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Intestinal parasitic infections among expatriate workers in Al-Madina Al-Munawarah, Kingdom of Saudi Arabia

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Abstract. Al Madinah Al Munawarah, Kingdom of Saudi Arabia (KSA) has one of the largest number of expatriate workers. Most of them are from Sri-Lanka, Indonesia, Philippines, India and Bangladesh. These countries are considered as endemic areas for intestinal parasites. A total of 2732 stool samples were screened for intestinal parasites. Positive cases were recorded among 407 stool samples (14.9%). The common parasitic infections were encountered among 20-29 age groups (18.5%) while, the lowest infection rate was among individual ≥ 50 years (11.8%). According to the nationality, the highest infections were recorded among Pakistanis (23.2%), followed by Philippines (22.2%), Sudanese workers (18.7%), and the lowest infection rates were recorded among Bangladeshi individuals. The infected persons were farmers, food handlers and shepherds. The detected intestinal parasites were *Giardia lamblia* (21.9%), *Entamoeba histolytica/Entamoeba coli* (17.8%), *Trichuris trichiur*a (16.2%), *Ascaris lumbricoides* (15.8%), hookworm (13%), *Hymenolepis nana* (8.9%), *Strongyloides sterocoralis (*3.5%), *Schistosoma mansoni* (2.2%), and *Enterobius vermicularis* (0.43%). In conclusion, the high prevalence of parasites among expatriates may produce health problem among the Saudi society due to the nature of the expatriates' work.

INTRODUCTION

Infections with intestinal parasites are the most prevalent in tropical and subtropical regions of the developing world where adequate water and sanitation facilities are lacking (Savioli *et al.*, 2004). The prevalence and spread of these parasites have been found to be related to the educational, environmental, sanitary and socioeconomic conditions of the people (Celiksoz *et al*., 2005).

In Kingdom of Saudi Arabi, it is required by the Saudi Health authorities that the expatriate workers should be infection-free and physically fit to avoid disease transmission, as most of the workers are employed as housemaids, food-handlers, private cookers and babysitters. The country of origin of expatriate labour, are from Sri Lanka, Indonesia, Philippines, India and Bangladesh. These regions are considered as endemic areas where intestinal parasites are causing a major health problem among populations living in these countries (Al-Madani & Mahfouz, 1995; Easton, 1999; Abahussain, 2005).

Many surveys have been carried out in various regions of KSA including Abha district (Al-Madani & Mahfouz, 1995), Riyadh (Kalantan, 2001), AL-Khobar (Abahussain, 2005), Mekkah (Wakid *et al*., 2009) and Al-Baha (Mohammad & Koshak, 2011). However, all these studies were carried out in regions that differ in their environmental conditions and the demographic characteristics of the populations living there.

Al Madinah Al Munawarrah is considered as the second holiest city in Islam after Mecca. It is located at the Eastern Part of Al Hijaz Region in the Kingdom of Saudi Arabia. Its land is fertile volcanic hill that inclines

towards the north direction. The area has a hot, continental climate with low humidity throughout the year. The city is very densely inhabited, and most of them are expatriate workers.

The aim of this study is to determine the prevalence of intestinal parasitic infections among expatriate workers and the impact of these workers as risk factors among the residents in KSA.

MATERIALS AND METHODS

Study area and population

In Kingdom of Saudi Arabia, it is required by the Saudi Health authorities that the expatriate workers should be infection-free and physically fit to avoid disease transmission, as most of the workers are housemaids, food-handlers, private cooks and babysitters. The countries of origin of the expatriate labourers are largely from Sri Lanka, Indonesia, Philippines, India and Bangladesh. These regions are considered as endemic areas where intestinal parasites cause major health problems among populations living in these countries (Al-Madani & Mahfouz, 1995; Easton, 1999).

Demographic characteristics of the studied populations

The study subjects composed of 2732 people of whom 1399 were males and 1333 were females giving a ratio of nearly 1:1. The age distribution of the screened individuals showed that 18.5% were aged 20-29 years and 13.3% were 30-39 years while 12% were 40-49 years and 11.8% were > 50 years old. Regarding their occupation, 20.6% of the workers were farmers followed by 18.75% food handlers, 17.81% shepherds, 13.35% drivers, 13.26% housemaids and 15.15% working in other occupations.

Sampling and Stool examination

The stool samples were collected from expatriate workers who attended the medical center for overall checkup required to obtain license for working in KSA. Each individual was provided with a plastic container marked with an identification number and the name of the subject. Each subject gave one stool sample. The collection of samples was performed throughout the period between February and June 2011.

Stool samples were examined using direct smear (normal saline) and formalin-ether concentration method (Fecal Concentrator Kit). They were examined after staining with Lugol's iodine (1%) to investigate the presence of protozoa and helminth eggs and larval stages. Heidenhain's Iron Hematoxylin permanent stain was used to confirm the presence of *Giardia lamblia* and *Entamoeba histolytica*.

Statistical Analysis

The data were statistically analyzed using SPSS software statistic program version 17.0 (Chi-square test).

RESULTS

As shown in Table 1, out of the 2732 examined stool samples, 407 (14.9%) were positive for infection. Single infection was reported in 357 (87.7%) samples, while double infections was encountered in 11% of the infected samples and four had triple infections (0.98%) and one sample having quadruple infections (0.24%). The recorded parasites in double, triple and quadruple infections are listed in Table 1.

Table 2 illustrates the prevalence of intestinal parasites according to gender, age and type of residence. It was found that infection rate in males was higher (16.4%) than females (13.4%) with a significant difference (P value < 0.05). The rate of infection was slightly affected by gender (Eta square value = 0.057). The highest percentage of infections was observed among age groups of 20-29 years (18.5%) with a significant difference (P value < 0.05) the infection rate was moderately affected by age (Eta square value = 0.060). According to type of license of residence, (new or renewed), the infection rate was higher (17.5%) among individuals renewing their license than individuals of new licenses (13.9%) with a significant difference (P value < 0.05) and (Eta square value = 0.055).

Table 1. Pattern and prevalence of intestinal parasitic infection among the studied samples

Types of parasite	No	Total No	%
Single Infection		357	87.7
Double Infection		45	11
Hookworm + *E. histolytica*	1		
Hookworm + *G. lamblia*	7		
Hookworm + *A.lumbricoides*	5		
Hookworm + *T. trichiura*	4		
T. trichiura + *A. lumbricoides*	15		
T. trichiura + *E. histolytica*	2		
A. lumbricoides + *E. histolytica*	1		
H. nana + *G. lamblia*	1		
A. lumbricoides + *G.lamblia*	3		
E. histolytica + *G. lamblia*	2		
G. lamblia + *S. sterocoralis*	2		
G. lamblia + *S. mansoni*	1		
G. lamblia + *H. nana*	1		
Triple infection		4	0.98
T. trichiura + *A. lumbricoides*+ *H. nana*	1		
G. lamblia + *T. trichiura*+ *H. nana*	2		
E. histolytica + *G .lamblia* + *Hookworm*	1		
Quadruple infection		1	0.24
S. sterocoralis + *G. lamblia* + *H. nana* + *E. vermicularis*			
Total No. of infected cases		407	14.9
Total samples		2732	

Table 2. Prevalence of intestinal parasitic infection among the studied samples according to gender, age and type of residence

Characteristic	No examined	+ve cases (%)	Chi square value	df	P value
Gender					
Males	1399	229 (16.4)	8.767	1	0.003
Females	1333	178 (13.4)			
Age (years)					
20–29	973	180 (18.5)	12.56	3	0.006
30–39	1199	160 (13.3)			
40–49	382	46 (12.)			
Type of residence					
New	1961	272 (13.9)	10.43	2	0.005
Renewed	771	135 (17.5)			

Table 3 exhibits that protozoan parasites were more prevalent than helminth parasites where *G. lamblia and E. histolytica/E. coli* were 22%, and 17.8% repectively, whereas, *Trichuris trichiura Ascaris lumbricoides*, hookworm, and *Hymenolepis nana* recorded 16.2%, 15.8%, 13% and 9% respectively. On the other hand, the most common parasite encountered among age group 20-29 years was *G. lamblia* (25.8%), while *T. trichiura*

Table 3. Distribution of intestinal parasitic infections among expatriates working in Al Madinah Al Munawarah according to age groups

Types of parasites	Age Groups								Total	%
	(20–29)		(30–39)		(40–49)		(50<x)			
	No.	%	No.	%	No.	%	No.	%		
E. histolytica/E. coli	31	14.6	28	15.8	14	26.9	8	38	81	17.8
G. lamblia	55	25.8	28	15.8	12	23	5	23.8	100	22
Hookworm	28	13	25	14.1	7	13.5	–	–	75	13
T. trichiura	32	15	35	19.8	6	11.5	2	9.5	51	16.2
E. vermicularis	2	0.93	–	–	–	–	–	–	2	0.43
A. lumbricoides	31	14.6	35	19.8	6	11.5	1	4.8	73	15.8
S. sterocoralis	6	0.46	5	2.8	2	3.8	3	14.3	16	3.5
H. nana	19	8.9	17	9.6	4	7.7	1	4.8	41	9
S. mansoni	5	2.3	3	1.7	1	1.92	1	4.8	10	2.2
Other	4	1.9	1	0.56	–	–	–	–	5	1.6

Table 4. Distribution of intestinal parasitic infections among expatriates working in Al Madina Al Munawarah according to gender and type of residence

Parasites	Males*		Females		New**		Renewal	
	No	%	No	%	No	%	No	%
E. histolytica/coli	53	21.5	28	13.0	48	14.95	33	23.2
G. lamblia	68	27.5	32	14.8	78	24.3	22	15.5
Hookworms	26	10.5	34	15.74	45	14.0	15	10.6
T. trichiura	13	5.3	62	28.7	52	15.57	23	16.2
E. vermicularis	2	0.8	–	–	2	0.62	–	–
A. Llumbricoides	24	9.7	26	22.7	56	17.4	17	2.2
S . sterocoralis	13	5.3	3	1.4	8	2.5	8	1
H. nana	35	14.7	6	2.7	24	7.5	17	2.2
S. mansoni	9	3.6	1	0.46	5	1.6	5	0.64
Others	4	1.6	1	0.46	3	0.93	2	0.25

*Chi square = 98.39, df =12, P value = 0.001

and *A. lumbricoides* (19.8%) were most common among age group 30-39 years and *E. histolytica/Entamoeba coli* was highly recorded (26.9%) among age group 40-49 years, and age group >50 years (38%) without significant difference (P value >0.05).

According to gender, it was evident that the most common intestinal parasites among females were helminthes: *Trichuris trichiura* (28.7%) followed by *A. lumbricoides* (22.7%), hookworms (15.7%), while the most common among males were protozoan parasites: *Giardia lamblia* (27.5%), followed by *E. histolytica/E. coli* (21.5%) with a significant difference (P value < 0.05) (Table 4). Moreover, the distribution of intestinal parasites among new and renewal cases showed that the most common intestinal parasites among new infections was *G. lamblia* (24.3%) followed by *A. lumbricodes* (17.4%), while the most common among renewal infections was *E. histolytica/E. coli* (23.2%) followed by *T. trichiura* (16.2%) and without significant variation (P value > 0.05).

As a result of stool examination in relation to nationalities (Fig. 1). It was revealed that

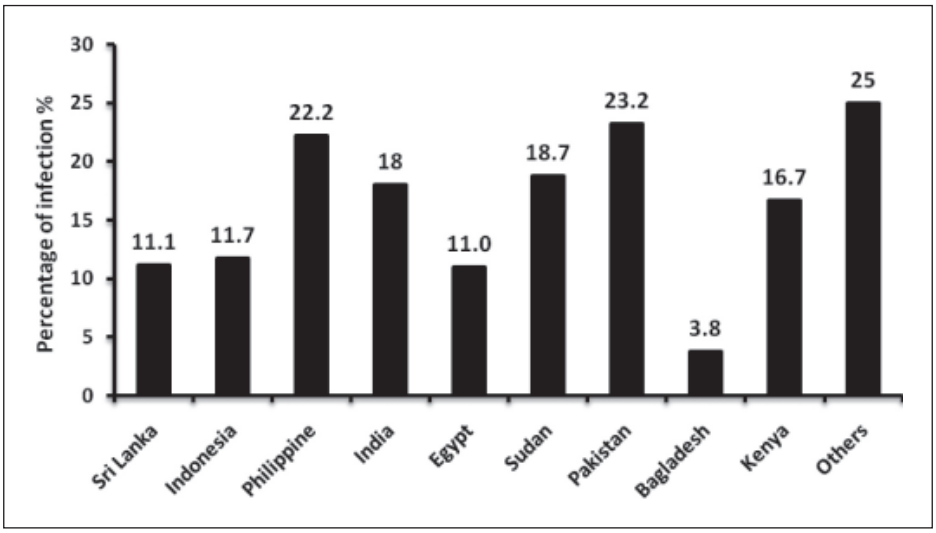

Figure 1. Prevalence of intestinal parasitic infections among expatriate workers according to country

the highest infection rate was recorded among Pakistani workers (23.2%), followed by Philippine individuals (22.2%), and Sudan workers (18.7%), while the lowest infection rates were recorded in Bangladesh individuals (3.8%) with a significant variation (P value < 0.05). The rate of infection is moderately affected by nationality (Eta square value = 0.090). In Table 5, the distribution of helminth parasites among the various expatriate populations showed that *T. trichiura* infection was common among the people from South East Asia like Philippines (38.5%), Sri Lanka (33.3%) and Indonesia (31.8%). On the other hand, African populations from Egypt and Sudan were commonly infected with *G. lamblia* (34.6% and 15.7% respectively) and *E. histolytica/ E. coli* (23.07% and 37.1% respectively) with a significant difference (P value < 0.05). It should be mentioned that no helminth infection was encountered among people from Bangladesh.

As illustrated in Fig. 2, the prevalence of intestinal parasites in screened samples with respect to the occupation of each individual. The highest infection rate was among farmers (20.6%) followed by food handlers (18.8%), shepherds (17.8%), drivers (13.4%) and housemaids (13.3%). There was a significant variation in prevalence according to occupations. The rate of infections was slightly affected by occupation (Eta square value = 0.042). *Trichuris trichiura* was the most common intestinal parasites recorded in housemaids (28.8%), while *G. lamblia* was the most common among drivers (30.3%) and farmers (24.2%), *E. histolytica/E. coli* was the most common intestinal parasites among shepherds (41.2%) and food handlers (66.6%) with a significant difference (P value < 0.05) as recorded in Table 6.

It is unusual to find *Schistosoma haematobium* infections, but in the current study four cases were encountered. Also one *Hymenolepis diminuta* positive case was recorded.

DISCUSSION

In the present study, the rate of infection of intestinal parasites was 14.9% in Al-Madinah expatriates. This is consistent with a previous study of Ali *et al.* (1992) among food handlers in Al Madinah where the percentage was 14%. On the other hand this percentage was lower than that reported in other Saudi cities, such as Al-Khobar (31.4%) as investigated by Abahussain (2005) where the most infected individuals were of Sri Lankan origin (44.8%).

Table 5. Distribution of intestinal parasitic infections among expatriates working in Al Madina Al Munawarah according to nationality

Types of parasites	Countries									
	Sri Lanka		Indonesia		Philippine		India		Egypt	
	No.	%	No.	%	No.	%	No.	%	No.	%
E. histolytica/E. coli	1	33.3	21	12.1	1	7.7	14	16.3	6	23
G. lamblia	–		18	10.4	1	7.7	27	31.4	9	34.6
Hookworm	1	33.3	31	17.9	1	7.7	8	9.3	1	3.8
T. trichiura	1	33.3	55	31.8	5	38.5	5	5.8	–	–
E. vermicularis	–		–		–		2	2. 3	–	–
A. lumbricoides	–		40	23.1	4	30.8	14	16.3	2	7.7
S. sterocoralis	–		5	2.9	1	7.1	7	8.1	–	–
H. nana	–		3	1.7	–		9	2.1	4	15.4
S. mansoni	–		–		–		–		3	11.5
Others	–		–		–		–		1	3.8
TOTAL	3		173		13		86		26	

Types of parasites	Countries									
	Sudan		Pakistan		Bangladesh		Kenya		Others	
	No.	%	No.	%	No.	%	No.	%	No.	%
E. histolytica/E. coli	26		5	12.2	–	–	–	–	7	15.9
G. lamblia	11		14	34.1	1	100	1	25	18	40.9
Hookworm	1		11	26.8	–	–	1	25	5	11.4
T. trichiura	3		2	4.9	–	–	–	–	2	4.5
E. vermicularis	–		–	–	–	–	–	–	–	–
A. lumbricoides	2		2	4.9	–	–	2	50	7	15.9
S. sterocoralis	2		–	–	–	–	–	–	1	2.3
H. nana	16		6	14.6	–	–	–	–	3	6.8
S. mansoni	6		–	–	–	–	–	–	1	2.3
Others	3		1	2.4	–	–	–	–	–	–
TOTAL	70		41		1		4		44	

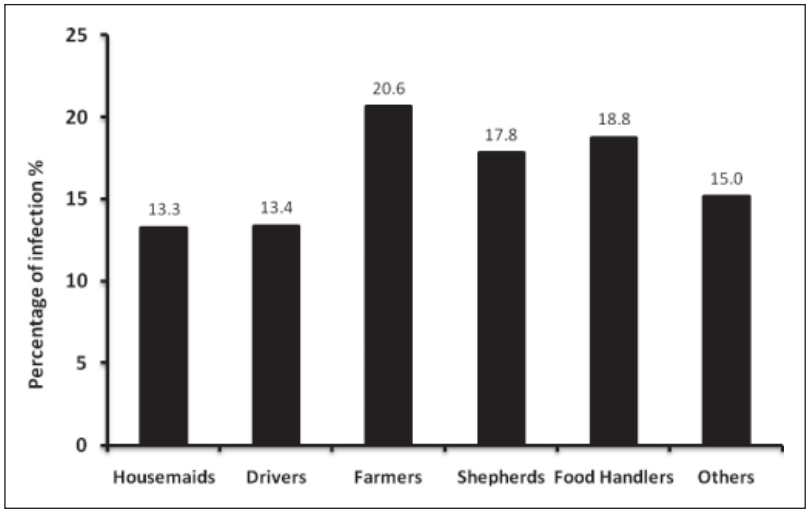

Figure 2. Prevalence of intestinal parasitic infections among expatriate workers according to their occupations

Table 6. Distribution of intestinal parasitic infections among expatriates working in Al Madina Al Munawarah according to jobs

Types of parasites	Job											
	House maids		Drivers		Farmers		Shepherds		Food handlers		Others	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
E. histolytica/E. coli	23	11.05	16	18	15	16.5	21	41.2	2	66.6	4	19
G. lamblia	32	15.4	37	30.3	22	24.2	8	15.7	1	33.3	10	47.6
Hookworm	34	16.3	12	13.5	13	14.28	1	1.96	–	–	–	–
T. trichiura	60	28.5	4	4.5	5	5.49	4	7.84	–	–	2	9.5
E. vermicularis	–	–	1	1.1	1	1.09	–	–	–	–	–	–
A. lumbricoides	47	22.6	13	14.6	12	13.18	–	–	–	–	1	4.8
S. sterocoralis	4	1.9	9	19.1	3	3.29	–	–	–	–	–	–
H. nana	6	2.9	5	5.6	15	16.5	12	23.5	–	–	3	14.3
S. mansoni	1	0.5	2	2.2	2	2.2	4	7.8	–	–	1	4.8
Others	1	0.5	–	–	3	3.3	1	1.96	–	–	–	–
TOTAL	208		89		91		51		3		21	

The difference from our study is attributed to the fact that, Al Madinah is a holy city and those who live there are only Muslims, while most of Sri Lankan workers coming to other Saudi cities are non Muslims. In Abha, the examined persons are all Asian female house keepers and the percentage of infection was 46.5% (Al-Harthi & Jamjoom, 2007). However, in Makkah, the prevalence of intestinal infections among food handlers was recorded as 31.94% (Wakid *et al.*, 2009) and in Riyadh, it was 33.3% (Al-Shammari *et al.*, 2001). There are many reasons for the highest rate of infections in Makkah. First, the stool samples were collected from patients complaining of enteritis, second the holy city is always full of visitors (crowding effect) as reported by Al-Harthi & Jamjoom (2007) and finally, the category of examined persons was food handlers working in hospitals (Wakid *et al.*, 2009; Zaglool *et al.*, 2011). In general, the pattern of parasitic infection in Saudis tends to differ from that in expatriates (Al-Shammari *et al.*, 2001; Alkhalife, 2006). The presence of multiple infections (12.3%) highlights the need for more investigation for cases that show one type of infection.

The highest recorded infections were found in G. *lamblia* (21.9%) followed by *E. histolytica/E. coli* (17.8%), *T. trichiura* (16.2%), *A. lumbricoides* (15.8%) and hookworm (12.95%). Other intestinal parasites such as *H. nana* (8.9%), *Strongyloides stercoralis* (3.5%), *Schistosoma mansoni* (2.2%) and *Enterobius vermicularis* (0.43%) were found at low rates. In Al-Khobar, Saudi Arabia, Abahussain (2005) reported that more prevalence of parasite infections were found among Indians (55.5%) followed by Indonesians (46.4%), Philippines (43%) then Sri Lankans (37.8%). The author also reported that *A. lumbricoides* was common among Indonesians. *Trichuris trichiura* and *E. histolytica* were the most common among Philippines and hookworm among Sri Lankan workers.

Comparing our results with Makki & Arafa (2010) in their study in Dammam, it was found that the total prevalence is higher than that recorded in our results (55.3%), while in parasites distribution the most prevalent was *E. histolytica* (50.5%) followed by *G. lamblia* (38.8%), *E. vermicularis* (12.1%), *E. coli* (12.1%), *T. trichiura* (11.1%), *H. nana* (11.1%), *S. haematobium* (10.1%), *A. lumbricoides* (9.09%), and *S. mansoni* (7.07%).

Similar to previous reports in other provinces in the region, two studies, in Riyadh (Dash *et al.*, 2010) and Makkah (Zaglool *et al.*, 2011) revealed that *G. lamblia* was the most prevalent infection encountered in the examined populations. Hill (2001) exhibited that transmission of *Giardia* by

food has occurred in multiple setting, including corporate offices, commercial food establishments and within small gatherings. These have typically been associated with an infected food handler, rather than environmental contamination of the food item.

The second most prevalent parasite recorded in the present work and also in other studies was *E. histolytica*. The current epidemiology of amebiasis is somewhat confusing because of the recently appreciated distinction between *E. histolytica* and *Entamoeba dispar* are hard to distinguish from each other as they are morphologically similar. Surveys that determine prevalence of infection by examining stool for parasites measure predominantly *E. dispar*, as this species is more common, while serologic surveys reflect the incidence of *E. histolytica* infection, as *E. dispar* infection does not result in a positive serologic test (Singh *et al.*, 2001).

It was found in the current study a decrease in infection rates of intestinal schistosomiasis, especially in workers coming from Egypt and this proves the success of controlling the epidemic of this disease and its spread. *Schistosoma haematobium* was surprisingly encountered in four cases. This finding may be attributed to stool contamination with urine during defecation.

The low percentage of pinworm infection encountered in the present work may be attributed to the fact that this parasite mainly infects children. The present study did not use scotch tape method for pinworm detection (Neva & Brown, 1994).

The high prevalence of infections among Pakistani workers (23.23%) in the present study was in agreement with Wadood *et al.* (2005) and Younas *et al.* (2008) that reported from the home country that the most common intestinal parasites were *G. lamblia* (34.14%), followed by hookworm (26.82%).

The overall rate of intestinal parasites in the current work among Philippines' workers was low (22.2%) as compared with other reports. For example, in other surveys (Carney *et al.*, 1987; Cross *et al.*, 1989; Esparar *et al.*, 2004), the number of people infected was 85%, 64% and 42.4% respectively. In our finding, *T. trichiura* eggs were the most common among approximately 38.46% of the Philippine workers, followed by *A. lumbricoide*s (30.76%). These results are consistent with the studies of Carney *et al.* (1987) and Cross *et al.* (1989).

Based on the data collected from Sudanese workers, it was found that the prevalence rate of intestinal parasites among them was 18.73%. This is lower than that recorded in their home country (24.4%) (Babiker *et al.*, 2009). They recorded, *E. coli* as 15.3%, *G. lamblia* 9.7%, and *E. histolytica* 4.3%. The percentage of intestinal parasites recorded among Sudanese workers, in the present study, was 37.1% for *E. histolytica* followed by 22.9% for *H. nana* (22.85%), and 15.7% for *G. lamblia* (15.71%).

In the current study, the prevalence of intestinal parasites among Indian workers was 18%, and the most common intestinal parasite among them was *G. lamblia* (31.4%). This is less than that recorded in their home country (India) and *Isospora belli* was the most common recorded protozoal infections (Gupta *et al.*, 2008) and *A. lumbricoides* was among the most helminth parasites (Wani *et al.*, 2010).

The prevalence of intestinal parasites among Indonesian workers as revealed in the present study was 11.7% which was lower than that recorded in their home country (84.3%). *Cryptosporidium* (4.9%) was the most common intestinal parasite among Indonesians, followed by *G. lamblia* (1.9%) (Kurniawan *et al.*, 2009) while in the present study, the most common intestinal parasite was *T. trichiura* (31.8%) followed by *A. lumbricoides* (23.1%) .

The prevalence of intestinal parasites among Kenyan workers was (16.7%). It was less than the prevalence of intestinal parasites in other studies (Hall *et al.*, 1982, Chunge *et al.*, 1991).

Among housemaids, the infectivity of intestinal parasites was 13.3% and the most common intestinal parasite among them was *T. trichiura* (28.8%), followed by *A. lumbricoides* (22.6%). Similar to the infection rate reported by Abahussain (2005) in Al-Khobar (46.5%), this study was consistent

with the type of common intestinal parasites in the present study: *Trichuris trichiura* (28.8%), followed by *A. lumbricoides* (22.2%). Also results of Abu-Madi *et al.* (2008) agreed with the present study in recording, *T. trichiura* (26.3%), high infection rate (33.9%). In the current study, the most common parasite among Asian females was *T. trichiura* which is in agreement with the study by Abahussain (2005) conducted in Al-Khobar. The relationship between the work of housemaids and the spread of *T. trichiura* among them is considered as risk factor in the transmission of infection to members of Saudi society because of direct contact with them.

In the present study, the infectivity of intestinal parasites among male food handlers was 18.8% and the most common parasite among them was *E. histolytica* (66.6%). The prevalence of intestinal parasites (18.8%) was lower than that encountered by Wakid *et al.* (2009) and Zaglool *et al.* (2011) in Makkah (31.94% and 23% respectively). On the other hand, the infection rate was higher than that recorded among food handlers in Al-Madina (Ali *et al.*, 1992), Dammam (Khan & Alkhalife, 2005) and Al-Khobar (Abahussain, 2005).

It should be mentioned that the overall prevalence among expatriates who obtained the license for the first time was 13.9% which is lower than those renewing their license (17.5%). When this result is compared with data reported by Kalantan *et al.* (2001), it should be concluded that there is an absence of significant association between holding a valid pre-employment health certificates (PEHC) and the test results. As explained by Elkins (1987), Mangali *et al.* (1987) and Eggerm *et al.* (1990), the reasons for high helminth infections among expatriates workers appears to be related to socio-cultural economic, and environmental factors that influence parasite survival and transmission in their home countries.

In conclusion, the spread of intestinal parasites among expatriates may produce health problem that may exert its effect on the Saudi society living in Al madinah Al Munawarrah for both residents and visitors (Pilgrims) due to the nature of the expatriates' work (housemaids, food handlers, farmers and drivers). On the other hand, low prevalence of helminth infection may be due to factors that influence survival and transmission of soil-transmitted helminthes mainly, the length of dry season and hot climate in Al Madinah may account for the reduced risk of infection and re-infection.

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REFERENCES

Abahussain, N.A. (2005). Prevalence of intestinal parasites among expatriate workers in Al-Khobar, Saudi Arabia. *Middle East Journal of Family Medicine* **3**(3): 17–21.

Al-Harthi, S.A. & Jamjoom, M.B. (2007). Preliminary study of the prevalence of intestinal parasites among diarrheic inhabitants in Makkah Al-Mukarramah. *Journal of Egyptian Society of Parasitology* **37**(2): 671–680.

Ali, S.I., Jamal, K. & Qadri, S.M. (1992). Prevalence of intestinal parasites among food handlers in Al-Medinah. *Annals of Saudi Medicine* **12**(1): 63–66.

Alkhalife, I.S. (2006). Retrospective analysis of intestinal parasitic infections diagnosed at a University Hospital in Central, Saudi Arabia. *Saudi Medical Journal* **27**(11): 1714–1718.

Al-Madani, A.A. & Mahfouz, A.A. (1995). Prevalence of intestinal parasitic infections among Asian female housekeepers in Abha District, Saudi Arabia. S.A. *Journal of Tropical Medicine and Public Health* **26**(1): 135–137.

Al-Shammari, S., Khoja, T., El-Khwasky, F. & Gad, A. (2001). Intestinal parasitic diseases in Riyadh, Saudi Arabia: prevalence, sociodemographic and environmental associates. *Tropical Medical International Health* **6**(3): 184–189.

Babiker, M.A., Ali, M.S.M. & Ahmed, E.S. (2009). Frequency of intestinal parasites among food-handlers in Khartoum, Sudan. *Eastern Mediterranean Health Journal* **15**(5): 1098–1104.

Carney, W.P., Nocun, R., Vergel, A.G., Pagaran, I., Mercado, A. & Cross, J.H. (1987). Intestinal parasites of man in Agusan Del Norte, Philippines with emphasis on schistosomiasis and capillariasis. *The Philippine Journal of Microbiology and Infectious Diseases* **16**(1): 5–9.

Celiksoz, A., Gufer, G., Oztop, A.Y. & Degerli, S. (2005). Prevalence of intestinal parasites in three socioeconomically different regions of Sivs, Turkey. *Universal Toronto Library* **23**: 134–191.

Chunge, R.N., Karumba, P.N., Nagelkerke, N., Kaleli, N., Wamwea, M., Mutiso, N., Andala, E.O. & Kinoti, S.N. (1991). Intestinal parasites in a rural community in Kenya: cross-sectional surveys with emphasis on prevalence, incidence, duration of infection, and polyparasitism. *East African Medical Journal* **68**(2): 112–123.

Cross, J.H., Zaraspe, G., Alquiza, L. & Ranoa, C. (1989). Intestinal parasites in some patients seen at San Lazaro Hospital, Manila, Philippines. *The Philippine Journal of Microbiology and Infectious Diseases* **18**(1): 25–27.

Dash, N., Al-Zarouni, M., Anwar, K.H. & Panigrahi, D. (2010). Prevalence of intestinal parasitic infections in Sharjah, United Arab Emirates. *Human Parasitic Disease* **2**: 21–24.

Easton, A. (1999). Intestinal worms impair child health in the Philippines. *B.M.J* Publishing Group Ltd., pp: 214–318.

Eggerm, R.J., Hofhuis, E.H. & Bloem, M.W. (1990). Association between intestinal parasites, and nutritional status in 3-8year- old children in Northeast Thailand. *Journal of Tropical Geographical Medicine* **42**: 312–323.

Elkins, D.B. (1987). A survey of intestinal helminthes among children of different social communities in Madras, India. *Transaction of Royal Society of Tropical Medicine and Hygiene* **78**: 132–133.

Esparar, D.G., Belizario, V.Y. & Relos, J.R.D. (2004). Prevalence of intestinal parasitic infections among food handlers of a Tertiary Hospital in Manila using direct fecal smear and formalin ether concentration technique. *The Philippine Journal of Microbiology and Infectious Diseases* **33**(3): 99–103.

Gupta, S., Narang, S., Nunavath, V. & Singh, S. (2008). Chronic diarrhoea in HIV patients: Prevalence of coccidian parasites, India. *Indian Journal of Medical Microbiology* **26**(2): 172–175.

Hall, A., Latham, M.C., Crompton, D.W., Stephenson, L.S. & Wolgemuth, J.C. (1982). Intestinal parasitic infections of men in four regions of rural Kenya. *Transactions of Royal Society of Tropical Medicince and Hygiene* **76**(6): 728–33.

Hill, D.R. (2001). *Giardai lamblia*. In *Principles and Practice of Clinical Parasitology*. Stephen H. Gillepie, and Richrad D. Pearson (eds.). Chichester, England, Jone Waily and Sons Ltd. **10**: 218–241.

Kalantan, K.A., Al-Faris, E.A. & Al-Taweel, A.A. (2001). Pattern of intestinal parasitic infection among foodhandlers in Riyadh, Saudi Arabia. *Saudi Society of Family and Community Medicine Journal* **8**(3): 1–12.

Khan, Z.A. & Alkhalife, I.S. (2005). Prevalence of *Blastocystis hominis* among "healthy" food handlers in Dammam, Saudi Arabia. *Journal of Egyptian Society of Parasitology* **35**(2): 395–401.

Kurniawan, A., Karyadi, T., Dwintasari, S.W., Sari, I.P., Yunihastuti, E., Djauzi, S. & Smith, H.V. (2009). Intestinal parasitic infections in HIV/AIDS patients presenting with diarrhoea in Jakarta, Indonesia. *Transactions of Royal Society of Tropical Medicine and Hygiene* **103**(9): 892–898.

Makki, S.M. & Arafa, W.A. (2010). Parasitosis among apparently healthy immigrant workers at Dammam, Saudi Arabia. *Journal of Egyptian Society of Parasitology* **40(**2): 311–320.

Mangali, A., Sasabone, P. & Syafruddin, A.K. (1987). Intestinal parasitic infections in Campalagian Distrct, South Sulawesi, Indonesia. *Southeast Asian Journal of Tropical Medicine and Public Health* **24**: 313–320.

Mohammad, K.A. & Koshak, E.A. (2011). A prospective study on parasites among expatriate workers in Al-Baha from 2009–2011, Saudi Arabia. *Journal of Egyptian Society of Parasitology* **41**(2): 423–432.

Neva, F.A. & Brown, H.W. (1994). Intestinal Nematodes of Human Beings. In *Basic Clinical Parasitology*. 6th ed, Appleton-Country- Croft, Norwalk, Connecticut pp: 113–151.

Savioli, L., Albonico, M., Engels, D. & Montresor, A. (2004). Progress in the prevention and control of schistosomiasis and soil-transmitted helminthiasis. *Parasitology International* **53**(2): 103–113.

Singh, U. & Petri, Jr. W.A. (2001). Amebas. In *Principles and Practice of Clinical Parasitology*, Stephen H. Gillepie, and Richrad D. Pearson (eds.). Chichester, England, Jone Waily and Sons Ltd. pp: 196–241.

Wadood, A., Rhman, A. & Qasim, K.F. (2005). Frequency of intestinal parasite infestation in children hospital Quetta, Pakistan. *Pakistani Journal of Medical Research* **44**(2): 87–88.

Wakid, M.H., Azhar, E.I. & Zafar, T.A. (2009). Intestinal parasitic infection among food handlers in the Holy City of Makkah during Hajj season 1428 Hegira (2007G). *Journal of King Abdul Aziz University Medical Science* **16**(1): 39–52.

Wani, S.A., Ahmad, F., Zargar, S.A., Amin, A., Dar, Z.A. & Dar, P.A. (2010). Intestinal helminthiasis in children of Gurez valley of Jammu and Kashmir State, India. *Journal of Global Infectious Diseases* **2**(2): 91–94.

Younas, M., Shah, S. & Talaat, A. (2008). Frequency of *Giardia lamblia* infection in children with recurrent abdominal pain in Peshawar, Pakistan. *Journal of Pakistani Medical Associations* **58**(4): 171–174.

Zaglool, D.A., Khodari, Y.A., Othman, R.A.M. & Farooq, M.U. (2011). Prevalence of intestinal parasites and bacteria among food handlers in a tertiary care hospital. *Nigerian Medical Journal* **52**(4): 266–270.