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RISK FACTORS OF INTESTINAL PARASITES AMONG FOOD HANDLERS IN EGYPT

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Abstract

Food handlers play an important role in transmission of intestinal parasitic infections (IPIs) during manufacturing, processing, handling, and serving of foodstuff. This study determined the prevalence of IPIs among food handlers in Greater Cairo, and the associated risk factors. A cross sectional study was designed as 250 food handlers attending four provision health offices from different governorates of Greater Cairo were examined. Demographic data and risk factors that increase the IPIs transmission were collected in designed questionnaire. Stool samples were collected and examined by direct wet/iodine mounts, formol diethyl acetate concentration, and modified Ziehl-Neelsen staining techniques. The results showed that sixty-five food handlers (26%) had IPIs. The commonest detected parasites were *Entamoeba histolytica/dispar* (24.6%), *Entamoeba coli* (20%), *Blastocystis hominis* (16.9%), *Giardia intestinalis* (12.3%), *Enterobius vermicularis* (10.8 %), and *Ascaris lumbricoides* (7.7 %). A higher significant ($p<0.001$) prevalence of IPIs was among food handlers from rural areas, with low educational levels, having neither health certificates nor personal hygienic control. However, insignificant differences were noticed regarding age, sex, and working experience.

Keywords: Food handlers, IPIs, Intestinal parasites, Stool examination.

Introduction

Intestinal parasitic infections (IPIs) are among the most risky public health problems globally particularly in the developing world leading to significant morbidity and mortality (Ahmed, 2023). WHO (2020) mentioned that about 1.5 billion people (24%) of world population suffered from soil-transmitted IPIs, helminths and protozoa. Unfortunately, pre-school children were more susceptible to infection (Kassaw *et al*, 2019). The IPIs are spread directly or indirectly by contaminated food, water, fruits, and vegetables (Tefera and Mebrie, 2014). Also, protozoa infection occur either after ingestion of cysts or oocysts through the feco-oral route and/or after ingestion of contaminated food or water (WHO, 2011). Food handlers with improper personal hygiene practices have a significant role in transmission of IPIs especially protozoa (Ayana *et al*, 2015). Food contamination can occur at any time during processing, distribution, or preparation with bad food handlers' self-hygiene, food hygiene knowledge and practices (Mobolaji and Olubunmi, 2014). In addition, asymptomatic patients are dangerous community source in spreading IPIs to others through food, water, and autoinfection (Feleke *et al*, 2023). The IPIs transmitted by food handlers ranged between 9% in Iran (Kheirandish *et al*, 2014), 36% in Ethiopia (Mama and Alemu 2016), up to 46.3% in Gambia (Jallow *et al*, 2017). They reported that the commonest parasites were *A. lumbricoides, E. histolytica/dispar, G. intestinalis, S. stercoralis, Hymenolepis nana, and Taenia* spp. Nevertheless, Abu-Madi *et al.* (2008) in Qatar among immigrant food handling occupations of both sexes reported an overall rate of 33.9%. Parasites were *Trichuris trichiura* (26.3% among the Philippine females), hookworms, *A. lumbrioides, E. histolytica/dispar*, *Blastocystis hominis*, and *G. lamblia*. They added that multiple infections were uncommon, but some patients (0.1%) had 5 parasitic species concurrently. Fathy (2011) in Sirte-Libya among 400 male food-handlers reported (35.5%) only *B. hominis*. Abu-Odeh in United Arab Emirates among 133 healthy individuals reported *B. hominis* (44.4%).

In Egypt, in Zagazig City districts up to

32.4% the IPIs were reported, which were *G. intestinalis, E. histolytica/dispar, Taenia* spp., *Cryptospodium* spp., *A. lumbricoides, H. nana, E. vermicularis,* and *Trichocephalus trichuris* (Badawey *et al,* 2015). Bayoumy *et al.* (2016) in the New Valley Governorate reported an overall prevalence rate of 39.1% among the primary and preparatory school children.

The present study aimed to estimate the risk factors of the intestinal parasitic infections (IPIs) among the preventatives food hand lers in the Greater Cairo (Cairo, Giza and Qalyubia).

Subjects and Methods

Study design: This cross-sectional study was conducted during the period from January to December 2020 on the food handlers from Greater Cairo who attended El Matarria-North Cairo, Abbassia- East Cairo and El Kanater El Khairyia, Qalyubia and El Harm, Giza Food Health Provision Offices for employment certification. The global positioning system (GPS) showed the distribution of these health offices. The sample size was clarified by a statistician and 250 of the food handlers were chosen by using a simple random-sampling technique, where they were allocated as numbers then using a random number generator to select the sample as: 50 (20%) from Abbassia health office and 100 (40%) from El-Mataria health office representing Cairo Governorate, 50 (20%) from El-Haram health office representing Giza governorate, and 50 (20%) from El Kanater El Khairyia health office representing Qalyubia Governorate.

Inclusion criteria: All food handlers were asymptomatic of both sexes, aged from 18 up to 60 years old, and with at least one year working experience.

Exclusion criteria: All the food handlers who suffered from acute or immunosuppressive diseases or on chemotherapies. Also, those on treatment for parasitic infection for three months before were excluded.

The standard medical questionnaire was adopted after Hripcsak and Wilcox (2002), and was translated into the Arabic language to be suitable for all the food handlers. The questionnaire was filled out on each one included sociodemographic data as name, sex, age, educational level, main job, and working experience, as well as the routine medical check-up, family diseases and/or therapeutic intake history, and awareness of food heath hygiene and food transmitted diseases.

Ethical considerations: The study protocol was approved (FMASU MS 483/2020) by the Ethics Committee, Faculty of Medicine, Ain Shams University, following the regulations of the Egyptian Ministry of Public Health and Population which went with Helsinki Declarations (1982). They gave signed consent after clarifying the study objectives and that the results would be for the study purpose.

Stool collection: All food handlers were given clean labelled screw-capped containers to deliver stools avoiding any urine contamination.

Stool examinations: Samples were macroscopically examined for the adult worms and gravid segments. Each sample was then divided into two parts; one part was microscopically examined by direct wet mount, and the second one was fixed in 10% formalin for formol ethyl-acetate concentration and MZN staining (Garcia, 2016).

Statistical analysis: Data were collected, tabulated, and computerized, to an IBM personal computer, and analysed using the statistical program (SPSS) Statistical Package for Social Science Version 23.0 (SPSS Inc., Chicago, Illinois, USA). The descriptive and analytical data included the frequencies and percentage. The Chi-square test was used for comparing between two or more qualitative data, and the agreement tested to the congruency of two results. The P-value was considered significant at 0.05 or less and highly below 0.001.

Result

The results were given in tables (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 & 12) as well as figures (1 & 2).

Table 1: Food handlers' demographic data.

Variations	No.	Percentage	Median	M±SD
Ages: ≤20 years	20	8.0	32	34.35±10.99
: 21-30 years	86	34.4		
: 31-40 years	71	28.4		
: 41-50 years	44	17.6		
: >50 years	29	11.6		
Male	238	95.2		
Female	12	4.8		
Residency: Rural	128	51.2		
: Urban	122	48.8		
Working experience: <5 years	80	32.0	8	10.83±8.45
: 6-10 years	63	25.2		
: 11-20 years	62	24.8		
: 21-30 years	39	15.6		
: >30 years	6	2.4		
Educational levels: University	18	7.2		
Intermediate school	219	87.6		
Primary & illiterate	13	5.2		

Table 2: Working place and jobs.

Variations	No.	Peercentage
General restaurant	84	33.6
Restaurant of hotel	46	18.4
Restaurant of food company	42	16.8
Restaurant of elderly home	19	7.6
Restaurant of orphanage	6	2.4
Restaurant of hospital	19	7.6
Juice shop	33	13.2
Café	1	0.4
Job: Restaurant manager	26	10.4
: Senior chef	17	6.8
: Chef	71	28.4
: Chef assistant	29	11.6
: Waiter	68	27.2
: Worker	39	15.6

Table 3: Food handlers with valid medical certificate and yearly licensed.

Variations	No.	Percentage
Regular medical checkup with certifiedlicense.	128	51.2
No regular checkup orcertified license.	122	48.8

Table 4: Food handlers and safety hygiene

Variations	Negative		Positive	
	No.	%	No.	%
Wearing protective coat or gown and haircover during working	125	50.0	125	50.0
Fingernail trimming.	101	40.4	149	59.6
Wearing of rings during work.	125	50.0	125	50.0
Availability of hand washing facility.	65	26.0	185	74.0
Hand washing with soap and water before working	88	35.2	162	64.8
Hand washing with soap and water after toilet.	131	52.4	119	47.6
Hand washing with soap and water after touching a dirty material.	146	58.4	104	41.6

Table 5: Food handlers and knowledge on IPIs transmission

Transmission variations	Negative		Positive	
	No.	%	No.	%
From person to person	121	48.4	129	51.6
Hand washing before food handling reduces IPIs.	128	51.2	122	48.8
Proper clothing and hair cover reduces IPIs.	142	56.8	108	43.2
Cleaning of utensils reduces IPIs.	138	55.2	112	44.8

Table 6: Micro-organisms by MZN-stained stool smears.

MZN staining	No.	%
Negative	225	90.0
Positive	25	10.0
Cryptosporidium spp.	15	60.0
Microsporidia	10	40.0

Table 6: Parasites detected in stools by different techniques

Stool analysis	No.	Percentage
Negative	185	74.0
Positive	65	26.0
E. histolytica/dispar	16	24.6
E. coli	13	20
B. hominis	11	16.9
E. histolytica & B. hominis	3	4.6
G. intestinalis	8	12.3
A. lumbricoides	5	7.7
E. vermicularis	7	10.8

Table 8: Correlation between IPIs and demographic data.

Variations	Positive(n=65)		Negative (n=185)		Chi-square test	
Health office target	No.	%	No.	%	x^2	P-value
Abbassia Health Office	10	15.4	40	21.6	3.274	0.351
Mataria Health Office	29	44.6	71	38.4		
Haram Health Office	10	15.4	40	21.6		
Kanater Health Office	16	24.6	34	18.4		
Ages: ≤20 years	7	10.8	13	7.0	8.195	0.085
21-30 years	30	46.2	56	30.3		
31-40 years	15	23.1	56	30.3		
41-50 years	9	13.8	35	18.9		
>50 years	4	6.2	25	13.5		
Sexes: Male	64	98.5	174	94.1	2.045	0.153
Female	1	1.5	11	5.9		
Residency: Rural	45	69.2	83	44.9	11.429	<0.001**
Urban	20	30.8	102	55.1		
Working experience:<5 years	27	41.5	53	28.6	8.304	0.081
6-10 years	20	30.8	43	23.2		
11-20 years	10	15.4	52	28.1		
21-30 years	7	10.8	32	17.3		
>30 years	1	1.5	5	2.7		
Educational level: University	7	10.8	11	5.9		
: Intermediate education	51	78.5	168	90.8	7.631	0.022*
: Primary & illiterate	7	10.8	6	3.2		

P-value >0.05 Insignificant; *P-value <0.05 Significant; **P-value <0.001 Highly significant.

Table 9: Correlation between IPIs and working place and job title of food handlers.

Working place & Job title	Positive(n=65)		Negative (n=185)		Chi-square test	
	No.	%	No.	%	x^2	P-value
General restaurant	37	56.9	47	25.4		
Restaurant of hotel	5	7.7	41	22.2		
Restaurant of food company	5	7.7	37	20.0		
Restaurant of elderly home	4	6.2	15	8.1		
Restaurant of orphanage	2	3.1	4	2.2	23.802	<0.001**
Restaurant of hospital	2	3.1	17	9.2		
Juice Shop	9	13.8	24	13.0		
Café	1	1.5	0	0.0		
Jobs: Senior chef	2	3.1	15	8.1		
Chef	10	15.4	61	33.0		
Chef Assistant	9	13.8	20	10.8		
Restaurant manager	2	3.1	24	13.0	21.809	<0.001**
Waiter	26	40.0	42	22.7		
Worker	16	24.6	23	12.4		

Table 10: Correlation between IPIs and food handlers' regular medical certificates

Regular valid medical certifi-cates	Positive (n=65)		Negative (n=185)		Chi-square test	
	No.	%	No.	%	x^2	P-value
Yes	15	23.1	113	61.1	27.805	<0.001**
No	50	76.9	72	38.9		

Table 11: Correlation between IPIs and food handling hygiene and safety related factors of food handlers.

Variations	Positive(n=65)		Negative(n=185)		x^2	P-value
	No	%	No	%		
Wearing protective coat or gown and hair cover during working	16	24.6	109	58.9	22.640	<0.001**
Fingernail trimming.	24	36.9	125	67.6	18.760	<0.001**
Wearing of rings duringwork.	33	50.8	92	49.7	0.021	<0.885
Availability of handwashing facility.	40	61.5	145	78.4	7.090	<0.008*
Hand washing with soapand water before startingwork.	24	36.9	138	74.6	29.926	<0.001**
Hand washing with soapand water after toilet.	12	18.5	107	57.8	29.900	<0.001**
Hand washing with soap and water after touching a material.	11	16.9	93	50.3	22.017	<0.001**

Table 12: Correlation between IPIs and food handlers' awareness.

Variations	Positive(n=65)		Negative(n=185)		x^2	P-value
	No.	%	No.	%		
IPIs are transmittable from person to person	15	23.1%	114	61.6	28.614	<0.001**
Hand washing before handling food reduce IPIstransmission	14	21.5	108	58.4	26.127	<0.001**
Proper clothing and hair coverreduce IPIs transmission	13	20.0	95	51.4	19.268	<0.001**
Cleaning of utensils decrease IPIs transmission	13	20.0	98	53.3	21.508	<0.001**

P-value >0.05 Insignificant; *P-value <0.05 Significant; **P-value <0.001 Highly significant.

Discussion

IPIs are among the major foodborne health problems globally especially in developing countries as most food handlers are asymptomatic and doing activities without considering illness propagation (Mama and Alemu, 2016).

In the present study, out of 250 food handlers attending four different food health provision offices for job certification, 65 (26%) were positive for IPIs. The most common parasites were *E. histolytica*, *E. coli*, *B. homi nis*, *G. intestinalis*, *A. lumbricoides*, and *E. vermicularis*, with the prevalence of 24.6%, 20%, 16.9%, 12.3%, 7.7%, and 10.8% respectively. Among the MZN-stained smears of IPIs infected food handlers 15/25 (60%) had *Cryptosporidium* spp. and 10 (40%) had *microsporidia*. This agreed with Badawey *et al.* (2015) in Zagazig district who reported that 32.4% of food handlers had IPIs (helminthic, protozoan, and mixed infections; 12%, 22.8% and 2.4%, respectively). Besides, Aklilu *et al.* (2015) in Ethiopia reported the dominancy of *E. histolytica* and *G. lamblia*. However, *G. intestinalis* was the most common protozoa among food handlers in Iran (Sharif *et al*, 2015). In Kenya, Kamau *et al* (2012) reported *G. intestinalis* was one of the six common parasites diagnosed among restaurant staff members. In Ethiopia, studies reported that IPIs among food handlers ranged between 16% (Mama and Alemu, 2016) and 36% (Girma *et al*, 2017). Al-Shabib *et al* (2016) in Saudi Arabia reported that 12.8% of the food handlers were IPIs positive. Also, Teimouri *et al.* (2021) in Iran reported that the overall prevalence of IPIs among the food handlers was 19.3% of which 20% were protozoa and 1.6% helminthic infections. They added that *G. intestinalis*, *E. coli*, and *Blastocystis* spp. were the commonest protozoa, and *A. lumbricoides*, *E. vermicularis* and *H. nana* were the most common worms. In Ethiopia, Desalegn *et al.* (2022) reported that 46.3% of the food handlers had IPIs, due to contact with domestic animals, lack of training in food handling and human infection control practices. Certainly, the differences in IPIs prevalence among countries are related to geographical status and climatic changes disasters (Morsy *et al*, 2024).

In the present study, there was a high significant association between IPIs rate and the food handlers from rural areas, working in general restaurants, with low educational levels and lacking previous health certificate ($p< 0.001$). Also, there was a correlation between IPIs rates and sociodemographic data; residency, in rural than urban areas, and in low and intermediate educational than university graduated. Nevertheless, there was no correlation between IPIs and age, sex, and working experience of food handlers. This agreed with Anjum *et al*. (2017) in India, they gave the same findings. In contrast, Mama and Alemu (2016) in Ethiopia report-

ed a high IPIs (22.6 %) in female food handlers than (12%) in males Moreover, the results of the current study showed a relatively higher infection rate in the age group younger than 30 years (57 %). This agreed with Moyo and Moyo (2020) in Zimbabwe.

In the present study, there was a highly significant prevalence of IPIs among those working in general restaurants, mainly waiters and workers ($p<0.001$). Omalu *et al.* (2013) in Nigeria reported that the food safety authorities must focus on personal hygiene and periodical medical check-ups. Zaglool *et al*. (2011) in Egypt stressed on the food handlers as potential sources of infections and suggested health institutions for appropriate hygienic and sanitary control measures. Sharif *et al*. (2015) in Iran recommended routine screening and food handlers treating were a proper tool to prevent the food-borne infections. WHO (2024), in the world food safety day mentioned that over 200 diseases are caused by eating contaminated food, and 40% of infected people were children less than 5 years old.

In the present study, there was a highly significant ($p< 0.001$) association between the IPIs and the food handlers awareness about their personal hygiene (hand-washing, proper clothing and hair cover, as well as cleaning of utensil). This agreed with Hajare *et al.* (2021), who reported that food handlers with high IPIs prevalence had relatively less knowledge about the parasitic infections. They interpreted this relation by that when the literacy rate increases, awareness about parasitic infections will also increase. Thus, lower need for health advice and good compliance with sanitary regulations will be achieved. Also, Hassan *et al* (2022) in Ain-Sham University Hospitals raised the awareness and comprehension to the food-handlers and food-borne illnesses. They added that the food-handlers must be periodically examined for food-borne diseases; parasites, bacteria and especially viral ones. Besides, Hafez *et al.* (2022) reported that among some groups all food handlers in Egypt governmental hospitals showed knowledge, attitude, and practices less than half of what they must be.

Conclusion

The food handlers play an important role in the spread of IPIs in the community. A first step in reducing the incidence and prevalence of foodborne hazards is to ensure that food handlers receive frequent and effective food safety training and routine medical check-up. This is obligatory to continue in food processing chain, and human safety.

Also, periodical health educations are mandatory not only in Egypt, but also abroad.

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Explanation of figures

Fig. 1: Parasites detected by direct iodine stool smears: a- *Entamoeba histolytica cyst*, b- *E. h.* trophozoite, c- *Entamoeba coli* cyst, d- *Blastocystis hominis*, e- *Giardia lamblia* cyst, f- *Ascaris lumbricoides* egg, and g- *Enterobius vermicularis* eggs.

Fig. 2: Parasites detected by MZN stain: a- *Cryptosporidium* spp. Oocyst, & b- *Microsporidia* spp.