

Original Article

Salmonella serotype Typhi, Shigella, and intestinal parasites among food handlers at Bahir Dar University, Ethiopia

Bayeh Abera¹, Gashaw Yitayew², Hiwot Amare²

¹ Department of Microbiology, Immunology and Parasitology, College of Medicine and Health Sciences, Bahir Dar University, Ethiopia

² Department of Microbiology, Bahir Dar Regional Health Research Laboratory Centre, Ethiopia

Abstract

Introduction: Food handlers play a major role in the transmission of *Salmonella* serotype Typhi (*S. Typhi*), *Shigella*, and intestinal parasites. This study was conducted to determine the prevalence of *S. Typhi*, *Shigella*, and intestinal parasites among food handlers at Bahir Dar University, Ethiopia.

Methodology: A cross-sectional study was conducted in June 2014. Stool samples from 410 food handlers were examined for bacterial pathogens and parasites. Pearson's Chi-square test, Fisher's exact test, and bivariate and multivariate logistic regression analyses were used where appropriate.

Results: The prevalence of *S. Typhi*, *Shigella*, and intestinal parasites among food handlers was 11 (2.7%), 5 (1.2%), and 53 (12.9%), respectively. Among eight intestinal parasites identified, the two most prevalent intestinal parasites were hookworm 26 (6.3%) and *G. lamblia* 13 (3.1%). Male food handlers were more likely to be positive than were female food handlers for *S. Typhi* and intestinal parasites. Furthermore, food handlers who had a history of regular medical checkups were less infected with intestinal parasites. Being male (AOR: 2.1, 95% CI: 1.2, 4.4) and not attending medical checkups (AOR: 2.9, 95% CI: 1.4, 6.1) were independent predictors of intestinal parasitic infection in food handlers. Male food handlers were reluctant to have regular parasitological examinations.

Conclusions: There was a high proportion of food handlers with *S. Typhi*, *Shigella*, and intestinal parasites in their faces. Special emphasis should be placed on *S. Typhi* carriers and male food handlers. Education and periodical medical checkups for intestinal parasites and *S. Typhi* should be considered as intervention measures.

Key words: *S. Typhi*; *Shigella*; intestinal parasites; food handlers.

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Introduction

Foodborne diseases are a major public health problem worldwide. According to the World Health Organization (WHO)'s estimates, 30% of the population suffers from foodborne diseases in developing countries, and two million deaths occur each year [1]. The problem is more severe in developing countries because of a lack of resources for environmental sanitation and personal hygienic practices [2]. In developing countries, 70% of cases of diarrhea are associated with the consumption of contaminated food [3]. Food handlers with poor personal hygiene working in food-serving establishments could be potential sources of foodborne infections [2,4].

Among sub-Saharan African countries, Ethiopia has the second- and the third-highest burden of *Ascaris lumbricoides* and hookworm, respectively [5,6].

Studies in different parts of Ethiopia reported that 29%–49.4% of food handlers working in various food establishments had intestinal parasites [4,7-9]. Therefore, food handlers can transmit intestinal parasites that do not require environmental maturation [10].

Salmonella serotype Typhi (*S. Typhi*) and *Shigella* are major causes of foodborne infections. Thus, they remain as important public health problems worldwide [11]. Moreover, clinical management and control of typhoid fever is challenging, especially in Africa, because of the development of multidrug resistance and vaccines are not immunogenic to young children [12]. *Shigella* spp. are more endemic in temperate and tropical climates. Globally, *Shigella* spp. cause approximately 80–165 million cases of morbidity and 600,000 deaths annually [13]. Therefore, food handlers

who have *S. Typhi* and *Shigella* may contaminate foods during processing.

Although various studies have been conducted to assess the prevalence of intestinal parasites among food handlers in different parts of Ethiopia, there is limited data on the prevailing prevalence of intestinal parasites, *S. Typhi*, and *Shigella* among food handlers in the study area. This study was therefore conducted to determine the prevalence and predictors of *S. Typhi*, *Shigella*, and intestinal parasites among food handlers working in mass catering establishments in Bahir Dar University, Ethiopia.

Methodology

Study design

A cross-sectional study was conducted among food-handlers working in catering establishments in Bahir Dar University in June 2014. During the study period, food handlers who had been on antibiotics and/or anti-intestinal parasites within the last 10 weeks were excluded.

Sample size and sampling technique

Sample size was determined using a single population proportion formula, considering 95% confidence interval (CI), 50% intestinal parasite prevalence, and margin of error of 5%. Moreover, 10% for no response rate was applied; thus, the final sample size was 422. The participants were selected randomly using registration lists.

Data collection

A pretested questionnaire was used to collect information by face-to-face interview. Information such as age, sex, service year, educational level, hand washing practices, and practice of medical checkups were collected from each study participant.

Parasitic examination

Food handlers were provided with clean, screw-capped containers after orientation. Stool specimens were collected at the microbiology laboratory, and samples were soon examined for intestinal parasites. Detection and identification of intestinal parasites were performed using saline direct wet mount at the parasitology laboratory by experienced parasitologists.

S. Typhi and Shigella isolation

Stool specimens were enriched in selenite F broth for 18 hours and inoculated into xylose-lysine-deoxycholate agar (XLD) (Oxoid, Basingstoke, UK) and MacConkey agar (BD, Difco, USA) and incubated

for 24 hours at 37°C. *S. Typhi* and *Shigella* spp. were identified using biochemical tests used according to the Clinical and Laboratory Standards Institute [14].

Statistical analysis

The data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 20 software. Pearson's Chi-square test and Fisher's exact test, where appropriate, were used to associate the prevalence of *S. Typhi*, *Shigella*, and intestinal parasites with categorical variables. Bivariate and multivariate logistic regression analyses were computed. Variables having a p value less than 0.2 in the bivariate analysis were considered for multivariate logistic regression analysis.

Ethical considerations

Prior to data collection, ethical approval was secured from the Research and Ethics Review Board of Bahir Dar University. Informed written consent was also obtained from each study participant. The study participants found to be positive for intestinal helminths and *S. Typhi* and *Shigella* were treated accordingly by physicians.

Results

A total of 410 food handlers (326 females and 84 males) participated in the study. The median age of the participants was 24 years. The majority of food handlers (81.3%) had one to five years of work experience. The educational levels and age categories of the participants are depicted in Table 1.

In hand washing assessment, 98.7% females and 94% males had a habit of washing their hands after using the toilet (Table 1). There was significant difference between genders in the practice of hair covering during food preparation ($P= 0.01$). Among participating food handlers, 78.3% of females and 15.6% of males had a habit of covering their hair during food processing (Table 1). Only 40 (9.7%) of food handlers were certified in safe food preparation and handling practices. At the time of survey, 52.2% food handlers had in-service training for safe food preparation and handling practices.

S. Typhi and Shigella

Overall, 16 (3.9%) of food handlers had either *S. Typhi* or *Shigella* spp. The prevalence of *S. Typhi* and *Shigella* spp., were 11 (2.7%) and 5 (1.2%), respectively (Table 1). A statistically significant difference was noted between female and male food handlers for *S. Typhi* because more male food handlers

were carriers of *S. Typhi* (P = 0.004). However, there was no significant difference for *Shigella* species (P = 0.272) (Table 2).

Intestinal parasites

The overall prevalence of intestinal parasites was 53 (12.9%). Of these, 37 (11.3%) female and 16 (19.0%) male food handlers had intestinal parasites. A statistically significant association was observed between gender and prevalence of intestinal helminths (P = 0.01) (Table 3). Furthermore, food handlers who had regular medical checkups were less infected with intestinal parasites than those who did not (P = 0.001) (Table 4). The predominant intestinal parasites identified in food handlers were hookworm and *G. lamblia*. Multivariate logistic regression analysis predicted that male food handlers were twice more likely to have intestinal parasites (adjusted odds ratio

[AOR]: 2.1; 95% CI: 1.2, 4.4) than females. Moreover, individuals with no practice of regular medical checkup were 2.9 times more likely to be infected with intestinal parasites than were their counterparts (Table 4).

Discussion

The present study showed that 12.9%, 2.7%, and 1.5% of food handlers were carriers of intestinal parasites, *S. Typhi*, and *Shigella* spp., respectively. Thus, food handlers harboring intestinal parasites that do not need environmental maturation such as *G. lamblia* and *S. Typhi* may contaminate food and spread the parasites directly to clients in food establishments [10].

In this study, single stool samples were used from each study participant rather than the triplicate samples recommended to detect intestinal parasites.

Table 1. Demographic and hygienic practice of food handlers in Bahir Dar University, 2014

Characteristics		Female (n = 326)	Male (n = 84)	P value	Total N (%)
Age (years)	< 18	7 (1.7)	6 (1.5)	0.35	13 (3.2)
	18–30	272 (66.3)	68 (16.6)		341 (83.0)
	31–40	47 (14.4)	9 (10.7)		56 (13.6)
Educational level	Illiterate	15 (3.6)	2 (0.5)	0.001	17 (4.1)
	Grades 1–6	23 (5.6)	8 (1.9)		31 (7.5)
	Grades 7–12	150 (36.5)	22 (5.4)		172 (41.8)
	> Grade 12	138 (33.6)	52 (12.7)		190 (46.2)
Service years	1–5	267 (65.0)	66 (16.1)	0.83	333 (81.2)
	6–8	17 (4.1)	7 (1.7)		24 (5.8)
	> 8	42 (10.2)	11 (2.7)		53 (13.0)
Regular medical checkup	Yes	282 (68.6)	60 (14.6)	0.004	342 (83.5)
	No	44 (10.7)	24 (5.8)		68 (16.5)
Certified in food preparation	Yes	35 (8.5)	5 (1.2)	0.37	40 (9.7)
	No	291 (70.8)	79 (19.2)		370 (90.3)
Habit of covering hair during food preparation	Yes	322 (78.3)	64 (15.6)	0.001	386 (94.2)
	No	4 (1.0)	20 (4.9)		24 (5.8)
Hand-washing habits	Yes	322 (98.7)	79 (94.0)	0.02	401 (97.8)
	No	4 (1.3)	5 (6.0)		9 (2.2)

Table 2. *S. Typhi*, *Shigella*, and intestinal parasites among food handlers in Bahir Dar University, 2014.

Organisms identified	Infected food handlers	Prevalence (%)
<i>S. Typhi</i>	11/410	2.7
<i>Shigella</i> spp.	5/410	1.2
Helminthes		
Hookworm	26/410	6.3
<i>S. stercoralis</i>	5/410	1.22
<i>A. lumbricoides</i>	4 /410	0.97
<i>H. nana</i>	2/410	0.5
<i>T. trichiura</i>	1/410	0.2
<i>S. mansoni</i>	1/410	0.2
Protozoa		
<i>G. lamblia</i>	13/410	3.1
<i>E. histolytica/dispar</i>	2/410	0.5

Furthermore, direct saline was used to examine stool samples. Therefore, the prevalence of intestinal parasites may have been underestimated.

The prevalence of intestinal parasites among food handlers in the present study conforms to the prevalence of intestinal parasites reported from India [15] and Thailand [16]. However, it is lower than findings reported in other part of Ethiopia. For instance, prevalences of intestinal parasites were reported to be 49.4% from Mekelle [9], 41.1% from Bahir Dar [4], and 44.1% from southwest Ethiopia [8]. However, the prevalence of helminths in the present study (9.5%) was higher than the 3.0% prevalence reported from Mekelle, Ethiopia [9]. The differences might be attributed to differences in geographical variation and

sociodemographic characteristics of the study population. Hookworm was the most prevalent parasite followed by *G. lamblia* among food handlers. Likewise, a study in Thailand reported that hookworm is the most prevalent infection among food handlers, with prevalence of 7.69% [16]. Furthermore, prevalences of hookworm of 8.1% and 8.3% were documented in Ethiopia [4] and Qatar [17], respectively. The prevalence of *G. lamblia* in the present study (3.1%) was lower compared to other findings in different part of Ethiopia, which reported 5.9% to 7.9% prevalence [4,8]. Food handlers with *G. lamblia* infection may directly transmit the parasite to consumers if it is ingested via contaminated food and water because *G.lamblia* cysts do not need environmental maturation

Table 3. *S. Typhi, Shigella spp., and intestinal parasites with predictors among food handlers.*

Variables	Participants N (%)	<i>S. Typhi</i> and <i>Shigella</i> spp. N (%)	P value	Parasites N (%)	P value
Gender					
Female	326 (79.5)	7 (2.1)	0.004	32 (9.8)	0.001
Male	84 (20.5)	9 (10.7)		21 (25.0)	
Age group (years)					
< 18	13 (3.2)	0	NA	3 (23.0)	0.22
18–30	341 (83.0)	14 (4.1)		46 (13.5)	
≥ 31	56 (13.6)	2 (3.6)		4 (7.1)	
Educational level					
Illiterate	17 (4.1)	1 (5.9)	NA	1 (5.9)	0.71
Grades 1–6	31 (7.5)	0 (0)		4 (13.0)	
Grades 7–12	172 (41.8)	10 (5.8)		21 (12.2)	
> Grade 12	190 (46.2)	5 (2.6)		27 (14.2)	
Medical checkup					
Yes	342 (83.5)	11 (3.2)	0.1	36 (10.5)	0.001
No	68 (16.5)	5 (7.3)		17 (25.0)	

Table 4. Multivariate logistic regression analysis of predictors of intestinal parasitic infection among food handlers

Characteristics	Participants N (%)	Intestinal parasite	
		Positive N (%)	AOR (95% CI)
Gender			
Female	326 (79.5)	32 (9.8)	1.0
Male	84 (20.5)	21 (25.0)	2.1 (1.2, 4.4)
Age group (years)			
< 18	13 (3.2)	3 (23.0)	1.0
18–30	341 (83.0)	46 (13.5)	0.4 (0.1, 2.1)
≥ 31	56 (13.6)	4 (7.1)	0.3 (0.01, 2.3)
Practice of medical checkup			
Yes	342 (83.5)	36 (10.5)	2.9 (1.4, 6.1)
No	68 (16.5)	17 (25.0)	
Level of education			
Illiterate	17 (4.1)	1 (5.9)	1.0
Grades 1–6	31 (7.5)	4 (13.0)	1.3 (0.12, 6.2)
Grades 7–12	172 (41.8)	21(12.2)	1.02 (0.12, 8.1)
> Grade 12	190 (46.2)	27 (14.2)	0.6 (0.07, 5.3)

AOR: adjusted odds ratio; CI: confidence interval

[10]. Moreover, Mintz *et al.* found that food handlers infected with *G. lamblia* were a vehicle for a *G. lamblia* outbreak in a commercial food establishment [18].

An interesting observation in the present study was that the prevalence of intestinal parasites was significantly higher in male food handlers than in female food handlers ($P= 0.001$). Although further study is required to elucidate the factors, poor practice of seeking medical checkups such as parasitological examination in male food handlers might be a factor. Likewise, higher prevalence of intestinal parasites in male than in female food handlers was reported from a study conducted in Thailand [16]. In the present study, 3.9% of food handlers had either *S. Typhi* or *Shigella* spp., indicating that food handlers in mass catering establishments are potential sources of typhoid fever and shigellosis infection in the student population. The prevalence of *S. Typhi* in the present study (2.7%) was higher than that reported from Gondar (1.3%) and Bahir Dar (1.6%), Ethiopia [4,19]. However, high prevalence of *S. Typhi* in food handlers was reported from Sudan (3.8%) [20] and India (17.14%) [21]. These findings indicate that food handlers who carry *S. Typhi* might play a role in the foodborne spread of *S. Typhi*. In this study, the prevalence of *Shigella* spp. among food handlers (1.5%) conforms to reports from Jordan (1.4%) and Sudan (1.3%) [20,22]. It is known that *Shigella* and *S. Typhi* do not have any natural reservoirs except humans; therefore, primary modes of transmission are associated with poor sanitation and hygiene practices of food handlers. Therefore, food handlers who carry *Salmonella* and *Shigella* should not be allowed to work until they are treated and completely cured.

Conclusions

This study revealed that food handlers working in a students' catering establishment had a high prevalence of *S. Typhi*, *Shigella*, and intestinal parasites. The prevalence of *S. Typhi* and intestinal parasites were significantly higher in male food handlers than in female food handlers. Lack of medical checkups was associated with the prevalence of *S. Typhi* and intestinal parasites. Thus, annual medical checkups of food handlers for both intestinal parasites and *S. Typhi* should be encouraged and enforced. Furthermore, health education on safe food handling and personal hygiene are important intervention measures.

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Corresponding author

Bayeh Abera, Asso. Prof, Medical Microbiologist
Department of Microbiology, Immunology and Parasitology,
College of Medicine and Health Sciences, Bahir Dar University,
Bahir Dar, Ethiopia
Mobile phone: +251918705245
Fax: 251582205932
Email: bayeabera15@gmail.com

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