Prevalence of intestinal parasites among food handlers attending public health laboratories in Khartoum State, Sudan

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Abstract

**Background:** Infections by intestinal pathogens especially protozoans and helminths are considered to pose a real health problem, particularly in the tropics. They cause considerable morbidity and mortality rates in developing countries. The high prevalence of these infections is closely correlated with poverty, poor environmental hygiene, and impoverished health services. This study aimed to detect prevalence and frequency of parasitic infections among food handlers in Khartoum Sudan.

**Methods:** Three hundred and fifty Food-handlers, attending public health laboratories in Khartoum, Sudan, for an annual medical check-up, were screened for intestinal parasites by four laboratory techniques viz. direct faecal examination, formal-ether concentration, Baermann technique and agar culture method.

**Results:** The infection rate was 23.7% by Formol-Ether Concentration technique, followed by direct saline stool preparation (7.1%). Out of 83 positive samples the infection rate among different nationalities was as follows: Sudanese 66 (81.9%), Ethiopians 13 (15.7%), Syrians 2 (2.4%) and Egyptians 0 (0%). Intestinal parasites were more prevalent among males (73; 25.1%) than female food handlers (10; 16.9%). Three protozoans, nematodes, two tap worms and one trematode worm were detected among infected population: their frequency were as follows: *Entamoeba histolytica* (7.4%), *Entamoeba coli* (6.86%), *Giardia lamblia* (6%), *Schistosoma mansoni* (1.40%), *Necator americanus* (1.43%), *Hymenolepis nana* (0.68%), *Strongyloides stercoralis* (0.68%), *Taenia saginata* (0.57%), *Ascaris lumbricoides* (0.57%) and *Trichostongylus species* (0.29%).

**Conclusion:** The overall prevalence of protozoan infections among food handler in Khartoum state, Sudan was 20.26% while the helminthic infections was 5.97%. Formol-ether concentration technique is better for detection of intestinal parasites than the direct faecal smear technique. Likewise, Barmann’s technique confirms detection of nematodes worms especially hookworms.
Introduction
In developing countries, intestinal parasitic infections remain a significant cause of mortality and morbidity\(^1\). Parasitic infections can cause growth delay, iron deficiency anaemia, especially in children, and other psychological and physical health conditions\(^3\). The high prevalence of these infections is closely associated with poverty, penurious health services, and poor environmental and personal hygiene\(^4\).

Soil-transmitted helminth (STH) and other helminth parasites like *Taenia saginata* and *Hymenolepis nana*, represent important causative agents of gastrointestinal infections. Intestinal protozoan dwellers, mainly *Giardia lamblia* and *Entamoeba histolytica*, also, contribute to intestinal disorders\(^1\).

Polluted soil and water sources, and poor personal hygiene are the major factors in the transmission of parasitic infections to humans through the fecal-oral route\(^5\). Contaminated food caused by inadequate environmental sanitation and insufficient personal hygiene by food-handlers have been implicated in epidemics of protozoan infections in humans\(^6\). Approximately 500 million people worldwide are diagnosed with amoebiasis, with an annual mortality between 40,000 and 110,000 according to the World Health Organization (WHO)\(^7\). In 1978 in Geneva the WHO scientific group on the changing pattern of food hygiene problems underlined that many of the hazards related with microbial or parasitic contamination had reduced because of the intensive efforts of food hygiene services and producers\(^8\). Parasitic infections in food-handlers, which are often asymptomatic, can cause a real threat to immune-compromised patients\(^9\). According to the policy of Sudan ministry of health, food-handlers should be screened annually for parasitic infections. The objective of this study is to determine the infection rate and study distribution of intestinal parasite among Sudanese food-handlers in Khartoum, Sudan.

Methods
This was a descriptive cross-sectional study conducted in Khartoum state in the central part of Sudan, during the period from October 2016 to April 2017. Khartoum state is located between longitudes 31.5–34°E and latitudes 15–16°N with an area of approximately 22,142 km\(^2\) (Figure 1) with a total population of about six million (see City Population site for Sudan). Stool samples were collected from public health laboratories (the public health lab in the Medical Commission) of Khartoum State; Omdurman locality, Khartoum North locality and Khartoum locality. The samples were analyzed at the Department of Parasitology, University of Science and Technology.

Sampling and sample size
A total of 350 stool samples were collected from food-handlers who attended for annual check-ups during the study period. About 101 stool samples were collected from participants in the public health lab in Medical Commission in Khartoum North locality, 160 stool samples were collected from participants in the public health Lab in Medical Commission in Omdurman locality and 89 stool samples were collected from participants in the public health Lab in the Medical Commission in Khartoum locality. The sample size was calculated using this formula\(^10\).

\[
n = \frac{Z^2 \times PQ}{d^2} \quad \text{or} \quad N = \frac{Z^2 \times P (p-1)}{d^2}
\]

Figure 1. Map of Khartoum State, Sudan.
Where \( n = \) sample size

\[
P = \text{prevalence rate}
\]

\[
Z = 1.96 \text{ at } \alpha = 0.05 \quad (\alpha = \text{desired confidence level})
\]

\[
d = \text{desired width of confidence (precision)}
\]

\[
Q = 100 - P
\]

There for the sample size (n) was determined as:

\[
1.96^2 \times 0.05 \times 0.05 \\
10^2
\]

\[
n = 96.04 \approx 96
\]

\[
N = (1.95)^2 \times (100 - 50) / 5^2 = 380
\]

\[
N = 380
\]

**Methods of samples examination**

Four different methods were used for examination of stool samples: direct faecal examination, the formal–ether concentration technique, Barmenn’s apparatus technique and Agar culture method.

**Direct faecal examination.** Direct microscopic (Olympus CX22 Microscope, Japan) examination of the sample was carried out in a systematic manner using a 4x objective lens to select the area to be screened, followed by a 10x objective lens to locate any parasitic objects. Suspicious objects were identified under a 40x objective lens. Then 2 drops of Lugol solution (Cat. No:09.0004.0500, dop\(^b\), Turkey) were added to facilitate identification of undifferentiated protozoan cysts and specimens were re-examined 5 minutes later.\(^1\)

**Formal–ether concentration technique.** The formal-ether concentration technique was performed by adding 1 g of faeces to 5 mL of formalin (10%), which was emulsified and strained, and the filtrate centrifuged for 2 min at 3000 rpm. Then 1 mL of sediment faeces and 9 mL of 10% formalin solution (cat no. F-04202, Oxford laboratory reagent, India,) were added to 3 mL of ethyl acetate and centrifuged further for 2 min at 2000 rpm. The upper 3 layers were decanted by inverting the tube and the last drop was allowed to fall back into the tube. Next, the filtrate was allowed to sediment by gravity for 15 min, prepared, examined and identified as in the direct smear technique.\(^1\)

**Barmenn’s apparatus technique.** Baermann’s technique was performed as described Garcia & Bruckner\(^1\) by adding 5 g of fresh stool in the bottom of the strainer. The strainer was placed in the funnel. Warm water (40\(^o\) C) was added to cover the faeces in the strainer. It was left undisrupted for 1–2 hours to give time for Strongyloides larvae to emerge from faeces into the water. The tip of the tube was opened and 7–10 mL of the fluid was collected into a centrifuge tube. A plastic bulb pipette was used to discard the suspension fluid into a container of disinfectant. The sediment was transferred to the slide and covered with a coverslip and was examined for motile larvae using 10x magnification.\(^1\)

**Agar culture method.** The procedure of agar plate culture was performed by adding 2g of fresh stool into the center of agar plate. Area approximately 1 in diameter was placed.

The lid was replaced and the plate was sealed with cellulose tape. The agar plate was maintained (right side up) at room temperature for 2 days. The sealed plates were examined after 2 days through the plastic lid under the microscope for microscopic colonies that develop as random tracks on the agar, indicating larvae at the ends of tracks away from the stool. A hole in the top of plastic petri dish was made with hot of forceps. 10 ml of 10% formalin was added gently through the hole onto the agar surface and swirled to cover the surface. The agar plate was then rinsed and allowed to stand for 30 min. The tape and lid of agar plate were removed. The 10% formalin was poured through a funnel into a centrifuge tube. The formalin rinse fluid was centrifuged for 5 min at 500xg. A wet smear preparation was prepared from the sediment and was examined at the 10x objective (low power) for the presence of larvae if larvae were found they were then identified with a 40x objective (high dry power)\(^1\).

**Data analysis**

The data were analyzed using SPSS (21.01) and Microsoft Excel 2010. Descriptive statistics for categorical data were formulated as frequency and percentage. Chi-Square test was used to compare of categorical data, while independent sample t-test was used to compare of numerical data. The significance level was considered at P-Value of < 0.05.

**Ethical considerations**

Samples were collected from participants after explanation of the importance of the study and signing the consent form. The ethical approvals were obtained from the National Committee for research, at the ministry of health. Results of direct wet preparation of samples collected were donated for treatment of all participants included in the study and some results were dispatched to a physician for treatment prescription.

**Results**

The total number of screened food-handlers included in the study was 350; the age of participant ranged from 16 to 68 years with an average age of 32 years, 46% of the participants were less than 29 years old compared with 54% of being 29 or above (Figure 2). The majority of participants were males (83.1.9%) and (16%) were female (Figure 3).

Distribution of samples according to the residence data showed that 101 participants were from Khartoum north (28.9%), 160 participants were from Omdurman (45.7%) and 89 participants were from Khartoum (25.4%) (Table 1). The majority of the participants were Sudanese (83.1.1%), followed by the Ethiopian (13.4%), Syrian (3.1%) and the Egyptian (0.03%) (Figure 4).

Direct microscopy detected intestinal parasitic infection in 7.1% of the food-handlers, by using the Formal-Ether Concentration technique (the most sensitive) the study found intestinal parasite’s infection 23.7% of the food-handlers. The result of Baermann’s...
technique was used to detect larva of *Strongyloides stercoralis* and Hookworm (Figure 5). The Agar culture method show in (Table 2). Parasitic infection in stool samples were found by the Formal-ether and direct saline stool preparation, the most prevalent protozoan parasite was *Entamoeba coli* and for helminthic parasites was *Ascaris lumbricoides* in Khartoum north locality (Table 3). The most prevalence protozoan parasite in Omdurman locality was *Entamoeba coli* (9.4%) and for helminth parasites *Schistosoma mansoni* (1.87%) (Table 4). The most prevalence protozoan parasite in Khartoum locality was *Giardia lamblia* (3.3%) and the most prevalent helminth infection was *Necator americanus* (3.3%) (Table 5). The overall prevalence of parasitic infections among food handler in Khartoum state are demonstrated in Figure 6.

Residence and occupation were found to have a significant association with the result of the direct wet examination. The OR indicated that those respondents who working in restaurants were 2.25 times more likely to have positive test compared with others (Table 6). Occupation was found to have a significant association with the result of formal ether and the OR indicated

<table>
<thead>
<tr>
<th>Table 1. Distribution of study population according to the residence.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residence</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Khartoum north</td>
</tr>
<tr>
<td>Omdurman</td>
</tr>
<tr>
<td>Khartoum</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
Table 4. Prevalence of parasitic infections among food handler in Omdurman locality.

<table>
<thead>
<tr>
<th>Type of Parasite recovered</th>
<th>Frequency</th>
<th>The percentage in Omdurman locality</th>
<th>The percentage in Khartoum state</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Giardia lamblia</em></td>
<td>11</td>
<td>6.88%</td>
<td>3.1%</td>
</tr>
<tr>
<td><em>Entamoeba coli</em></td>
<td>15</td>
<td>9.4%</td>
<td>4.29%</td>
</tr>
<tr>
<td><em>Entamoeba histolytica</em></td>
<td>16</td>
<td>10%</td>
<td>4.57%</td>
</tr>
<tr>
<td><em>Schistosoma mansoni</em></td>
<td>3</td>
<td>1.87%</td>
<td>0.86%</td>
</tr>
<tr>
<td><em>Hymenoleps nana</em></td>
<td>2</td>
<td>1.25%</td>
<td>0.57%</td>
</tr>
<tr>
<td><em>Taenia spp</em></td>
<td>1</td>
<td>0.62%</td>
<td>0.29%</td>
</tr>
<tr>
<td><em>Strongyloides stercoralis</em></td>
<td>1</td>
<td>0.62%</td>
<td>0.29%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>n =160</strong></td>
<td><strong>n =160</strong></td>
<td><strong>N=350</strong></td>
</tr>
</tbody>
</table>

Table 5. Prevalence of parasitic infections among food handler Khartoum locality.

<table>
<thead>
<tr>
<th>Type of Parasite recovered</th>
<th>Frequency</th>
<th>The percentage in Khartoum locality</th>
<th>The percentage in Khartoum state</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Giardia lamblia</em></td>
<td>3</td>
<td>3.3%</td>
<td>0.86%</td>
</tr>
<tr>
<td><em>Entamoeba coli</em></td>
<td>1</td>
<td>1.1%</td>
<td>0.28%</td>
</tr>
<tr>
<td><em>Entamoeba histolytica</em></td>
<td>7</td>
<td>7.86%</td>
<td>2%</td>
</tr>
<tr>
<td><em>Necator americanus</em></td>
<td>3</td>
<td>3.3%</td>
<td>0.86%</td>
</tr>
<tr>
<td><em>Schistosoma mansoni</em></td>
<td>2</td>
<td>2.2%</td>
<td>0.86%</td>
</tr>
<tr>
<td><em>Hymenoleps nana</em></td>
<td>1</td>
<td>1.1%</td>
<td>0.57%</td>
</tr>
<tr>
<td><em>Taenia saginata</em></td>
<td>1</td>
<td>1.1%</td>
<td>0.29%</td>
</tr>
<tr>
<td><em>Strongyloides stercoralis</em></td>
<td>1</td>
<td>1.1%</td>
<td>0.29%</td>
</tr>
<tr>
<td><em>Trichostrongylus</em></td>
<td>1</td>
<td>1.1%</td>
<td>0.29%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>n =89</strong></td>
<td><strong>n =89</strong></td>
<td><strong>N=350</strong></td>
</tr>
</tbody>
</table>

Discussion

For this study we select a descriptive cross-sectional and analytical facility bases study to be conducted in public health lab(s) of Khartoum State. The study was conducted between the years 2015 and 2018. This study is subject to several limitations, gastrointestinal parasitic infections are frequently reported among different sectors in Khartoum state especially in the territories of the town where hygienic conditions are poor. Most of the targeted participants do not seek any medical or health advice unless they have been to enforce to do so during routine annual medical check up. This study found that formal-ether concentration technique is the most sensitive method for diagnosing the intestinal parasites. The level of infection with intestinal helminthes in food-handlers in Khartoum state, Sudan (5.97%) was much more than that reported by Babiker *et al.* who found that 2.7% of Sudanese food-handlers were infected with intestinal helminthes*. It also higher than that reported by Tomaso *et al.* (0.2%) among food-handlers in Austria. This may be the result of the migration of foreign nationals to the capital, migration of individuals from the rural areas to urban areas, lack of personal hygiene, poor management of waste...
Table 6. Socioeconomic Correlates of the test direct wet Examination.

<table>
<thead>
<tr>
<th>variable</th>
<th>Chi-square value</th>
<th>P value</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>0.452</td>
<td>0.785</td>
<td>1.05</td>
</tr>
<tr>
<td>residence</td>
<td>8.145</td>
<td>0.018</td>
<td>-</td>
</tr>
<tr>
<td>gender</td>
<td>1.510</td>
<td>0.220</td>
<td>1.20</td>
</tr>
<tr>
<td>nationality</td>
<td>0.452</td>
<td>0.501</td>
<td>1.06</td>
</tr>
<tr>
<td>occupation</td>
<td>14.254</td>
<td>0.046</td>
<td>2.25</td>
</tr>
</tbody>
</table>

Table 7. Socioeconomic Correlates of the Formal ether concentration.

<table>
<thead>
<tr>
<th>variable</th>
<th>Chi-square value</th>
<th>P value</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>age</td>
<td>0.211</td>
<td>0.616</td>
<td>1.09</td>
</tr>
<tr>
<td>residence</td>
<td>3.241</td>
<td>0.197</td>
<td>-</td>
</tr>
<tr>
<td>gender</td>
<td>1.790</td>
<td>0.182</td>
<td>1.09</td>
</tr>
<tr>
<td>nationality</td>
<td>0.155</td>
<td>0.724</td>
<td>1.02</td>
</tr>
<tr>
<td>occupation</td>
<td>22.140</td>
<td>0.032</td>
<td>4.23</td>
</tr>
</tbody>
</table>

The intestinal protozoal infection ratio of our study was low (20.26%) among food handlers in Khartoum State, Sudan. This finding was strongly supported by similar study conducted In Northwest Ethiopia, 29.1%

Our study has a low infection rate when comparing with the study conducted in 2009 by Babiker et al. (29.4%). This could be attributed to difference of subjects participated in the two studies. For this study, examining Ethiopians, Egyptian and Syrians gave a very low infection rate that affects the overall prevalence. Similar variation was also reported when comparing this study with other research done else were, for example, in Jordan, the frequency of infection by intestinal protozoal was 30.2%.

The current study revealed that Infection with G. lamblia was lower than that reported in Somalia (77%).

Furthermore, a similar study in Jordan presented by Al-Lahham et al. showed that the high rate of infection by intestinal protozoal (30.2%) which is higher than our conducted study. It has been previously reported that about 15% of food-borne disease epidemics are the consequence of infection by food-handlers. 6.5% of food handlers in Bahir Dar town in Ethiopia had protozoal and helminthic infection. Infected food-handlers have been involved in parasitic transmission, resulting in an
In our study, a relationship was found in parasitic infection with occupation and residence, but no association was found between the frequency of parasite infection and age, gender, and nationality. We find that the annual monitoring of food-handlers in Khartoum is insufficient to screen parasitic infections and that more frequent screening, for example, monthly screening, should be supported. Our recommendations are that health education and personal hygiene should be included in the annual check of food handlers. The use of the most sensitive technique for diagnosing intestinal parasitic infections should be established.
Data availability
Dataset 1: Demographic and parasitic infection data for participants
http://doi.org/10.5256/f1000research.14681.d204800

Competing interests
No competing interests were disclosed.

References

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