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Intestinal Parasitosis Among Food Handlers In The University Hospitals Of Antananarivo, Madagascar

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Abstract: Introduction:Intestinal parasitic infections (IPIs) are a major public health in Madagascar. Food handlers in hospital settings may be potential sources in the transmission of intestinal parasites. The aim of this study was to estimate the prevalence of intestinal parasites and identify associated factors among food handlers in Antananarivo University Hospitals in 2018.
Methods:A descriptive analytical study was conducted. Data were collected by a pre-tested face-to-face questionnaire, supplemented by an observational control. Fresh stool samples were collected from the participants, and examined microscopically by the stool technique 3 successive times spaced 3 to 5 days apart.
Results: Of the 74 staff, the prevalence was 27.03% or 20 cases. Ascaris lumbricoides is the most encountered parasite with a rate of 37.50% (n=10), followed by T. trichiura of 29.16% (n=8), then Giardia intestinalis of 8.33% (n=2), and Ankylostoma duodenale, cysts of Endolimax nana, Entamoeba histolytica/ E.dispar, Entamoeba hartmanni were also found. No association of risk factors that could influence intestinal parasitosis was found.
Conclusion:This high prevalence of intestinal parasitosis among food handlers is of major public health importance. Routine screening for intestinal parasitosis at least once a year and good personal and food hall hygiene to ensure food safety in teaching hospitals should be realized.

Keywords: Intestinal parasitic infections, food handlers, Madagascar

INTRODUCTION

Food borne diseases are public health problems worldwide.Intestinal parasitosis is classified as a neglected tropical disease and is associated with poor hygiene. They constitute a major public health problemin developing countries such as Madagascar, of which 3.5 billion are infected worldwide (1, 2). Food handlers who handle the production and distribution of food among society may be potential sources of direct or indirect transmission of these parasitic infections (3). Parasitic infections in food handlers can pose a threat to people who are more vulnerable to infections, which really justifies the importance of good food handling in hospitals (4).Many research works indicated different factors suchas lack of personal and environmental sanitation, lackof safe

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water supply, human behavior, poverty, and ignoranceof health promotion practices had association withprevalence of Intestinal parasitosis among food handlers (5,6) .Food handlers with poor personal hygiene in food establishmentcan be considered as dangerous to the societybecause they are unaware of their potential to transmit. In Madagascar: to our knowledge, no study on intestinal parasitosis among food handlers in university hospital cafeterias has been conducted to date. In this context, we conducted a study on intestinal parasitosis among food handlers in the cafeterias of Antananarivo university hospitals in 2018. Therefore, the aim of this study was to assess the prevalence of intestinal parasitosisand associated factors among the food handlers working in the catering services of the university hospitals of Antananarivo.

1. MATERIALS AND METHODS

1.1. Study site

Our study was carried out in the four (04) catering services of the university hospitals of Antananarivo: Hospital center Mother-Child Ambohimiandra (CHUMEA), Joseph Raseta Befelatanana University Hospital (CHUJRB), Hospital Center of Soavinandriana (CENHOSOA), Sainte Fleur Pavilion at the Joseph Ravoahangy Andrianavalona University Hospital (CHUJRA).

1.2. ***Study Design***

This was a descriptive and analytical cross-sectional study. Intestinal parasitosis in catering staff of university hospitals were studied during a two-month survey from July 03 to August 31, 2018.

1.3. Study population

Study population comprised of asymptomatic food handlersworking in the four cafeterias of University hospitals of Antananarivo. About 76food handlers were working in these cafeterias during the study period and their list was obtainedfrom human resource management of each hospitals.

1.4. Inclusion and exclusion criteria

All staff working at the university catering services that consented to participate in the study and brought stool samples was included. While all the staff of the university hospitals who did not bring fresh stool samples and who have taken anti parasitic drugs in the last3 weeks before the study were excluded.All catering staff that had at least one of the three (03) stool examinations, showing the presence of intestinal parasites on macroscopic and/or microscopic examination of the stool returned positive was considered positive.

The variables studied were the results of the KAOP stool examination and the data collected from the questionnaire. The conditions for stool collection were explained to the participants and three collection bottles were distributed.Socio-demographic data, and other associated risk factorswere collected using interview by pre tested structuredquestionnaire.

A structured and pretested questionnaire was used to collectdata related to socio-demographic, economic, personal andenvironmental characteristics. Variables such as age, sex,monthly income, personal hygiene, regular medical checkup,waste management and accessibility to safe water supplywere included in the questionnaire. The questionnaire was prepared into local language and French. Trained staffs collected the data.

1.5. *Specimen collection and examination*

For each patient, three samples were requested three to five days apart. Each freshly collected stool sample was analyzed within two hours of collection.After receiving of the specimen, a macroscopic examination is performed, which includes the analysis of the consistency and color of the stool and the search for blood or mucus. Then, a direct microscopic examination of the stool sample wasdone by direct wet mount preparations in normal saline and iodine solution. Formol ether concentration sedimentation techniques were also done as per the standards.

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1.6. Data quality management

Microscopic examinations were done by experiencedlaboratory technologist with at least 2 years work experience. Cross checking of slides was done blindly by otherlaboratory technologist and a standard operational procedureof examinations was followed. Careful cleaning,coding and entering of data were done.

1.7. Data analysis

The data collected were transcribed on the data collection form. The collected data were processed on the Epi-info 7.0 software. This processed data was transcribed on Microsoft Word 2016 computer software for text and Microsoft Office Excel 2016 for tables and graphs.

The Chi2 test was used for comparison of percentages and a $p < 0.05$ was defined as the threshold for significance.

1.8. Ethical Considerations

The data were collected after obtaining permission from the heads of the university hospitals. A written informed consent wasobtained from all study participants before data collection. Results were kept confidential and food handlers found positive for any parasitic infection were informed of the result and treated with appropriate anti-parasitic treatment.

1.9. Limitations of the study

This study has several limitations. First, information bias may have occurred, as some staff members might have provided inaccurate or socially desirable responses to the survey. Second, not all participants submitted the full set of three stool samples, which could have reduced the diagnostic sensitivity for certain parasites. Finally, the anal scotch tape test for *Enterobius vermicularis* (pinworm) was not performed, potentially leading to an underestimation of the prevalence of this infection. Finally, the study was conducted several years ago, which may limit the current applicability of the findings; however, it underscores the need for more recent, comprehensive, and methodologically robust studies to better assess the present epidemiological situation.

2. RESULTS

2.1. Socio-demographic characteristics

Our study involved 76 catering agents of the four (04) university hospitals of Antananarivo, 74 of them consented to participate in the study. Among them, 41 were women (55.4%)and 33 men (44.6%). The sex ratio (M/F) was 0.8.The age range of the participants was from 17 to 68 years with a mean age of 28 years. The majority (68.9%, n=51) lay in the age group of 15- 30 years (Table 1).

Table 1: Socio-demographic characteristics of the food handlers, Antananarivo University Hospitals, 2018

Characteristics (n= 74)	Categories	Frequency (N)	Percentage (%)
Sex	Male	33	44.59
	Female	41	55.40
	Sex ratio	0.8	
Age in years	[15-30[	51	68.91
	[30-45[	15	20.27

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	>45	8	10.81
Educational status	Primary school	9	12.16
	Secondary school	47	63.51
	College and above	18	24.32
Job position	Cook	21	28.37
	Cashier	8	10.81
	Dishwasher	8	10.81
	Waiter	19	25.67
	cleaner	7	9.45
	Others	11	14.85

2.2. **Prevalence of intestinal parasitosis in food handlers**

All agents gave a first stool sample with a prevalence of 27, 03% or 20 positive cases. For the second stool sample, 4 agents did not bring stool, and we found 10 positive cases with one new case of intestinal parasitosis (13.51%). And for the third stool sample, 28 agents did not bring specimens. On macroscopic examination, no adult parasites were observed in all stool samples.

From the total of stool specimens, 27,03% were positivefor at least one parasite species. Eight types of intestinalparasites were identified. The most prevalent parasite was *Ascaris lumbricoides*(50 %, n=10/20) followed by *Trichuristrichiura* (n= 5/10) and then *Giardia intestinalis* with a rate of 8.33% (n=2)(table 02)We found *Ankylostoma duodenale*, *Entamoeba histolytica/Entamoeba dispar(Eh/Ed), Entamoeba hartmann*i with 4.16% each (n= 4).Depending on the technique used, direct examination with lugol iodine was able to detect protozoa such as *Giardia intestinalis* and cysts of *E.histolytica/E.dispar* and *E.hartmanni*. On direct examination using physiological water, our study detected the presence of helminths including *A.lumbricoides* (n=10), followed by *T.trichiura* (n=5) and one case of *A. duodenale* was found. Among the 28.38% of the agents infected with intestinal parasitosis 16 individuals showed monoparasitism and 5 individuals showed polyparasitism. Polyparasitism was dominated by the association of *A.lumbricoides* and *T.trichiura* in 4.05% (n=3) of cases.

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Table 2: Parasite species found by direct examination using Lugol's iodine and physiological water

Technical used	Parasites	Frequency (N)	Percentage (%)
Lugol'sIodine	*Giardia intestinalis* (Cyst)	2	2,70
	Entamoeba histolytica/ Entamoeba dispar(Cyst)	1	1,35
	Entamoeba hartmanni (Cyst)	1	1,35
Physiological water	*Ascaris lumbricoïdes*	10	13,51
	Trichuris trichiura	5	6,76
	Ancylostoma duodenale	1	1,35

2.3. **Univariate analysis of risk factors for intestinal parasitosis in MDA**

Several factors were assessed for possible association with intestinal parasitosis infection (IPI) among the food handlers as shown in Tables 3,4,5.A univariate analysis of the risk factors was performed; the variables that could influence intestinal parasitosis were socio-demographic characteristics, clinical characteristics, personal hygiene, food hygiene, hygiene of the dining room, and knowledge of the food handlers on intestinal parasitosis.

Among socio-demographic characteristics, no association with intestinal parasitosis was found, p values were non-significant. For age, the p-value was equal to 0.90, for gender it was 0.42, for educational level p was 0.30 and for position held in the cafeteria p was 0.94.

There was no association between clinical characteristics and intestinal parasitosis in our study, for all variables, the p-value was non-significant.

As for the personal hygiene of the food handlers, all responded that they took care of their nails, wore a clean gown and cap, however intestinal parasitosis was presented with a rate of 27,03% (n=20), no association was found with intestinal parasitosis, but for hand washing with soap and water after body contact, 20.27% (n=15) of MDAs who answered yes had intestinal parasitosis against 8.10% (n=6) who answered no, the p value was non-significant at 0.53.

As for the hygiene of the food practice of the food handlers, all answered yes in washing hands with soap and water before the preparation of food, the existence of materials for the protection of cooked food, the washing of hands with soap and water after each defecation, but we found intestinal parasitosis with a rate of 28.38%.

For the level of knowledge of the MDAs on intestinal parasitosis, all the MDAs answered yes on hygiene and food safety training. Among them who answered yes on the adequate training on catering, 21.6% (n=16) of them presented intestinal parasitosis against 6.75% (n=5) of the infected personal who did not receive this training. Regarding the knowledge of MDAs about

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intestinal parasitosis, 8.10% (n=6) of MDAs who answered yes had been infested with intestinal parasitosis against 20.27% (n=15) infected who had no knowledge about intestinal parasitosis.

Table 3: Socio-demographic factors associated with IPIs among food hanlders, in Antananarivo University Hospitals, 2018

Variables	Categories	Parasitic Infections		OR (95% CI)	*p value*
		Positive (n= ; %)	**Negative (n= ; %)**		
Age (years)	[15-30[	14 (18.92)	37 (50)		
	[30-45[	4 (5.4)	10 (13.52)	0,71 [0,16-3,15]	0,90
	>15	2 (2.70)	7 (9.46)	0,69[0,08-5,54]	
Gender	Female	12 (16.21)	29 (39.2)	1,15 [0,28-4,62]	0,42
	Male	8 (10.81)	25 (33.78)		
Educational status	Primary school	4 (5.4)	5 (6.76)	4,59 [0,54-38,56]	0,30
	Secondary school	13 (17.56)	34 (45.95)	2,19[0,38-12,44]	
	College and above	3 (4.05)	15 (20.28)		

IPIs : intestinal Parasitic Infection

OR: Odds ratio

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Table 4: Factors associated with IPIs among food hanlders, in Antananarivo University Hospitals, 2018

Variables	Categories	Positive (n= ; %)	Negative (n= ; %)	OR (95% CI)	*p value*
	Yes	20 (27.03)	54(72.97)		1
Hand washing	No	0	0		
Hand washing before food preparation	Yes	20 (27.03)	54(72.97)		1
	No	0	0		
Hand washing after contact with body	Yes	14 (18.93)	43(58.10)	1,67 [0,52-5,36]	0,53
	No	6 (8.10)	11 (14.87)		
Hand washing after defecation	Yes	20(27.03)	54(72.97)		1
	No	0	0		
Source of water	Robinet	20(27.03)	54(72.97)	[0,74-14,95]	0,07
Drinking water treatment	Yes	16(21.64)	50(67.56)	3,33	0.075
	No	4(5.40)	4 (5.40)		
Use of Soap in the toilet	Yes	20 (27.03)	54(72.97)		
Fingernail status	Trimmed	20 (27.03)	54(72.97)		

OR: Odds ratio

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Table 5: Knowledge of IPI's by the food handlers working in Antananarivo University Hospitals, 2018

Variables	Categories	Positive (n= ; %)	Negative (n= ; %)	OR (95% CI)	*p value*
	Yes	20 (27.03)	54(72.97)		1
Hygiene and food safety training	No	0	0		
Knowledge training on Intestinal Parasitosis	Yes	6 (8.10)	21 (28.38)	2.41 [0,16-36.48]	1
	No	14 (18.92)	33 (44.60)		
Knowledge about IPIs contaminations	Yes	6 (8,10)	21 (28,38)	0,86 [0,07-10,72]	0,77
	No	14 (18.92)	33 (44.60)		
Prevention of IPIs	Knowledge	6 (8,10)	21 (28,38)	1,17 [0,09-13,99]	0,46
	No	14(18.92)	33 (44.60)		
Deworming	< 6 months	12 (16.21)	35 (47.3)	0,79 [0,27-2,30]	0,78
	> 6 months	8 (10,81)	19 (25.68)		

OR: Odds ratio

3.DISCUSSION

Contaminated food is a major threat to public health since it remains a key source of morbidity and mortality and hinders socio-economic development (6). The main route of transmission of intestinal parasitic infections is fecal-oral, via food, water and environments contaminated with these parasites (5). Food handlers directly involved in the production and distribution of food are among the most important sources of transmission of parasitic infections to consumers (7). To design a system for the prevention and control of these infections, epidemiological studies are necessary to determine transmission routes, infection virulence, and

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major pathogen sources (8). The control of intestinal parasitosis also falls under the agenda of the Sustainable Development Goals (SDGs) No. 3.3, which is "to end neglected tropical diseases by 2030."

During our study, conducted from July to August 2018, 74 food service agents participated among the 76 registered in the four university hospitals of Antananarivo. Among them, 18 handlers presented intestinal parasitosis. The prevalence in our study was high compared to studies reported in Northern Iran in 2013 (15.5%) (9), Saudi Arabia (23%) in 2009 (10), and 27.1% in Gondar, Northwest Ethiopia (11). It was lower than in Southeast Anatolia (52.2%) (12), Ethiopia (45.3%) in 2015 (13), Iran (34.9%) (14), Ivory Coast (35.7%) (15), and India (41.1%) (16). The heterogeneity of prevalences reported in these studies could be related to multiple factors: methodological differences, study population size, diagnostic sensitivity, climatic conditions, socioeconomic status, hygiene practices, environmental sanitation, and lack of awareness of health promotion measures that allow MDAs to improve control over their own health (17).

Parasitological stool examination (PSE) remains the key examination for the detection and identification of intestinal parasites (11,16). In our study, two methods were used: a direct KAOP stool examination using physiological water and Lugol's iodine, and a concentration/water sedimentation technique. The prevalence of intestinal parasitosis by direct examination of fresh stools was 24.32% (18 cases), while the concentration technique revealed 28.38% (21 cases), confirming the higher efficiency of the concentration technique (18). Given the discontinuous elimination of parasites in stool and the possibility of pauciparasitism, the use of concentration or highly sensitive techniques is recommended to increase detection probability (19). Specific methods such as anal tape for pinworm eggs (20), Harada-Mori filter paper for *S. stercoralis*, Baermann's extraction for larvae, and parasite serologies should also be considered.

In the present study, multiple intestinal parasitic infections were observed. Parasitological data revealed seven pathogenic species common worldwide and one non-pathogenic (*Entamoeba hartmanni*). Species prevalence varied across regions. The high prevalence of *Ascaris lumbricoides* was similar to results from Cameroon (21) and parts of Ethiopia (22,23). However, *E. histolytica/E. dispar* cysts were reported at 32.3% in Mekelle, Ethiopia, followed by *G. intestinalis* at 4.9% (23). The predominance of nematodes in our study is explained by their epidemiological character as geohelminths. Geohelminth infection is endemic in developing countries where heat, humidity and fecal contamination favor transmission (24). These conditions perpetuate the evolutionary cycle in tropical environments. The maturity of their eggs requires evolution in soil outside humans, favoring their dissemination in dust (25).

Univariate analyses between sociodemographic characteristics of MDA and intestinal parasitic infection showed no statistically significant effect (Table 01). The age range 15–30 years predominated (68.91%, n=51), with a mean age of 28 years (range 17–68). The highest infection rate was observed in this group (20.27%, n=15) (Table 01), but no significant difference was found (p=0.90), indicating equal exposure to parasitic infection across ages. Parasite eggs in soil can contaminate food and hands, entering the mouth at any age (26).

The majority of participants were women (55.40%, n=41), and parasitic infection was higher among women than men. These results differ from those in Arba Minch, where most participants were male (57%) (27). Although both sexes were involved in food distribution, the higher infection rate among women (p=0.024) may reflect behavioral differences, even though some surveys have shown male predominance (28).

Most of our study population had a high school education (63.51%, n=47), and participants with secondary education (18.91%, n=14) had the highest infection rate, with no significant difference (p=0.30). This is comparable to studies in Ethiopia, where most food handlers had low education levels, such as in Addis Ababa, Bahir Dar and Gondar (11,14,22). An effective way to prevent pathogen transmission by these personnel is strict adherence to personal hygiene and hygienic food handling. Education and training programs for food handlers and public health campaigns are essential to prevent foodborne diseases.

The majority of infected staff were waiters (9.45%) and cooks (6.75%) (Table 01), occupations likely to transmit parasites through food. This corroborates a study in Morocco, where infection was highest among food preparers (6.83%) and cleaners

(3.73%) (29). Poor hygiene in these groups can be a major source of intestinal parasites (16). It is important to raise awareness among food handlers to practice good hygiene and break the chain of parasite transmission.

The current Ministry of Health program focuses mainly on preventive chemotherapy to control intestinal parasitosis (6). In our study, parasitosis was present even in subjects taking antiparasitic drugs within ≤6 months or >6 months, with respective rates of 17.56% and 10.81%. No association was found between parasitosis and deworming timing (p=0.78). It is well documented that drug efficacy is suboptimal and differs between parasite species (30). Routine antihelminthic use may increase potential drug resistance. Drug therapy alone offers temporary relief, as reinfection is frequent in endemic areas with constant transmission (30,31). Therefore, preventive chemotherapy must be combined with individual and collective prophylaxis measures.

In developing countries with weak food hygiene regulation, food handlers are often employed without screening for infections (9). This was reflected in our study, where none of the handlers had health checks or certificates (Table 05), similar to findings in Bahir Dar, Ethiopia (16). The health status of handlers is a major determinant of food contamination.

According to our survey, all participants stated that they cared for their fingernails while working, yet 28.38% (n=21) had intestinal parasitosis. Food handlers may harbor parasites under fingernails and contaminate food (32). Intestinal pathogens excreted via feces contaminate fingers, especially when handwashing is neglected. Compared to the rest of the hand, fingernails are dirtier and more difficult to clean (33); they may contain eggs, larvae, and cysts. Food handlers' hands can be vectors for foodborne illness due to poor hygiene or cross-contamination (10). A study in northwestern Ethiopia confirmed that parasites under fingernails could affect food handlers' health (14). In addition, incompletely treated individuals may act as carriers of enteric parasites (34).

For water reliability, the source used at the four sites was JIRAMA tap water. Intestinal parasitosis was present even among those claiming to treat drinking water (22.97%). A study in Iran (2015) found most handlers reported hygiene measures, but reported good practices may reflect information bias, emphasizing the need to raise staff awareness about food safety (9). Limited access to safe water, or use of unprotected sources such as wells or rivers, can also be contamination factors (35).

CONCLUSION

This study highlights a notably high prevalence of intestinal parasites among food handlers in Antananarivo, indicating that these workers are potential key sources of fecal–oral transmission to the community. Systematic screening and periodic deworming of food handlers, combined with targeted health education, are essential measures to reduce infection rates and improve food safety.

Beyond individual preventive actions, stronger national policies on food safety, regular hygiene training, and integration of parasite control within broader public health and "One Health" frameworks are urgently required. Developing cost-effective diagnostic tools and continuous epidemiological surveillance would further enhance food safety and help curb parasitic disease transmission across Madagascar.

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Author's contribution: Study concept and design: KJZ, ZNJ acquisition of data: KJZ, analysis and interpretation: KZJ, ZNJ, NR all the authors read and approved the manuscript.

Conflict of interest: The authors declare that they have no conflict of interest.

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