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Study to Estimate Intestinal Parasitic Infections among High Risk Occupational Persons Respecting Different Socioeconomic Status

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Abstract: *Background*: Human intestinal parasitic infections (IPIs) causing reduce worker productivity and waste of economics resources. Employment and occupational natures are important factors in association with IPIs. Food handlers, Street sweepers and Medical stuff are frequently at high risk to parasitic infections. *Objective*: our study was conducted to estimate intestinal parasitic infections among high risk individuals in some occupational groups. *Subjects and methods*: Our study concluded 300 individuals from different three occupational fields (100 medical stuff, 100 food handlers and 100 street sweepers) attending NHTMI were laboratory examined for intestinal parasites by urine and stool analysis (macroscopically, microscopically), coproantigens detections and serologically to detect serum antibodies for schistosomiasis, amoebiasis and fascioliasis. *Results*: Prevalence of intestinal parasitic infection was 54.3% (163/300); street sweepers have the highest prevalence; 41.1 %(67 /163), then the food handlers 36.8% (60 /163) and the least was among the medical stuff; 22.1% (36/163). The most prevalent species was *Entamoeba histolytica* (12%), *Giardia lamblia* (9.7%), *Enterobius vermicularis* (9.3%), *Cryptosporidium* spp. (9%), *Hymenolepis nana* (5.7%), *Entamoeba coli* (4.7%), *Taenia* spp. (4%), *Heterophyes heterophyes* (3.7%), *Ascaris lubmricoides* (3.7%), *Ancylostoma duodenale* (2.3%), *Schistosoma mansoni* (2.3%), *Schistosoma haematobium* (2%), *Strongyloides stercoralis* (2%) and *Fasciola spp*.(0.7%) respectively. The prevalence was higher among those with very low socioeconomic status than with high socioeconomic status (41.1%, 11.7%), respectively. Illiterate and primary educated participant had the highest prevalence of infection (35.6%). Also, the prevalence among those with unsafe water supply / improper sewage disposal was 46%, 36.2%; as18.6 times more likely with participants with safe water supply and 14.9 times more likely with those with proper sewage disposal respectively. *Conclusion/Recommendations*: Intestinal parasitic infections representing public health problem. Street sweeper should be treated as a vulnerable group, prevention and safety measures should be emphasized and used for those workers. Pre-employment and periodical stool examination /three months, as well as health education programs are recommended among food handler. Medical stuff are at risk for infection; so, effective infection control measures should be maintained.

Key words: Intestinal Parasites · Occupational Field · Risk Factors

INTRODUCTION

One of the most important health problems worldwide is intestinal parasitic infections (IPIs) particularly in developing countries [1, 2]. IPIs, affecting about 3.5 billion people with over 450 million health problems annually, approximately 25% of the world's population suffering from parasitic infection [3-5]. IPIs are more prevalent in underdeveloped agricultural and rural areas of, infections reduced worker productivity resulting in a waste of economic resources [6]. In Egypt, prevalence of intestinal parasites is about 61% and considered to be one of the main etiologic agent causing diarrhea/ dysentery [7].

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Intestinal parasitic infections include protozoan and helminthes; Protozoan infections such as Ameobiasis, Giardiasis and Cryptosporidiosis while helminthic infections include Ascariasis, Enterobiasis, Ancylostomiasis and Trichuriasis. Infection with these parasites may be complicated with iron deficiency anemia, vitamin A deficiency, diarrheal or dysentery, malnutrition, delay growth, physical and mental health problems [8, 9]. Moreover, immune compromised patients (as HIV, transplanted and hemodialysis patients) may suffer from serious gastrointestinal disorders [10, 11].

Transmission of infections is mainly occurs directly / indirectly through food, water or contaminated hands. Spread of infection is closely related to environmental conditions, educational level, bad hygienic or sanitary condition, improper drinking water supplies, low socioeconomic status and inadequate medical care [12, 13].

Employment and occupational natures are important factors in association with IPIs. Food-handlers deal with food production and distribution of between societies considered one of the most important sources of human's transmission of the infections especially asymptomatic cases who act as a potential and continuous source of IPIs or other enteropathogenic diseases [14, 15].

Street sweepers play important roles for keeping the cities and communities clean. The nature of their work is removing debris from streets and collecting solid waste. Thy coming into contact with different hazardous materials as fecal matter, sharp metallic objects, air particulates, chemical fumes, mice/rats, mosquitoes, stray animals and animal carcasses. As a result of this occupational exposure, they are at high risk to parasitic infections [16, 17].

Because of the work environment and the job duties of medical staff, they are frequently exposed to many hazards. They have high risk of contact with infectious agents from patients and contaminated environmental surfaces [18].

Objective: The current study was conducted to estimate the prevalence of intestinal parasitic infections among certain occupations (food handlers, medical staff and street cleaners/sweepers) and to spot light on the associated factors to get a strategy to prevent and control the infections.

MATERIAL AND METHODS

Patient's Group: A cross - sectional study was conducted on randomized 300 Egyptian individuals from certain three occupational fields selected from the attendance of NHTMI during the period between August 2018 and April 2019. The studied subjects were 100 food handlers, 100 medical stuff, (physicians, chemistries, nurses and technicians) 100 street sweepers (50 males and 50 females in each group) Ethical approval was obtained from the Research Committee (RC) of General Organization for Teaching Hospitals and Institutes (GOTHI), written or verbal consent was taken from each participant.

Study Tools: Each studied participant was subjected to:
A- Questionnaire (age, sex, occupational, educational status, residence, source of water supply and type of sewage disposal system).

Samples Collections:

- Fresh urine sample was collected in a dry, clean, sterile and labeled container.
- Fresh stool sample was collected in a dry, clean sterile, labeled container, each was divided into four sub samples,1st sub sample prepared by direct smear method, the 2nd subsample prepared by parasep concentrator tubes, the 3rd subsample was examined by Kato-Katz method and 4th subsample for Copro antigens detection (all subsamples were examined immediately without delay).
- Blood sample: Five ml of peripheral blood was collected from each subject and centrifuged to separate serum that kept in cryo tube and preserved at -20 c until examined by Indirect Haemagglutination Test (IHA).

Procedures and Examination:

- Complete urine examination: By macroscopically and microscopic examinations and chemical items were examined using Automated DIRUI -H.500 DEVICE.
- Macroscopic stool examination: visible blood, mucous, pus, larvae, worms and the consistency were detected.
- Microscopic stool examination, using direct smear stained with Lugol iodine [19], Paraseb concentrator tubes on FE5 FECAL AUTOMATED PARASITIC WORK STATION and by Kato -Katz techniques [20]; for identification of parasitic eggs, larvae, cysts, trophozoites.
- Copro Antigens detections: - For *Entamoeba*, *Giardia lamblia* and *Cryptosporidium* antigens: using commercially available kits by COMBI- RIDA SCREEN, N 1712, BIOPHARMA, GERMANY, Immunochromotogrophic quantitative rapid quick test.

- Serologic examination: -By Indirect Haemagglutination Test (IHA) using commercially available kits by FUMOZE DIAGNOSTICS - FRANCE. Test procedures and interpretation guided by manufactures instructions as the following:
- For Schistosomiasis, titer ≥ 1: 160 indicates significant reaction, with presumption of acute infection.
- For Fascioliasis, titer ≥ 1: 320 indicates significant reaction in favor of acute infection.
- For Amoebiasis, titer ≥ 1; 160 indicates a significant reaction in favor of visceral amoebiasis.

Statistical Analysis: All statistical analyses were carried out by SPSS version 16. Descriptive statistics such as mean, standard deviation and range were used to describe quantitative data while frequency and proportion were used for qualitative one. Chi square and T test used to assess the differences between the groups. Odds ratio (OR) was used as a measure of the strength of association.

RESULTS

A total number of 300 workers was included in the study that (50% males and 50 % females) with equally distributed in the different occupational groups (medical staff, food handlers and street sweepers). The mean age was 38.8± 10.9 and ranged from 18 to 64 years. About one third of the participants had very low socio economic status and all among the street sweepers and only 13.3% had high socio economic status and all among the medical staff. As regard education, more than one quarter of the participants (27.3%) was illiterate and all among the street sweepers, 18 % was primary educated, 35.3 % was secondary educated and only 13.3% was highly educated and all among the medical group. More than two thirds of the participants had safe water supply (73%) and safe sewage disposal (78.7%) (Table 1).

The overall prevalence of parasitic infection among the participants was 54.3% (163/300) in which 39.3% (118/300) had single infection while 15% (45/300) had double infections. Street sweepers have the highest prevalence of parasitic infection (41/100 had single infection and 26/100 had double infections) while 45/100 and 15/100 had single and double infections respectively among food handlers (36.8%). The least prevalence was among the medical staff in which single infection was 32/100 *and* double infections 4/100). (Table 2).

Parasitic infection profile revealed 14 parasitic species. Their prevalence among the participants and their distribution among the studied occupational groups were illustrated in Figure 2, the most prevalent species was *Entamoeba histolytica* (12%) followed by

Table 1: Sociodemographic data of the participants

Characteristics	Medical staff N = 100	Food handlers n = 100	Street sweepers n = 100	Total participants N =300 (%)
Age (mean ± sd) Range	41.8± 9.7	32.3±11.0	42.2±8.9	38.8± 10.9
	24-60	18-60	22-64	18 - 64
Sex				
Male	50	50	50	150 (50)
female	50	50	50	150 (50)
Socio economic status				
Very low	0	0	100	100 (33.3)
Low	0	54	0	54 (18)
Moderate	60	46		106 (35.3)
High	40	0	0	40 (13.3)
Education				
Illiterate	0	0	82	82 (27.3)
Primary educated	0	55	18	73 (24.3)
Secondary educated	42	45	0	87 (29)
Highly educated	58	0	0	58 (19.3)
Environmental sanitation				
Safe water supply				
Yes	100	54	65	219 (73)
No	0	46	35	81 (27)
Safe sewage disposal				
Yes	100	68	68	236 (78.7)
No	0	32	32	64 (21.3)

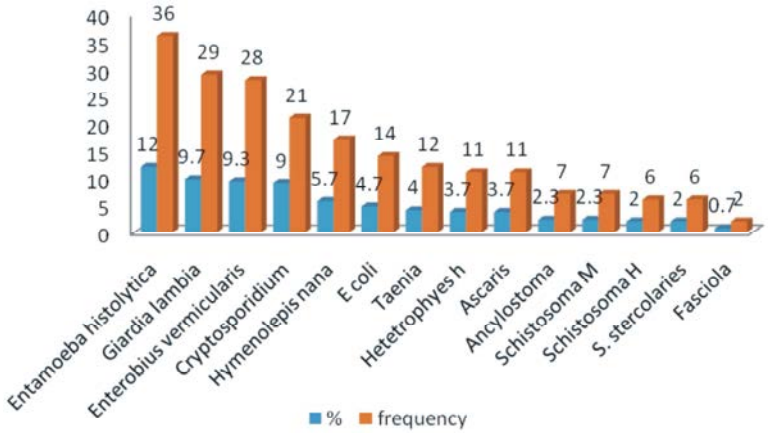

Fig. 1: Types of intestinal parasites among the participants

Table 2: Prevalence of intestinal parasitic infection among the studied groups

State of infection	Medical staff N = 100	Food handlers n = 100	Street sweepers n = 100	Total participants N =300 (%)
no infection	64	40	33	137 (45.7)
*Positive infection	36	60	67	163 (54.3)
Single infection	32	45	41	118 (39.3)
Mixed infection	4	15	26	45 (15)

*Total number of single and mixed infection

Table 3: Frequency of parasitic infection among different occupational groups

Types of intestinal parasites lumn1	Medical staff N = 100	Food handlers n = 100	Street sweepers n = 100	Total participants N=300(%)
Entamoeba histolytica	9	11	16	36 (12)
Giardia lamblia	8	11	10	29 (9.7)
Enterobius vermicularis	6	10	12	28 (9.3)
Cryptosporidium parvum	7	8	6	21 (9)
Hymenolepis nana	4	8	5	17 (5.7)
Entamoeba coli	0	3	11	14 (4.7)
Taenia spp.	0	6	6	12 (4)
Hetetrophyes heterophyes	2	5	4	11 (3.7)
Ascaris lumbricoides	1	5	5	11 (3.7)
Ancylostoma duodenale	0	3	4	7 (2.3)
Schistosoma mansoni	1	2	4	7 (2.3)
Schistosoma haematobium	0	1	5	6 (2)
Strongyloides stercolaries	0	1	5	6 (2)
Fasciola spp.	0	1	1	2 (0.7)

Giardia lamblia (9.7%), *Enterobius vermicularis* (9.3%) and *Cryptosporidium* (9%) then *Hymenolepis nana* (5.7%) *Entamoeba coli* (4.7%) and *Taenia spp.* (4%). Also, other species was detected as *Hetetrophyes hetetrophyes* (3.7%), *Ascaris lumbricoides* (3.7%), *Ancylostoma duodenale* (2.3%), *Schistosoma mansoni* (2.3%), *Schistosoma haematobium* (2%), *Strongyloides stercolaries* (2%) and *Fasciola spp*. (0.7%) (Figure 1).

Table 3; showed the distribution of intestinal parasites types among the different occupational groups. Among medical stuff, the most prevalent species was *Entamoeba histolytica* (9/100), *Giardia lamblia* (8/100), *Cryptosporidium parvum*. (7/100) and *Enterobius vermicularis* (6/100), *Hymenolepis nana* (4/100), *Ascaris lumbricoides* (1/100) and *Schistosoma mansoni* (1/100), while *E.coli, Taenia spp., Ancylostom duodenale, Schistosoma haematobium, Strongyloides stercoralis* and *Fasciola spp.* were not detected among this group.

Among food handlers, *Entamoeba histolytica* was the most frequent as (11/100) equally to *Giardia lamblia. Enterobius vermicularis* (10/100), *Cryptosporidium parvum.* (8/100) equally to *Hymenolepes nana*, while *Entamoeba coli was* (3/100), *Taenia spp.* (6/100), *Heterophyes heterophyes* (5/100) equally to Ascaris

Table 4: Prevalence of intestinal parasitic infection according to Sociodemographic data

Characteristics	Infected participants n=163 (54.3%)	Non infected N= 137 (45.7 %)	Chi square test	P value
Age	38.2 ±11.5	39.5±10.1	t =1.06	0.28
Sex				
Male	89 (54.6)	61 (44.5)		
Female	74 (45.4)	76 (55.5)	3.02	0.08
Occupation				
Medical personal	36 (22.1)	64 (46.7)		
Food handlers	60 (36.8)	40 (29.2)		
Street sweepers	67 (41.1)	33 (24.1)	21.3	<0.001
Socio economic status				
Very low	67 (41.1)	33 (24.1)		
Low	44 (27.0)	10 (7.3)		
Moderate	45 (27.6)	61 (44.5)		
High	7 (4.3)	33 (24.1)	50.4	<0.000
Education				
Illiterate	58 (35.6)	25 (18.2)		
Primary	58 (35.6)	14 (10.2)		
Secondary	28 (17.1)	59 (43.1)		
High	19 (11.7)	39 (28.5)	56.1	<0.001
Safe water supply				
Yes	88 (54)	131(93.6)	65.4	<0.001
No	75 (46)	6 (4.4)	Odds ratio= 18.6 95% CI (7.76, 44.6)**	
Safe sewage disposal				
Yes	104 (63.8)	132 (96.4)	46.9	<0.001
No	59 (36.2)	5 (3.6)	Odds ratio= 14.9 95% CI (5.8, 38.6)*	

* Independent sample T test ** Confidence interval

lumbricoides. *Ancylostoma duodenale* (3/100), *Schistosoma mansoni* (2/100), *Schistosoma haematobium* (1/100) equally to *Strongyloides stercoralis* and *Fasciola spp*.

While street sweepers showed 36/100 for *amoeba histolytica*, 29/100 *Giardia lamblia*, 12/100 *Enterobius vermicularis*, 6/100 for *Cryptosporidium equally to Taenia spp*., 5/100 for *Hymenolepis nana* equally to *Ascaris lumbricoides and Schistosoma haematobium*, 4/100 for *Heterophyes heterophyes equally to Ancylostoma duodenale and Schistosoma mansoni* and 1/100 for *Fasciola spp.* respectively.

No statistical significant difference was found in the prevalence of intestinal parasitic infections in relation to the age of the participants (p >0.05). According to their sex, the prevalence of infection was higher among males (54.6%) than females (45.4%) without significant statistical difference (p >0.05). There was significant statistical difference in the prevalence of infections as regards occupation, education and Socio economic status (p =0.000). Street sweepers have the highest prevalence (41.1%) then the food handlers (36.8%) and the least was among the medical staff (22.1%). Parasitic infection was highest among the participants with very low socio economic status (41.1%) and the least among those with high Socio economic status (11.7%). Illiterate and primary educated participants had the highest prevalence (35.6%) followed by secondary educated (17.1%), the highly educated participants had the lowest prevalence. According to environmental sanitation, 46% of the infected participants had unsafe water supply and about 36.2% had unsafe sewage disposal. Participants with unsafe water supply were 18.6 times more likely to be infected with parasites than those with safe water supply (95% CI 7.76, 44.6). Also Participants with unsafe sewage disposal were 14.9 times more likely to be infected with parasites than those with safe sewage disposal (95% CI 5.8, 38.6).

DISCUSSION

Human intestinal parasitic infections (IPIs) is a major cause of public health problem worldwide especially in the developing countries [21]. This study demonstrates the prevalence of intestinal parasitic infections among different risky occupational groups. The overall

prevalence of IPIs among the participants was 54.3% (163/300), of them 39.3% (118/300) had single infection while 15% (45/300) had multiple infections. This is similar to results obtained by [22] who found that 55% were infected with intestinal parasites among rural population in Sohag Governorate, Egypt. Bayoumy *et al.* [23] Reported that 67.1% of chronic diarrheic patients found to be infected with intestinal parasites in Delta region. Also, Mekonnen *et al.* [24] found that the overall prevalence of 52.1% (76.1% single infection and 23.9% double infections) in community based survey in Southwest Ethiopia, while in rural areas of West Malaysia, the prevalence of intestinal parasite was 73.2% [25].

Among our studied occupational groups, street sweepers have the highest prevalence of parasitic infections (41.1%, n = 67 /163) followed by food handlers (36.8%, n = 60/300) and the lowest prevalence was among medical staff (22.1% n = 36/300). In a previous studies by [16, 17], they detected that street sweepers coming into contact with blood, fecal matter, air particulates, mice/rats, flies, mosquitoes, stray animals and animal carcasses, debris, decayed matters remaining in containers, leachates and sludge that sometimes contains worms, also, they provide that personal protective equipment was not regularly used and sometime not available without any convenient washing facilities. In addition, Rahma *et al.* [26] reported bad attitudes of street sweepers towards taking preventive measures and personal hygiene. This could explain our results as we found that street sweepers had the highest prevalence of parasitic infection.

The lowest prevalence of infection was among medical staffs which are highly educated, moderate and high socio economic status and supplied with sanitary environment. However, among the medical staff there is 32% had single parasitic infection and 4% had double infections. This may be related to the nature of their work of contact with patients, contaminated materials with lake of infection control and outdoor feeding.

As regards street sweepers, 67% had parasitic infections, 41% had single infection and 26% had double infections. This result comes in agreement with Mba [27] who conducted a study among waste handlers workers in Nigeria and found that 63.5% of the street-sweepers had parasitic infections. Also, in agreement with results in Thailand; as 65% [28]. On the other hands, the finding in this work is 3 folds higher than prevalence reported by Ewis *et al.* [17]. in study conducted in Beni-Suef district, Egypt where the rate was 21.7%. Also higher than results reported by Baroody [19], as about 49.1% were infected with parasites among municipality solid-waste workers (MSWW) in Alexandria, Egypt. However, it is lower than the detected prevalence among MSWWs in Philippines (98%), Brazil (97%) and India (92%) [28].

Risky nature of some jobs is an important areas of risk for IPIs in the community. Food handlers may act as reservoir or source of the infection, with limited health education and lack of personal hygiene may be implicated in the role of transmission for many infections to their consumers in the community [15].

In our study, 60 % of food handlers had parasitic infections; as 45% single and 15% double parasitic infections. This result is 2 fold higher than reported by Badawey *et al.* [14] who conducted study among 250 food handlers from Zagazeg, Egypt in which infection rate was 32.4%. However, the prevalence of parasitic infections in that work varied according to occupational category to reach 55% among fruits/ vegetables sellers. Also, the result of this study was higher than other studies that were conducted the infection rate in Addis Ababa University, Ethiopia, 45.3% [30], in Eldoret Town, Kenya, 30.5% [31]; and in Gaza Strip, Palestine, 24.3% [32].

This discrepancy could be due to the difference among study population in relation to the occupational category, nature of the work and the differences in the educational level, other socioeconomic conditions and personal hygiene. Also the difference may be related to the diagnostic tools.

Parasitic infection profile had revealed 14 types of parasitic species. The most prevalent species was *Entamoeba histolytica* (12%) followed by *Giardia lamblia* (9.7%), *Enterobius vermicularis* (9.3%), *Cryptosporidium parvum* (9%), *Hymenolepis nana* (5.7%), *Entamoeba coli* (4.7%) and *Taenia spp*. (4%). Also, other species was detected as; *Hetetrophyes hetetrophyes* (3.7%), *Ascaris lumbricoides* (3.7%), *Ancylostoma duodenale* (2.3%), *Schistosoma mansoni* (2.3%), *Schistosoma haematobium* (2%), *Strongyloides stercolaries* (2%) and *Fasciola spp*. (0.7%). The distribution of these parasitic species was not different among the studied groups except for *Entamoeba coli*, *Taenia* spp., *Ancylostoma duodenale*, *Schistosoma haematobium*, *Strongyloides stercoralis* and *Fasciola spp*., as these species were not detected among medical stuff. These prevalences are quite in agreement with the results estimated by Badawey *et al.* [14] in which *Giardia lamblia* was 10%, *Entamoeba histolytica* 10%, *Taenia spp*. 4%, with lower prevalence rates for *Cryptosporidium* parvum 2.8%, *Ascaris lumbricoides* 2.4% *Hymenolepis nana* 2%, *Enterobius vermicularis*

1.6% and *Schistosoma mansoni* 0.8%. Kamau *et al*., in their study on 312 certified food handlers in Kenya, detected *Entamoeba histolytica* in 12.5%, with lower prevalence rate for *Giardia lamblia* and *Ascaris lubmricoides* than this study [13]. Also Balarak *et al*. [15] reported that *Giardia lamblia* was the most frequent 63.33% followed by *Entamoeba coli* 22.1%, while *Ascaris lumbricoides* was 5.83% among the studied food handlers in Iran.

Lower prevalence was estimated by [29] for *Hymenolepis nana* (0.6%), *Ascaris lumbricoides* (1.4%), *Enterobius vermicularis* (1.7%), *Entamoeba coli* (1.7%), *Giardia lamblia* (2.9%) *Entamoeba histolytica* (3.2%), while they estimate higher prevalence for *Cryptosporidium parvum* (23.4%) among MSW workers in Alexandria, Egypt.

This difference in the types of parasite species may be attributed to the differences in diagnostic analysis, geographic areas, climatic condition, occupation, socioeconomic conditions and safety measures.

Regarding relationship between parasitic infection versus socio demographic data, no significant statistical difference in the prevalence of IPIs in relation to the age of the participants was found ($p > 0.05$). This finding in agreement with that reported by [14, 15]. On the contrary, a significant association between age and parasitic infections was detected by Tefera and Mebrie [34].

According to sex, prevalence of infection was higher among males (54.6%) than females (45.4%) with no significant statistical differences ($p > 0.05$). This results agree with [15, 24].

The health of workers in any occupation gets influenced in large extent by their work environment and the nature of work. Parasitic infection was significantly associated with the occupation ($P<0.001$). Street sweepers have the highest prevalence followed by food handlers then the medical staff as discussed before. Prevalence of infection was significantly higher among participants with low socio economic status ($P<0.001$). Many other studies confirmed Low socioeconomic status as important risk factors [22, 25]. That effect could be attributed to several factors as bad sanitation, poor hygiene, overcrowded conditions and lake of medical services.

As regards education, there was a significant relationship between educational level and infection ($P<0.001$). The prevalence of infection was significantly higher among Illiterate and primary educated participants. Similar results were obtained in other studies In Egypt, reporting the importance of receiving hygiene education at schools, so; undereducated individuals will not be aware of the importance of proper personal hygiene [29, 35, 36].

Our results stated that there was significant statistical association between infection and unsafe water supply (Odds ratio= 18.6, 95% CI =7.76 to 44.6), this may be due to the fact that contaminated water is a major source of intestinal parasitic infection. This finding was in agreement with [37, 38]. Significant association of unsanitary sewage disposal and IPIs was revealed in this study (Odds ratio= 14.9, 95% CI= 5.8 to 38.6), as the intestinal parasites are transmitted mainly by the fecal-oral route or by direct penetration of the skin. So, the risk of infection will increase with such unsanitary environment.

From our findings, we concluded that intestinal parasitic infections still considered as an important public health trouble. The occupational group of street sweepers should be treated as a vulnerable group as they are uneducated. Low socioeconomic status and insanitary environment are significantly related to the high prevalence of IPIs. Multidimensional actions should be taken. Applying standardized waste management processes, proper sanitation improving socio economic status are the best actions. Preventive and safety measures including personal protective equipment should be emphasized and used for those workers. Occupational health services including regular health examination and health education should be provided to these workers.

Also, we conclude a high rate of intestinal parasitic infection among food handlers and may predispose consumers to significant health risks. Therefore, we recommended for guidelines safety measures, improvement of environmental sanitation pre-employment and periodic clinical and laboratory complete stool examinations (using more than one technique) every three months, treatment of the infected cases, health education program and regular follow up of the validity of health cards for food handlers to control the parasitic infection among them.

Additionally, we conclude that medical staff was at risk for IPIs. Effective infection control measures should be maintained. Further studies should be done to provide more evidence about the prevalence and investigate their sources of infections for prevention and control.

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