Hindawi
International Journal of Microbiology
Volume 2020, Article ID 8867033, 9 pages
https://doi.org/10.1155/2020/8867033

Research Article

Prevalence of Intestinal Parasites and Gastrointestinal Carriage of Pathogenic Gram Negative Enteric Bacteria among Apparently Healthy Food Handlers of Public Hospitals, Addis Ababa, Ethiopia

Tegegn Belhu,[1] **Kinfe Fissehatsion**,[2] **Abraham Tesfaye**,[3] **Dr Yohannes Woldekidan**,[3] **and Kassu Desta**[2]

[1]*Addis Ababa City Administration Health Bureau Public Health Research and Emergency Management Laboratory, Addis Ababa, Ethiopia*
[2]*Addis Ababa University, College of Health Sciences, Department of Medical Laboratory Sciences, Addis Ababa, Ethiopia*
[3]*Ethiopia Public Health Institute (EPHI), Addis Ababa, Ethiopia*

Correspondence should be addressed to Tegegn Belhu; tegegnbelhu@gmail.com

Received 16 June 2020; Revised 26 August 2020; Accepted 2 November 2020; Published 18 November 2020

Academic Editor: Giuseppe Comi

Background. Foodborne diseases are major public health problems in developing countries like Ethiopia. Food handlers with poor personal hygiene working in hospitals could be infected with different intestinal parasites and pathogenic enteric bacteria. Therefore, they could pose a potential risk of foodborne infection to patients and the community. *Methods*. An institutional based cross-sectional study conducted from March to June 2017. Besides, sociodemographic data were collected using a structured questionnaire, freshly passed stool specimens for direct wet mount smear examination, and formalin ether concentration techniques performed for the detection of parasites. For bacterial identification culture, biochemical tests and antimicrobial sensitivity (Kirby-Baure disk diffusion method) have been performed. Finally, validated data were analyzed using statistical package for social science version 20 (SPSS). *Results*. From 368 food handlers who participated in the study, 81% were females. 119 (32.34%) were positive for at least one intestinal parasite. The most prevalent parasite was *Entamoeba histolytica/dispar* 48 (13%), followed by *Giardia lamblia* 36 (9.78%), *Taenia Species* 21 (5.7%), *Ascaris lumbricoide* 8 (2.2%), *Trichuris trichiura* 5 (1.4%), and *Hook worm* 1 (0.3%). Regarding the prevalence of enteric bacteria 17(4.6%), food handlers were positive for *Salmonella* 14 (3.8%) and *Shigella flexneri* 3 (0.8%). No *E. coli* O157 : H7 was isolated. All 100% ($n = 14$) *Salmonella* isolates were resistant to ampicillin (10 μg) and erythromycin (15 μg). Similarly, 100% ($n = 3$) of *Shigella flexneri* isolates were resistant to ampicillin (10 μg) and tetracycline (30 μg). 14.3% ($n = 2$) *Salmonella* and 66.7% ($n = 2$) *Shigella flexneri* isolates were MDR. *Conclusion*. The study showed significant carriage of pathogenic microorganisms among food handlers. Therefore, hospital administrators and other stake holders should put measures in place to break chain of transmission routes from silent carrier to other peoples particularly patients at hospital and the community at large.

1. Introduction

Food contamination may occur at any point during its journey through production, processing, distribution, and preparation. The risk of food getting contaminated depends largely on the health status of the food handlers, their personal hygiene, knowledge, and practice of food hygiene [1]. The common way of transmission of these pathogens is through contaminated objects with feces while food can be contaminated in different ways. Therefore food handlers that are infected with parasites and enteric bacteria with poor personal hygiene working in food-serving establishments could also be potential sources of infections. They can harbor and excrete intestinal parasites and contaminate foods from their feces, then to food processing, and finally to healthy individuals and patients [2–5].

Some group of people with the weakened immune system, such as patients admitted in hospitals, elders, pregnant women, and patients on chronic steroid treatment, are more vulnerable to foodborne disease due to the reason that only little number of pathogens is enough to cause disease. The supply of contaminated foods to these vulnerable peoples poses a great danger of infection [6–11]. The World Health Organization's global report on surveillance of antimicrobial resistance report makes a clear case that resistance to common bacteria has reached alarming levels in many parts of the world [4].

The foodborne infection which is mostly caused by contaminated food is still a widely prevalent public health problem in developing countries like Ethiopia. The main causes of foodborne illness are bacteria, which accounts for 66% of foodborne disease, and 4% of foodborne disease is caused by intestinal parasites [2]. The World health organization (WHO) estimated that in developed countries, up to 30% of the population suffers from foodborne diseases each year [4]. Foodborne diarrheal diseases are responsible for the death of 1.9 million peoples annually across the world and up to 2 million deaths are estimated per year in developing countries [2].

2. Methods

2.1. Study Design, Setting, and Study Period. A cross-sectional study was conducted from March to June 2017 among 368 apparently healthy food handlers of public hospitals in Addis Ababa.

2.2. Population. All food handlers recruited in public hospitals permanently or through contracts were considered as a study population.

2.3. Sample Size Calculations and Data Collection. A total of about 400 food handlers were working at these public hospitals during the study period, but only 368 food handlers included in the study by convenience sampling technique. A structured questionnaire was used to collect data (sociodemographic, food preparation, and handling practice related information).

2.4. Laboratory Investigation. A freshly passed stool specimen (about 3 times the size of a pea) was collected with a uniquely labeled sterile container and examined for intestinal parasitic infection. The remaining specimen was transported by Carry–Blair medium using a sterile applicator stick to microbiology laboratories with triple packaging at room temperature within 2 hours of collection for further investigation of culture and susceptibility testing.

2.5. Parasitological Examinations. About 1-2 mg of stool emulsified in a drop of normal saline (0.85% NaCl) at the center of a clean, nonscratched slide, coverslip placed, and scanned under 10× and 40× objective lenses of a light microscope for detection of intestinal protozoan trophozoite, cysts, and ova of nematodes. From the sediment of formalin ether concentration, both wet and Iodine mounts prepared and scanned under 10× and 40× objective lenses for the detection of cysts, ova, and larvae. Iodine mount was used to observe the characteristic features of cyst and trophozoite of protozoa in more detail [12].

2.6. Culture and Identification. Specimens inoculated on selenite F broth and sorbitol MacConkey were followed by incubation at 37°C for 24 hours. The growth on selenite F broth was subcultured into XLD. SMAC and XLD were examined for colorless and red colonies, respectively. Biochemical tests were performed from colonies on XLD for the final identification of the isolates. Using Biochemical tests, enteric bacteria were identified and a polyvalent antisera test was done to identify *Shigella species*.

2.7. Antimicrobial Susceptibility Testing. Kirby-Baure disc diffusion method was utilized for the identification of bacterial isolate through fresh subcultures of the isolates after overnight growth on Muller Hinton Agar. Organisms sensitive to the antibiotic are inhibited from growth in a circular zone around the antibiotic impregnated paper disk and inhibition zone measured [13]. The following were antibiotic disks with their concentration in μg. trimethoprim/sulfamethoxazole (1.25/23.75), ampicillin(10), erythromycin(15), azithromycin(15), gentamycin(10), Doxycyclin(30), Ciprofloxacin(5), nalidixic acid(30), cefotaxime(30), Chloramphenicol(30), and Tetracycline(30). These drugs were selected based on the second edition Ethiopian medicine formulary 2013. An isolate considered as MDR if resistant to three or more drugs of different classes/groups of antibiotics.

2.8. Quality Assurance. To assure quality of data, 20 questionnaires pretested before data collection, data collector trained, and data have been double-checked before being entered to SPSS for analysis. Moreover, the analytical quality assurance monitored through strict adherence to standard operating procedures and both positive and negative quality control has run simultaneously.

2.9. Data Recording and Analysis. Data entered into Microsoft Excel 2007, edited and cleaned before being exported to Statistical Package for Social Science version 20 (SPSS). Crude and adjusted odds ratios within 95%CI calculated for statistical significance evaluation. Finally, variables with p value < 0.3 in a bivariate analysis were evaluated by multivariate analysis to look at their relative effect on the outcome (an intestinal parasitic infection).

2.10. Ethical Clearances. Ethical approval letter obtained from the Departmental Research and Ethics Review, Committee of Addis Ababa University, College of Health Sciences, School of Allied Health Science, Department of Laboratory Sciences and Addis Ababa City Administration Health Bureau. Written informed consent was also obtained from study participants. Strict confidentiality was maintained during the interview process and anonymity kept during data processing and report writing. Food handlers who were found to be positive for enteric pathogens referred to their respective medical center for appropriate antimicrobial treatments.

3. Results

3.1. Sociodemographic Characteristics of Study Participants. A total of 368 study subjects participated in the study and the majority of them were females 298 (81%) with a mean age of 34.07 + 9 years. 210 (57.1%) food handlers were in the age group of 18–35 years and 36% of the study participants were working at a position of cooking and the rest 24%, 16%, and 24% were working at hosting, cleaning utensils, and other job positions in dining rooms, respectively. 149 (40.5%) participants had completed primary school. All (100%) of food handlers were urban residents and having a practice of shoe-wearing and useing pipe water sources. 268 (72.8%) worked for greater than 2 years in dining rooms. Only 77(20.9%) and 187(50.8%) of the food handlers participated in this study had formal food preparation and handling training and took medical checkups at least within the last six months, respectively (Table 1). Hand washing materials such as soaps were available in 45% of study sites (11 hospitals) while latrine was present and in good condition at all study hospitals.

3.2. Prevalence of Intestinal Parasites and Enteric Bacteria. The most prevalent parasite was *Entamoeba histolytica/dispar* 48(13%) followed by *Giardia lamblia* 36(9.78%), *Taenia Species* 21 (5.7%), *Ascaris lumbricoide* 8(2.2%), *Trichuris trichiura*, 5(1.4%), and *Hook worm* 1(0.3%). 99(33.2%) of female and 20(28.6%) of male participants were positive for intestinal parasitic infection. Although 218(59.2%) of respondents reported they had a habit of washing hand with water and detergent after toilet use, 51(23.4%) of them were positive for intestinal parasitic infection. 187(50.8%) did medical checkup within the past six months. The majority, 322(87.5%) participants, stated that they had a regular nail trimming habit. But 102(31.7%) of them were positive for intestinal parasitic infection (Table 2).

Regarding the prevalence of enteric bacteria, 17 (4.6%) of them were found to be positive for *Salmonella* species and *Shigella flexneri*. The most prevalent bacterial isolate in this study was *Salmonella* 14 (3.8%), followed by *Shigella flexneri* 3 (0.8%). The prevalence of enteric bacteria was 9 (4.1%) and 8 (5.3%) among female and male respondents, respectively (Table 2).

3.3. Associated Risk Factors/Determinants of Intestinal Parasitic Infection. No statistically significant differences were found between female and male food handlers with different age groups, $p = 0.482$ and 0.91, respectively. In addition, no statistical association was found between food handlers who have different educational status, more than two years work experience in the hospital, has swimming habit, prepare food when suffering from diarrhea, do not wash hand before touching food, and have no regular nail trimming habit (p value 0.42, 0.9, 0.37, 0.47, 0.8, and 0.5), respectively.

Food preparation training, hand washing habit after toilet, medical checkup, sharing knife and another sharp material for food preparation, and the habits of eating raw or undercooked food were associated with intestinal parasitic infection ($p < 0.3$).

The logistic regression analysis result showed that food handlers who had food preparation and handling training had a more likely protective effect (63%) from getting intestinal parasitic infection (OR:0.37, 95%CI (0.19–0.75)) than food handlers who did not train. Intestinal parasitic infection was less likely to occur (62% protective effect) among food handlers who washed their hands after toilet use with water and detergent (OR: 0.38, 95%CI (0.23–0.62)) than those who did wash with water only after toilet use.

The extent of intestinal parasitic infection was also less likely to occur with a protective effect of 64%, among food handlers who had no habit of eating raw or undercooked food (OR:0.36, 95%CI (0.22–0.61)) compared to those who had a habit of eating raw or undercooked food. Food handlers who had practiced medical checkup within the past six months had a less likely risk of being infected with intestinal parasites (OR: 0.35, 95%CI (0.22–0.58)) as compared to those food handlers who did not practice the checkup. The risk of getting intestinal parasitic infection is less likely among food handlers who did not share knife and other equipment used for food preparation (OR: 0.23, 95%CI (0.23–0.8)) compared to those who share knife and other equipment (Table 3).

3.4. Antimicrobial Susceptibility Pattern of Bacterial Isolates. All 100% ($n = 14$) *Salmonella* isolates were found to be resistant to ampicillin and erythromycin. 2 (14.3%) isolates were resistant to three drugs of different groups (ampicillin, erythromycin, and trimethoprim/sulfamethoxazole) (Table 4).

4. Discussion

The prevalence of intestinal parasites among food handlers was (32.4%) which is consistent in studies conducted at Gondar Town, Northwest Ethiopia 29.1% [14], southern part of Ethiopia 36% [15], Khartoum, Sudan 29.4% [16], Omdurman, Sudan 30.1% [17], and in Holly City of Makah 31.94% [18].

Compared to the finding of this study higher prevalence of intestinal parasite among food handlers have been reported from studies conducted at different parts of the world such as in Addis Ababa, Ethiopia 45% [19], in Hawassa, Ethiopia 63% [20], in Mekelle, Ethiopia 49.4% [21], in Abukota, Nigeria 97% [22], in Bahirdar Town, Northwest Ethiopia 41.1% [23], in Ibrid, Jordan 48% [24], in Sanliurfa, Southeastern Anatolia 52.2% [25], in Minas, Brazil 47.1% [26], and in Zulia state, Venezuela 48.7% [27]. This discrepancy may be due to much difference in sample size and geographical location.

Furthermore, a lower prevalence of intestinal parasite reported from studies conducted among food handlers in

Table 1: Sociodemographic characteristics of food handlers in public hospitals, Addis Ababa, Ethiopia March to June 2017($n = 368$).

Socio demographic data	Frequency	Percent
Male	70	19
Female	298	81
18–35	210	57.1
36–53	151	41.0
>53	7	1.9
Illiterate	48	13.0
Primary school	149	40.5
Secondary school	133	36.1
Technical and vocational	17	4.6
Collage/University	21	5.7
Single	149	40.48
Married	207	56.3
Divorced	12	3.3

n = sample size.

Table 2: Prevalence of intestinal parasites and pathogenic Gram-negative enteric bacteria among 6 food handlers in public hospitals, Addis Ababa, Ethiopia, March to June 2017($n = 368$).

Variables		Total tested no. (%)	Positive intestinal parasite no. (%)	Positive enteric bacteria no. (%)
Sex	Male	70 (19)	20 (28.6)	0 (0)
	Female	298 (81)	99 (33.2)	17 (5.7)
Age group	18–35	211 (57.3)	69 (32.7)	11 (5.2)
	36–53	150 (40.8)	46 (30.7)	5 (3.3)
	>53	7 (1.9)	4 (57.1)	1 (14.3)
Educational status	Illiterate	48 (13.1)	8 (16.7)	3 (6.25)
	Primary school	149 (40.5)	60 (40.3)	7 (4.7)
	Secondary school	133 (36.1)	45 (33.8)	6 (4.5)
	TVET	17 (4.6)	3 (17.6)	1 (5.9)
	College/University	21 (5.7)	3 (14.3)	0 (0)
Years working at hospital	<2 years	100 (27.2)	33 (33)	3 (3)
	2–10 years	167 (45.4)	51 (30.5)	8 (4.8)
	11–20 years	68 (18.5)	25 (36.8)	5 (7.4)
	>21 years	33 (8.9)	10 (30.3)	1 (3)
Food preparation and handling training	Yes	77 (20.9)	13 (16.9)	0 (0)
	No	291 (79.1)	106 (36.4)	17 (5.84)
Hand washing habit after toilet	With water only	150 (40.8)	68 (45.3)	8 (5.3)
	With water and detergent	218 (59.2)	51 (23.4)	9 (4.1)
Eat raw/undercooked food	Yes	217 (59)	88 (40.6)	10 (4.6)
	No	151 (41)	31 (20.5)	7 (4.6)
Wash hand before touching food	Yes	337 (99.6)	110 (32.6)	14 (4.2)
	No	31 (8.4)	9 (29)	3 (9.7)
Prepare food when suffering from diarrhea	Yes	50 (13.6)	19 (38)	2 (4)
	No	318 (86.4)	100 (31.4)	15 (4.7)
Nail trimming habit	Yes	322 (87.5)	102 (31.7)	14 (4.3)
	No	46 (12.5)	17 (37)	3 (6.5)
Swimming habit	Yes	53 (14.4)	13 (24.5)	1 (2)
	No	315 (85.6)	106 (33.7)	16 (5.1)
Sharing a knife and other equipment	Yes	271 (73.6)	102 (37.6)	12 (4.4)
	No	97 (26.4)	17 (17.5)	5 (5.2)
Sharing a knife and other equipment months	Yes	187 (50.8)	37 (19.8)	8 (4.3)
	No	181 (49.2)	82 (45.3)	9 (4.9)

Northwest Iran 3.73% [28], in Shiraz, Iran 10.4% [29], in Gaza strip, Palestine 24.3% [30], in Ibrid, Jordan 15.1% [24], among food handlers in tourist area restaurants and educational-institutions cafeteria, in Thailand 10.3% [31] and among tertiary care hospitals North India 1.3 to 7% [32], in Omdurman, Sudan 6.9% [17]. The lowest prevalence of intestinal parasites in these studies may result from good food hygiene practice.

Table 3: Multivariate logistic regression analysis: Predictors for intestinal parasitic infection among food handlers working in public hospitals, Addis Ababa, Ethiopia, March to June 2017 ($n = 368$).

Predictors		Positive No. (%)	Negative No. (%)	Crude OR 95% CI	Adjusted OR 95%CI
Formal food preparation training	Yes	13 (16.9)	64 (83.1)	0.36 (0.19–0.67)	0.37 (0.19–0.75)
	No	106 (36.4)	185 (63.6)	1.00	1.00
Wash hand with water and detergent after toilet use	Yes	51 (23.4)	167 (76.6)	0.37 (0.24–0.58)	0.38 (0.23–0.62)
	No	68 (45)	82 (55)	1.00	1.00
Eat raw/ undercooked food	Yes	88 (41)	129 (59)	1.00	1.00
	No	31 (20.5)	120 (79.5)	0.38 (0.24–0.61)	0.36 (0.22–0.61)
Regular medical checkup within the past 6 months	Yes	37 (19.8)	150 (80.2)	0.3 (0.19–0.47)	0.35 (0.22–0.58)
	No	82 (45)	99 (55)	1.00	1.00
Share knife	Yes	102 (38)	169 (62)	1.00	1.00
	No	17 (17.5)	80 (82.5)	0.35 (0.2–0.63)	0.23 (0.23–0.8)

n = Sample size.

Table 4: Antibiotic sensitivity pattern of *Salmonella* isolated from stool specimens of food handlers in public hospitals, Addis Ababa, Ethiopia, March to June 2017.

Antibiotics	AST			
	R	%	*S*	%
Ampicillin (10 μg)	14	100	0	0
Cefotaxime (5 μg)	1	7.1	13	92.9
Erythromycin (15 μg)	14	100	0	0
Ciprofloxacin (5 μg)	0	0	14	100
Gentamycin (10 μg)	0	0	14	100
Doxycycllin (30 μg)	0	0	14	100
Trimethoprime/sulfamethoxazole (1.25/23.75 μg)	2	14.3	12	85.7

R = resistant , *S = sensitive.*

Table 5: Antibiotic sensitivity pattern of *Shigella flexneri* isolated from stool specimens of food handlers in public hospitals, Addis Ababa, Ethiopia, March to June 2017.

Antibiotics	AST			
	R	%	*S*	%
Ampicillin (10 μg)	3	100	0	0
Cefotaxime (5 μg)	0	0	3	100
Azithromycin (15 μg)	1	33.3	2	66.7
Naldixic acid (30 μg)	1	33.3	2	66.7
Ciprofloxacin (5 μg)	0	0	3	100
Gentamycin (10 μg)	0	0	3	100
Chloroamphenicol (30 μg)	0	0	3	100
Tetracycline (30 μg)	3	100	0	0
Trimethoprime/sulfamethoxazole (1.25/23.75 μg)	1	33.3	2	66.7

R = resistant, S = sensitive. All 100% ($n = 3$) *Shigella flexneri* isolates were resistant to ampicillin and tetracycline whereas two (66.7%) *Shigella flexneri* isolates were MDR (Table 5).

Even though the common causes of protozoan intestinal parasitic infection throughout Ethiopia are amoebiasis 0–4% and giardiasis 3–23% [11], the most common protozoa in the current study is *Entamoeba histolytica/dispar (*13%), followed by *Giardia lamblia (*9.78%). The reason could be that the cyst stages of *Entamoeba histolytica and dispar* were not differentiated in the presented study. Prevalence of *Entamoeba histolytica/dispar* among food handlers in the Southern part of Ethiopia 14% [33], in Bahirdar Town, Northwest Ethiopia 12.8% [23], is comparable with the result of the present study. Lower results were recorded in studies from different parts of the world, such as in Omdurman, Sudan 2.6% [17]. The second dominant parasite in the present study was *Giardia lamblia* (9.78%) which is in agreement with a study done in Hawassa Town, Ethiopia 13.4% [20], in Zulia state, Venezuela 13.4% [27], in Gondar, Northwest Ethiopia 11% [11]. Additional studies conducted at food handlers in Mekelle, Ethiopia [21] and in Bahirdar Town, Northwest Ethiopia [23] showed a comparable prevalence of 7%. The prevalence of *Giardia lamblia* reported from a study conducted in Northwest Iran among food handlers was 63.3% [28]. A study among food handlers of Sanliurfa, in southeastern Anatolia showed 26.8% [25]. Other studies were conducted among food handlers in tourist area restaurants and educational-institutions cafeteria, Thailand [31], in Minas, Brazil [26], in Omdurman, Sudan [17] and in Addis Ababa, [19] showed 24%, 21.1%, 20.5%, and 18.8% prevalence, respectively. These higher results may be due to epidemiological and host differences. The lower result in the present study may be due to the advancement in public health since the studies conducted in the past decades. Lower results were reported among food handlers of tertiary care hospitals, North India 0–4.05% [32], Gaza strip, Palestine 2.3% [30], and in the holy city of Makkah 1.98% [18].

Besides intestinal protozoa, a significant prevalence of intestinal helminthiasis reported by the current stud. *Taenia species (5.7%),* which is higher than the result of the studies conducted in Addis Ababa, Ethiopia 5.2% [19], Mekelle, Ethiopia 1.3% [21], Gondar, Northwest Ethiopia 0.5% [11]. This higher prevalence may be related to the common habit of eating raw/undercooked foods of the food handlers because about 59% of the study participants reported their habit of eating uncooked or undercooked food. The prevalence of *Ascaris lumbricoide* among food handlers was 2.2%, which is in agreement with results of studies, in Addis Ababa, Ethiopia 2.1% [19] and the holy city of Makkah 0.8% [18], in Gondar, Northwest Ethiopia 6.5% [11], in Sanliurfa, Southeastern Anatolia 5.83% [25] and in Minas, Brazil 5.8% [26]. Higher prevalence was reported from comparable studies conducted at Gondar town, Northwest Ethiopia 18.11% [14], southern Ethiopia 9.27% [33], food handlers of Sanliurfa, Southeastern Anatolia 10.7% [25]. The prevalence of *Trichuris trichiura* among food handlers in Addis Ababa, Ethiopia, was 1.1% [19], in Gondar Town; Northwest Ethiopia was 1.6% [14]. All findings were comparable to the result of the present study which is 1.4%. Higher prevalence of *Trichuris trichiura* is found in studies conducted on food handlers in Abukota, Nigeria, 24% [23], the holy city of Makkah 10.7% [18]. The lower prevalence in the current study may be due to that all food handlers participated were urban residents. The prevalence of *Hook worm* in this study, 0.3%, was in agreement with the result of a study conducted at Gondar town, Northwest Ethiopia 0.8% [14].

In the current study, 3.8% and 0.81% of food handlers were positive for *Salmonella* and *Shigella flexneri,* respectively. The prevalence of *Salmonella* was in agreement with similar studies conducted on food handlers of different groups: in Addis Ababa, Ethiopia 3.5% [19], in Gondar Town, Northwest Ethiopia 3.1% [14], in Omdurman, Sudan 3.8% [17] in tertiary care hospitals, North India 5% [32]. The higher carriage rate of *Salmonella* has been reported from a study in Ibrid, Jordan 6%. Lower prevalence of *Salmonella* was found in studies conducted in Jimma from hand rinse samples 0.9% [15], on food handlers of tertiary care hospitals in India 0–2.5% [32], and in Kumasi, Ghana 2.3% [34]. The prevalence of *Shigella* was also in agreement with the results of previous studies among food handlers in Addis Ababa, Ethiopia 0% [19], from hand rinse sample in Jimma, Ethiopia 0% [15]. Higher prevalence of *Shigell*a was also found in a study conducted in food handlers of tertiary care hospitals in India 9.3%, 1.28%, and 1.23% in three consecutive years [32], 3.1% at Gondar town, Northwest Ethiopia [14], in Ibrid Jordan 1.4% [24]. The high discrepancy may be because the study conducted in India includes food handlers who were suffering from dysentery. Higher prevalence, 1.3% of *Shigella* among food handlers, had been reported from a study in Omdurman, Sudan [17].

One of the most dramatic characteristics of pathogenic microorganisms is their ability to infect higher organisms and cause infectious diseases. However, the interaction of a host and a disease-causing bacterium can result in different outcomes: clearance, persistent infection, or prolonged carriage. Most *Salmonella* infections are short-term episodes. A certain fraction of *Salmonella* infections in humans can lead to persistent infection or prolonged carriage of this pathogen. Even though carrier individuals are asymptomatic, they are often contagious [35]. A disease might originate from nonsick infected people which can be applied to typhoid fever epidemiology. The main reservoir of *S. typhi* is humans who are symptom-free yet secrete live pathogens [36].

In our study, 3.8% of food handlers were found to culture positive for *Salmonella*. Nevertheless, 36% and 24% participated in food cooking and hosting, respectively. These carrier food handlers can shade *Salmonella* that can last for more than 12 months [37, 38]. The transmission of *Salmonella* from asymptomatic food handlers is not a new event. It is known since the early twentieth century, Mary Mallon (Typhoid Mary) worked as a cook at different households in the USA was the first known asymptomatic carrier of *S. typhi*, and during her work, she infected 51 to 57 people in nine different epidemics [39, 40]. “Mr. N,” who was employed as a milker and cowman in southeast England and found accountable for a 207-case outbreak of typhoid fever, was another example of an asymptomatic carrier of *S. typhi* [41]. A 1% asymptomatic carrier rate of nontyphoidal *Salmonella* is also reported by a study conducted in India which may last up to 8 years [42–44]. In a study conducted in China 28.9% ($n = 84$), *S.* Newport strains of human origin were isolated from asymptomatic individuals [45]. Therefore asymptomatic food handlers found in the current study can transmit the infection through contaminated food to naive hosts, such as patients, attendants, and the hospital community that can establish a new infection cycle. According to Ames and Robins, the prevalence of *S. typhi* carriage in women (3.8%) is almost 2-fold higher than that in men (2.1%), while it increases as age increased [46, 47]. Here, our study shows the prevalence of carriage of Salmonella among female food handlers is 4.7% and 0% among male ones. This situation aggravates the risk of prolonged carriage and high risk transmission.

Regarding the drug susceptibility pattern of *Salmonella* isolates, all 100% ($n = 14$) were found to be resistant to ampicillin and erythromycin. This is in agreement with a study conducted among food handlers in Addis Ababa, Ethiopia [19] by which all isolates of *Salmonella* were resistant. The result was consistent with the result of a study in Bahirdar Town, Northwest Ethiopia [23], by which all 100% isolates were resistant to ampicillin. However, a slightly lower resistance rate, 61.5% to ampicillin recorded in a study conducted in Gondar, Northwest Ethiopia. All 100% ($n = 14$) were sensitive to ciprofloxacin, doxycyclin, and gentamycin, which was in line with the result of a study in Addis Ababa, Ethiopia [19] by which 100% of the isolates were sensitive. But a study at Bahirdar Town food handlers, Northwest Ethiopia [23] showed 16.6% and 66.7% resistance to ciprofloxacin and doxycycline, respectively. Fourteen percent *Salmonella* isolates were found to be MDR by which it was resistant to three and more drugs of different groups (ampicillin, erythromycin, and trimethoprim), but in a study conducted at Gondar University [35], 46.2 isolates were MDR. All isolates of *Shigella flexneri* were found to be resistant to ampicillin and tetracycline in the present study. The result is in agreement with the result of a study in southwest Iran 87% of *Shigella flexneri* isolates were resistant to ampicillin. In the present study, 33.3% of isolates were resistant to nalidixic acid and Trimethoprim/sulfamethoxazole. Lower resistance rate of 10% to nalidixic acid and higher rate to Trimethoprim/sulfamethoxazole 85% was found. About sixty-six percent of *Shigella flexineri* were found to be MDR.

5. Conclusion

This study shows an overall prevalence of 32.34% and 4.6% food handlers working at public hospitals in Addis Ababa, Ethiopia, for different intestinal parasites and pathogenic Gram-negative enteric bacteria, respectively. These carrier food handlers could act as a vehicle to transmit for patients and the community. Therefore, intervention to stop the risk of foodborne infection is required.

Furthermore, some of the associated risk factors have a statistical association with an intestinal infection which needs intensive intervention through regular medical checkup and providing continuous education about personal hygiene because most of the potential risks of infection identified from this study are related to personnel hygiene, but sociodemographic characteristics of the food handlers were not significantly associated with the prevalence of intestinal parasitic infection that indicates no potential risk of transmission. Also, all *Salmonella* and Shigella *flexneri* isolates were found to be resistant to ampicillin. Furthermore, *Salmonella* isolate are resistance to erythromycin and *Shigella flexneri* isolates were resistant to tetracycline, which could indicate antimicrobial prescriptions of physicians have taken into consideration and universal guideline of antibiotics should be followed strictly.

Generally, the finding of this study could provide significant information particularly for public health officials, to combat foodborne diseases that arise from food handlers.

Abbreviations

ATCC: American Type Culture Collection
CDC: Centers for Disease Control
DCA: Deoxy Cholate Agar
DST: Drug Susceptibility Test
E.*coli* O157: H7 : Enterohemorrhagic *Escherichia coli* serotype O157 : H7
MDR: Multidrug resistant MHA Muller Hinton Agar OR Odds Ratio
*μ*g: Micro Gram
SOPs: Standard Operating Procedures
SPSS: Statistical Package for Social Science
WHO: World Health Organization
XLD: Xylose Lysine Dextrose.

Data Availability

The required data have already been included in the manuscript.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

The authors would like to thank all participants of this study, particularly hospital directors, for their participation and cooperation.

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