.

Munoz-Antoli, C., A. Pavon, A. Marcilla, R. Toledo and J.G. Esteban, 2014. Prevalence and risk factors related to intestinal parasites among children in Department of Rio San Juan, Nicaragua. Trans. R. Soc. Trop. Med. Hyg., 108: 774-782.

Nematian, J., E. Nematian, A. Gholamrezanezhad and A.A. Asgari, 2004. Prevalence of intestinal parasitic infections and their relation with socio-economic factors and hygienic habits in Tehran primary school students. Acta Trop., 92: 179-186.

Nissapatorn, V., Y. Lim, I. Jamaiah, L.S.H. Agnes and K. Amyliana *et al*., 2005. Parasitic infections in malaysia: Changing and challenges. Southeast Asian J. Trop. Med. Public Health, 36: 50-59.

Nobre, L.N., R.V. Silva, M.S. Macedo, R.A. Teixeira, J.A. Lamounier and S.C. Franceschini, 2013. Risk factors for intestinal parasitic infections in preschoolers in a low socio-economic area, Diamantina, Brazil. Pathog. Global Health, 107: 103-106.

Patel, P.K. and R. Khandekar, 2006. Intestinal parasitic infections among school children of the Dhahira Region of Oman. Saudi Med. J., 27: 627-632.

Pedraza, D.F., D.D. Queiroz and M.C. Sales, 2014. Infectious diseases among Brazilian preschool children attending day care centers. Ciencia Saude Coletiva, 19: 511-528.

Pullan, R.L., J.L. Smith, R. Jasrasaria and S.J. Brooker, 2014. Global numbers of infection and disease burden of soil transmitted helminth infections in 2010. Parasites Vectors, Vol. 7. 10.1186/1756-3305-7-37

Qadri, M.H., M.A. AI-Gamdi and R.A. Al-Harfi, 1995. Asymptomatic Salmonella, shigella and intestinal parasites among primary school children in the eastern province. J. Family Community Med., 2: 36-40.

Ramakrishnan, K., R. Shenbagarathai, A. Uma, K. Kavitha, R. Rajendran and P. Thirumalaikolundusubramanian, 2007. Prevalence of intestinal parasitic infestation in HIV/AIDS patients with diarrhea in Madurai city, South India. Jpn. J. Infect. Dis., 60: 209-210.

Ryan, N.J., G. Sutherland, K. Coughlan, M. Globan and J. Doultree *et al.*, 1993. A new trichrome-blue stain for detection of microsporidial species in urine, stool and nasopharyngeal specimens. J. Clin. Microbiol., 31: 3264-3269.

Salcedo-Cifuentes, M., O. Florez, A. Bermudez, L. Hernandez, C. Araujo and M.V. Bolanos, 2012. Intestinal parasitism prevalence amongst children from six indigenous communities residing in Cali, Colombia. Revista Salud Publica, 14: 156-168.

Sanad, M.M. and J.S. Al-Malki, 2007. Cryptosporidiosis among immunocompromised patients in Saudi Arabia. J. Egypt. Soc. Parasitol., 37: 765-774.

Sayyari, A.A., F. Imanzadeh, S.A.B. Yazdi, H. Karami and M. Yaghoobi, 2005. Prevalence of intestinal parasitic infections in the Islamic republic of Iran. East Mediterr. Health J., 11: 377-383.

Sharif, M., A. Daryani, F. Asgarian and M. Nasrolahei, 2010. Intestinal parasitic infections among intellectual disability children in rehabilitation centers of northern Iran. Res. Dev. Disabil., 31: 924-928.

Sinniah, B., A.K.R. Hassan, I. Sabaridah, M.M. Soe, Z. Ibrahim and O. Ali, 2014. Prevalence of intestinal parasitic infections among communities living in different habitats and its comparison with one hundred and one studies conducted over the past 42 years (1970 to 2013) in Malaysia. Trop. Biomed., 31: 190-206.

Vahedi, M., S. Gohardehi, M. Sharif and A. Daryani, 2012. Prevalence of parasites in patients with gastroenteritis at East of Mazandaran Province, Northern Iran. Trop. Biomed., 29: 568-574.

WHO., 1999. Removing obstacles to healthy development: Report on infectious disease. WHO/CDS/99.1, World Health Organization (WHO), Geneva, Switzerland, pp: 1-68.

WHO., 2010. Soil-transmitted helminthiasis. Number of children treated 2007-2008: Update on the 2010 global target. Weekly Epidemiol. Rec., 85: 141-148.

Wongstitwilairoong, B., A. Srijan, O. Serichantalergs, C.D. Fukuda, P. McDaniel, L. Bodhidatta and C.J. Mason, 2007. Intestinal parasitic infections among pre-school children in Sangkhlaburi, Thailand. Am. J. Trop. Med. Hyg., 76: 345-350.

Yilmaz, H., Z. Tas-Cengiz and M. Cicek, 2008. Investigation of cryptosporidiosis by enzyme-linked immunosorbent assay and microscopy in children with diarrhea. Saudi Med. J., 29: 526-529.

Yirgalem, G., D. Abraham and E. Berhanu, 2014. Prevalence of intestinal parasitic infections among children under five years of age with emphasis on *Schistosoma mansoni* in Wonji Shoa Sugar Estate, Ethiopia. PloS One, Vol. 9. 10.1371/journal.pone.0109793

Zakai, H.A., 2004. Intestinal parasitic infections among primary school children in Jeddah, Saudi Arabia. J. Egypt. Soc. Parasitol., 34: 783-790.