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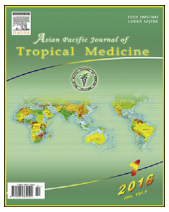

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# Prevalence of intestinal parasite infections among patients in local public hospitals of Hail, Northwestern Saudi Arabia

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ABSTRACT

**Objective:** To evaluate the prevalence of intestinal parasites among patients in Hail, Northwestern Saudi Arabia.

**Methods:** Stool samples were collected from 130 patients (69 females and 61 males) in Hail General Hospital. Each sample was examined by direct wet mount microscopic examination using both normal saline and Lugol's iodine preparation and concentration techniques using salt and formol–ether solutions. Permanent stained smears were performed for intestinal coccidian using modified Ziehl-Neelsen technique.

**Results:** The overall prevalence of intestinal parasitic infection was 45.38% (59 cases). Forty-four (33.84%) were found to be infected with one or more intestinal protozoa, 5 (3.84%) were infected with helminthes and 10 (7.69%) had mixed infection with both helminthes and protozoa. The most common intestinal helminth detected was *Ancylostoma duodenale* ($n$ = 5, 3.84%), followed by *Ascaris lumbricoides, Taenia* sp. and *Trichuris trichiura* ($n$ = 2 for each species, 1.5%). For intestinal protozoa, the coccidian *Cryptosporidium parvum* ($n$ = 25, 19.23%) was the most common followed by *Entamoeba histolytica/dispar* ($n$ = 21, 16.15%), *Giardia lamblia* ($n$ = 15, 11.54%), *Entamoeba coli* ($n$ = 5, 3.85%) and *Blastocystis hominis* ($n$ = 3, 2.30%). The prevalence of intestinal parasitic infections in females was significantly higher than in males ($P < 0.05$).

**Conclusions:** This is the first study highlighting that intestinal parasites are still an important public health problem in Northwestern Saudi Arabia. Therefore, health education would be the best way to prevent from intestinal parasite infections which are mainly food borne diseases.

## 1. Introduction

Parasitic infections are a major public health problem worldwide; particularly in the developing countries and constituting the greatest cause of illness and disease [1,2]. Current assessments suggest that at least one third of the total population in the world is infected with intestinal parasites. Indeed, it is estimated that about 3.5 billion people in the world are infected with intestinal parasites, of whom 450 million are ill [3,4]. The majority is living in tropical and subtropical parts of the world. The prevalence of the intestinal parasitic infections varied from one region to another and it also depends largely on the diagnostic methods employed and the number of stool examinations done.

Saudi Arabia is one of the most important countries receiving the largest influx of expatriate workers from different regions of the world including Bangladesh, Philippine, India, Indonesia, Pakistan, Sri Lanka and Egypt. All of these countries are known to be endemic for many diseases including those caused by intestinal parasites. Although, all workers are medically examined twice in their country of origin and when they enter Saudi Arabia, many studies have demonstrated the high rate of infection with intestinal protozoa and helminthes among this population [5–7]. Indeed, previous studies in different regions of Saudi Arabia revealed high prevalence rates of infection with intestinal

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parasites among specific populations including food handlers (23%), school children (33.8%), expatriates (varying between 14.9% and 55%), and Saudi and Non-Saudi patients attending hospitals (varying between 39.7% and 77.1%) [5–13].

Most of these previous studies conducted in Saudi Arabia were focused on some regions such as Jeddah, Mekkah, Al-Madina Al-Munawara and Riyadh providing updated data concerning the prevalence of intestinal parasite infection among different populations. However, to the best of our knowledge, no report is available about the prevalence of human intestinal parasite in Northwestern Saudi Arabia. Thus, the aim of the present study was to determine the prevalence of human intestinal parasitic infections in Hail region.

## 2. Material and methods

### 2.1. Study area and population

The study was conducted in Hail region between September and December 2012. Hail is located in Northwestern Saudi Arabia (27 °N, 41 °E), characterized by a continental desert climate with hot summers (average high temperature 29.2 °C) and cool winters (average low temperature 13.3 °C). Hail is located in a high altitude (1 140 m above mean sea level) with an annual precipitation of 100.6 mm. Participants in this study were both symptomatic and asymptomatic of Saudi and Non-Saudi patients in the Hail General hospital.

### 2.2. Stool sample collection

Samples were collected in sterile plastic containers, carefully labeled and transported to the laboratory of parasitology in the Department of Clinical Laboratory Sciences, College of Applied Medical Science, University of Hail. Each stool specimen was processed as follow:

### 2.3. Macroscopic examination

The stool specimens were examined for the presence of adult worms like *Enterobius*, and proglottids of *Taenia* either with the naked eye or by using a hand lens.

### 2.4. Direct microscopic examination using normal saline and iodine preparation

About 1–2 mg of stool was emulsified in 1–2 drops of normal saline (0.9%) or Lugol's iodine solution. A cover-slip was then placed and the slide was scanned under 10× and 40× objective lenses of a light microscope. Saline direct smear is used mainly for the detection of intestinal protozoa trophozoites motility. Iodine direct smear allows the examination of the characteristic features of the protozoa and the identification of the *Entamoeba histolytica/dispar* (*E. histolytica/dispar*) cyst from the commensal *Entamoeba coli* (*E. coli*). Parasitological assessment was performed by qualified laboratory technologists.

### 2.5. Formol–ether concentration

After completion of direct stool examination, one gram of each sample was emulsified in 10% formalin solution and formol–ether concentration technique was performed as described elsewhere in order to increase the chance of detecting parasites [14].

Permanent stained smears were performed for intestinal coccidian parasites by the modified Ziehl-Neelsen technique according to Utzinger et al. (2010) [15] and modified trichrome stain according to Ryan et al. (1993) [16].

### 2.6. Statistical analysis

Collected data were entered into a Microsoft Excel data base and then analyzed using the Epi-Info version 6.04 (Centers for Disease Control and Prevention, Atlanta Georgia and WHO, Genève Suisse) statistical software. Prevalence was calculated as percentage value. Statistical association of intestinal parasitic infection prevalence with gender and nationality was analyzed using $\chi^2$ test. A statistically significant association between variables is considered to exist if $P < 0.05$.

## 3. Results

In total, 130 patients participated in this study. Among them 48 (36.93%) were Saudi and 82 (63.07%) were Non-Saudi. Regarding the gender, 61 (46.93%) were male and 69 (53.07%) were female. The overall prevalence of intestinal parasitic infection among these patients was determined to be 45.38% (59/130). It was 35.41% (17/48) and 51.22% (42/82) among Saudi and Non-Saudi patients, respectively. The prevalence of infection with intestinal parasites was not significantly different among these two groups ($P = 0.08$) (Table 1). However, females were found to have a higher percentage of infection (59.42%) compared to the male group (29.50%). The association between the gender and intestinal parasitic infection was statistically significant ($P = 0.0\ 006$) (Table 1).

Out of the 130 patients examined, 44 (33.84%) were found to be infected with one or more intestinal protozoa, 5 (3.84%) were infected with helminthes and 10 patients (7.69%) had mixed infection with both helminthes and protozoa.

Regarding the number of parasites species detected in each sample, 40 patients (30.76%) were infected with a single parasite species with a single protozoon ($n = 36$) and a single helminth ($n = 4$); seven (5.38%) were infected with two different intestinal

**Table 1**
Prevalence of intestinal parasitic infection according to the nationality and gender.

| Factor | No. examined | Infected number | Prevalence (%) | 95% *CI* | $\chi^2$ | *P*-value |
|---|---|---|---|---|---|---|
| Nationality | | | | | | |
| Saudi | 48 | 17 | 35.41 | 22.55–50.60 | 3.05 | 0.080 0 |
| Non-Saudi | 82 | 42 | 51.22 | 40.00–62.31 | | |
| Gender | | | | | | |
| Male | 61 | 18 | 29.50 | 18.86–42.74 | 11.69 | 0.000 6 |
| Female | 69 | 41 | 59.42 | 46.92–70.86 | | |

**Table 2**
Proportion of mono-parasitism and poly-parasitism of intestinal parasite infection.

| Type of infection | No. of species | Species associated | Case (%) |
|---|---|---|---|
| Mono-parasitism | 1 species ($n$ = 40) | *Cryptosporidium* sp. | 15 (11.53) |
| | | *E. histolytica/dispar* | 15 (11.53) |
| | | *G. intestinalis* | 6 (4.61) |
| | | *Taenia* sp. | 1 (0.76) |
| | | *Dicrocelium dendriticum* | 1 (0.76) |
| | | *Fasciolopsis buski* | 1 (0.76) |
| | | *Hyterophyes hyterophyes* | 1 (0.76) |
| Total mono-parasitism | | | 40 (30.76) |
| Poly-parasitism | 2 species ($n$ = 7) | *A. duodenale* + *T. trichiura* | 1 (0.76) |
| | | *Taenia* sp. + *E. histolytica/dispar* | 1 (0.76) |
| | | *Entrobius vermicularis* + *Cryptosporidium* sp. | 1 (0.76) |
| | | *G. intestinalis* + *E. histolytica/dispar* | 4 (3.07) |
| | 3 species ($n$ = 9) | *A. duodenale* + *As. lumbricoides* + *E. coli* | 1 (0.76) |
| | | *Schistosoma mansoni* + *G. intestinalis* + *Cryptosporidium* sp. | 1 (0.76) |
| | | *Hymenolepis nana* + *E. coli* + *Cryptosporidium* sp. | 1 (0.76) |
| | | *Entamoeba hartmani* + *Blastocystis hominis* + *Cryptosporidium* sp. | 2 (1.53) |
| | | *A. duodenale* + *E. coli* + *Iodamoeba butshilii* | 1 (0.76) |
| | | *G. intestinalis* + *E. coli* + *Cryptosporidium* sp. | 2 (1.53) |
| | | *A. duodenale* + *Strongyloides stercoralis* + *Blastocystis hominis* | 1 (0.76) |
| | 4 species ($n$ = 2) | *A. duodenale* + *G. intestinalis* + *E. nana* + *Cryptosporidium* sp. | 1 (0.76) |
| | | *Hymenolepis diminuta* + *Iodamoeba butshilii* + *E. nana* + *Cryptosporidium* sp. | 1 (0.76) |
| | 5 species ($n$ = 1) | *T. trichiura* + *As. lumbricoides* + *G. intestinalis* + *E. histolytica/dispar* + *Cryptosporidium* sp. | 1 (0.76) |
| Total poly-parasitism | | | 19 (14.61) |
| Total of infected patients | | | 59 (45.38) |

parasite species with two helminthes ($n$ = 1), two protozoa ($n$ = 4), one protozoon and one helminth ($n$ = 2); nine patients (6.92%) were infected with three parasites simultaneously; two patients (1.53%) with four intestinal parasite species and a single patient (0.77%) was simultaneously infected with four different species of intestinal parasites.

Prevalence of intestinal helminth infection among the participants was 11.53% (15/130): Among this group, four were infected with a single helminth species, seven patients had a mixed infection of one helminth species and one or more species of protozoa, while four others had two intestinal helminth species (with or without protozoa association) (Table 2). The predominant intestinal helminth diagnosed was *Ancylostoma duodenale* (*A. duodenale*) (Hookworm) 3.84% (5/130) followed by *Ascaris lumbricoides* (*As. lumbricoides*), *Trichuris trichiura* (*T. trichiura*) and *Taenia* sp. with two cases each (1.54%). The other 8 helminthes species detected represented together 6.15% (8/130) of intestinal parasitic infection (Table 3).

Regarding prevalence of intestinal protozoa infection, *Cryptosporidium parvum* (19.23%) was the most predominant protozoa identified from stool of the studied participants followed by *E. histolytica/dispar* (16.15%) and *Giardia intestinalis* (*G. intestinalis*) (11.54%). Other protozoa including the non pathogenic ones such as *E. coli*, *Entamoeba hartmani*, *Endolimax nana* (*E. nana*) and *Iodamoeba butschlli* were less detected (Table 3).

**Table 3**
Frequency distribution of intestinal parasites identified from patients stools.

| Parasite species | Population infected | Prevalence (%) |
|---|---|---|
| Helminths | | |
| *A. duodenale* | 5/130 | 3.84 |
| *As. lumbricoides* | 2/130 | 1.54 |
| *T. trichiura* | 2/130 | 1.54 |
| *Taenia* sp. | 2/130 | 1.54 |
| *Entrobius vermicularis* | 1/130 | 0.77 |
| *Strongyloides stercoralis* | 1/130 | 0.77 |
| *Hymenolepis nana* | 1/130 | 0.77 |
| *Hymenolepis diminuta* | 1/130 | 0.77 |
| *Schistosoma mansoni* | 1/130 | 0.77 |
| *Fasciolopsis buski* | 1/130 | 0.77 |
| *Dicrocoelium dendriticum* | 1/130 | 0.77 |
| *Heterophyes heterophyes* | 1/130 | 0.77 |
| Protozoa | | |
| *Cryptosporidium parvum* | 25/130 | 19.23 |
| *E. histolytica/dispar* | 21/130 | 16.15 |
| *G. intestinalis* | 15/130 | 11.54 |
| *E. coli* | 5/130 | 3.85 |
| *Blastocystis hominis* | 3/130 | 2.30 |
| *Entamoeba hartmani* | 2/130 | 1.54 |
| *E. nana* | 2/130 | 1.54 |
| *Iodamoeba butschlli* | 2/130 | 1.54 |

## 4. Discussion

Parasitic infections are endemic worldwide and have been described as constituting the greatest single worldwide cause of illness and disease [3]. These infections are usually associated with poor sanitary habits, lack of access to safe water and improper hygiene. The degree of each factor and the prevalence of infections vary from one region to the other [5]. The knowledge of intestinal parasitic infection extension in a given community is crucial for planning an efficient intervention programs. The present study assessed the prevalence of intestinal parasite infection in Hail region, Northwestern Saudi Arabia. In this study, 45.38% of the diagnosed patients were positive for intestinal parasitic infection. This intestinal parasitic disease affected both Saudi and Non-Saudi patients. The difference in the prevalence of infection between these two groups was statistically not significant. Non-Saudi patients are the expatriate workers

coming mainly from Bangladesh, Philippine, India, Indonesia, Pakistan, Sri Lanka and Egypt which are endemic foci for intestinal parasites [17–22].

A large variation in the prevalence of intestinal parasite infection was noticed by comparing our result to those already reported in many regions of Saudi Arabia. Indeed, in Saudi Arabia, previous stool surveys have indicated that approximately 9.5%–77.1% of the various studied groups were infected with intestinal parasites [5,8,10–12,23–26]. This large discrepancy in the prevalence of intestinal parasite could most likely be explained by the group of examined patient. Indeed, in the group of foreigner workers the prevalence of intestinal parasite was the highest one ranging between 14.9% and 77.1% [6,7,9,12,27]. In the group of food handlers the prevalence varied between 14% and 23% [5,28,29]. However in the Saudi patients group this prevalence was between 2.3% and 70% [10,12,30].

Nevertheless, by comparing the overall prevalence of intestinal parasite found in our current study to the previous studies examining the stool of patients, we noticed that our finding is consistent with other studies conducted in Saudi Arabia in different geographical areas indicating that intestinal parasitic infection is an important public health problem in Saudi Arabia since the last century [10,11,31–33]. Worldwide high prevalence rates were reported from developing countries such as southern India where the overall period prevalence of intestinal parasites was 97.4%/m [34]. Another study in Sierra Leone showed a prevalence rate of 73.5% [35]. The higher rates in these communities may be attributed to improper hygiene and agricultural backgrounds.

*Cryptosporidium* sp., *E. histolytica/dispar* and *G. intestinalis* were the most common intestinal parasites identified in the current study. The same result was also reported by Al-Megrin (2010) and Al-Braiken (2008) in Riyadh and Jeddah respectively [8,10]. While *E. histolytica* and *G. intestinalis* were reported in many studies as the most common protozoa, the oocyst of *Cryptosporidium* was rarely described considering the difficulty of its identification without Ziehl Neelsen stain. It is an apicomplexan intracellular protozoan parasite, known as a significant cause of diarrhea worldwide especially in children and immune-compromised patients. This infection may end fatally in immune-compromised patients [36]. This protozoan parasite can be transmitted orally by drinking water and by direct person-to-person contact.

While a relatively high prevalence of intestinal protozoa was noticed, a lower intestinal helminth infection rate was observed in the presence study. This finding could most likely be explained by the climate of the study area (Hail) which is known to be dry all over the year. This condition will participate in the desiccation of the eggs of helminthes (infective stage) that become not infective if ingested.

This study revealed a relatively high prevalence of intestinal parasites among patients visiting Hail hospital. Both helminthes and protozoa parasites were identified in the studied populations. *A. duodenale* and *Cryptosporidium* sp. are the most prevalent helminth and protozoan parasite respectively. Since most of the intestinal parasites are transmitted by the feco-oral route, provision of safe water supply and latrines, improvement of sanitation and health education on personal and environmental hygiene are crucial to control and reduce intestinal parasite infections in the area.

## Conflict of interest statement

We declare that we have no conflict of interest.

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