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Isolation and Antimicrobial Sensitivity Patterns of Enteric Bacterial Pathogens from Asymptomatic Food Handlers, Jimma, Ethiopia

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Abstract: Background: Most enteric bacteria are harmless but species which belong to *Salmonella*, *Shigella*, *Yersinia* and certain strains of *Escherichia coli* are pathogens. The emergences of increased antimicrobial resistances are global challenges, particularly in developing countries due to misuse of antimicrobial agents. This study was aimed at determining the prevalence and antimicrobial sensitivity patterns of enteric bacterial pathogens isolated from food handlers in Jimma Town, Ethiopia. Methods: A cross-sectional study was conducted from July 16/2012 to November 23/2012 among 218 food handlers. Structured questionnaire was used to assess associated factors for enteric bacterial infection. Stool samples were collected andantimicrobial sensitivity tests were done using Mueller Hinton Agar (MHA) by Kirby-Bauer disc diffusion method following standard procedures. Descriptive statistics were performed using SPSS version 16.P-values less than 0.05 were considered as statistically significant. Results: The prevalence of enteric bacterial pathogens was found to be 6.9% (15/218). All *S. typhi* isolates showed resistance to two antimicrobials; amoxicillin-clavulanic acid and streptomycin. However, they all showed sensitivity to most antimicrobials. Half of *Shigella* isolates showed resistance to two antimicrobials; chloramphenicol and trimethoprim-sulfamethoxazole where as the other half showed resistant toother four antimicrobials; amoxicillin-clavulanic acid, ampicillin, streptomycin and tetracycline. One-third of enterohaemorrhagic *Escherichia coli* (EHEC) O157:H7 strains of the isolates were found to be resistant to two antimicrobials; amoxicillin-clavulanic acid and tetracycline. Enteric bacterial infection had a significant association with poor training in food handling and preparation (p=0.034), not knowledgeable about food borne infection (p<0.001) and inconsistent hand washing (p=0.033). Conclusion: Most of the isolates were resistant to ampicillin, streptomycin and tetracycline while all were sensitive to ciprofloxacin and nalidixic acid. Health education along with continuous food safety training should be given to food handlers so that they can adhere with effective hygienic practices.

Keywords: Antimicrobial, Enteric Bacterial Pathogens, Food Handler, Sensitivity

1. Background

Enteric bacteria are microbes that reside in the guts of animals and humans. The human gut is therefore the natural habitat for various bacteria species and majority of them participate in metabolic activities that salvage energy and absorbable nutrients protecting the colonized host against invasion by alien microbes and important atrophic effects on intestinal epithelia and on immune structure and function. Thus, they play an essential role in the development and homeostasis of the immune system [1].

Enteric bacterial pathogens, the major causes of food borne gastroenteritis in humans, remain important health problems worldwide. Such infections associated with food contamination are the major public health problems especially in developing countries resulting in morbidity, mortality and socioeconomic impacts such as high rates of hospitalizations and high treatment costs [2]. Currently, one of the major reasons for morbidity as well as mortality associated with gastrointestinal infections is the increasing resistance of the organisms for available antimicrobial agent

[2], [3]-[4].

Food handlers who harbor enteric bacteria asymptomatically and who are not adhered with good hygienic practices and inadequate knowledge on food safety are likely to contaminate the food with enteric bacterial pathogens and could also be the source of food borne infections [4]. However, the consequences of food contamination vary among countries and regions of the world depending on climate, geography and degree of social and economic development [4], [5], [6] - [7].

Since food handlers are engaged in food preparation, transport and provision, they are implicated for the transmission of enteric bacterial pathogens to the community if appropriate hygienic practices are not habituated [7], [8] – [9].

Indeed a prerequisite for the prevention and control of diseases due to enteric bacterial pathogens is a clear understanding of their epidemiology. Therefore, an effective means of prevention of their transmission from food handler to consumers is strict adherence to good personal hygiene and hygienic food handling practices.However, for instance, hand washing, being a simple and effective way to cut down cross-contamination, yet often forgotten [5], [10].

People commonly experience dinning out in food establishments such as Hotels, Restaurants and Cafeterias. These establishments prepare and provide various food items to many people implying a possible risk of infection if sanitary and hygienic conditions are not strictly followed [7], [9]. Although certain studies were conducted in some parts of Ethiopia, holistic information regarding enteric bacterial infections and risk factors among food handlers in many parts of the country including the study area is limited. Moreover, emergence or rise in drug resistant enteric bacterial pathogens is a major public health concern needed to be addressed recently. Hence, this study is aimed at determining the prevalence and antimicrobial sensitivity patterns of enteric bacterial pathogens isolated from food handlers found in Jimma town, southwest Ethiopia.

2. Methods

2.1. Study Area

The study was conducted in Jimma town which is located 350 kms south west of Addis Ababa (the capital city of Ethiopia). It is located at an average altitude of 1780 meters above sea level with geographical coordinates of approximately 7°41' N latitude and 36° 50'E longitude. It lies in the climatic zone locally known as 'Woyna Dega' (areas located between 1,500 - 2,400 m above sea level) which is considered ideal for agriculture as well as human settlement. The town is generally characterized by warm climate with mean annual maximum temperature of 30°C and mean annual minimum temperature of 14°C. The annual rainfall ranges from 1138 to 1690 mm. According to the central statistical agency (CSA) of 2007, the total population of the town is 130,254. The town has various food establishments such as Hotels, Restaurants and Cafeterias which serve for the people of the town as well as the visitors.

2.2. Study Design and Sample Size Determination

Cross-sectional study was conducted from July 16/2012 to November 23/2012 among food handlers working at food establishments found in Jimma town. Sample size was determined using single population proportion formula $n= Z^2 p (1-p) / d^2$, with the following assumptions: prevalence (p) of 17% from a previous study in Nigeria [11], 95% confidence level, 5% margin of error, and 10% for anticipated non-response rate. Accordingly, the minimum sample size (n) was found to be 239. The total sample size was allocated proportionally to 102 Hotels, 94 Restaurants and 86 Cafeterias. Accordingly, 86, 80 and 73 participants were planned to be included from each selected food establishment in the study. But, 78, 72, and 68 participants were included giving a total of 218 participants (91.2% response rate). Lottery method random sampling procedure was used to recruit study participants.

2.3. Data Collection

2.3.1. Demographic and Personal Risk Factors Survey

Data on demographic profile of the participants' and factors predisposing to enteric bacterial pathogens was gathered using pretested questionnaire. The questions included information on sex, age, educational status, and hand washing practice are among the others.

2.3.2. Stool Sample Collection

Stool samples were collected using clean, dry and leak proof stool cups. The specimens were then immediately placed in to Cary-Blair transport medium.The samples were then transported to Jimma University Medical Microbiology Laboratory in ice packed box for bacterial culture and identification.

2.4. Sample Processing and Identification of Bacteria

For isolation of enteric bacteria, stool samples were directly inoculated onto MacConkey agar. The samples were also sub-cultured on to Xylose Lysine Deoxycholate (XLD) agar after enrichment with Selenite cystine broth (prepared in 10ml amounts) and incubated at 37°C for 18-24 hours. After 24 hours of incubation at 37°C, isolates were identified following the standard procedures using biochemical tests hydrogen sulfide (H_2S)production, indole production and motility in Sulfide-Indole-Motility (SIM) medium, citrate utilization, urease production, different carbohydrate fermentation reactions and Lysine decarboxylase (LDC) in Simmon's Citrate agar, Urea agar, Kligler's iron agar (KIA) and lysine iron agar (LIA) [12]. All the biochemical media wereobtained from Oxoid, (Hampshire, England) (Fig 1).

2.5. Antimicrobial Susceptibility Testing

Antimicrobial sensitivity test procedures and they were done using Mueller Hinton Agar (MHA) by Kirby-Bauer disc diffusion method following standard procedures (Fig 2). The following antimicrobial agents were used for the isolates: amoxicillin-clavulanic acid (AML, 30μg), ampicillin (AMP,

10μg), chloramphenicol (C, 30μg), ciprofloxacin (CIP, 5μg), gentamicin (CN, 10μg), ceftriaxone (CRO, 30μg), nalidixic acid (NA, 30μg), streptomycin (S, 10μg), trimethoprim-sulfamethoxazole (TS, 25μg) and tetracycline (TET, 30μg) (Oxoid, England). The resistance andsensitivitywere interpreted according to the Standards.[13]
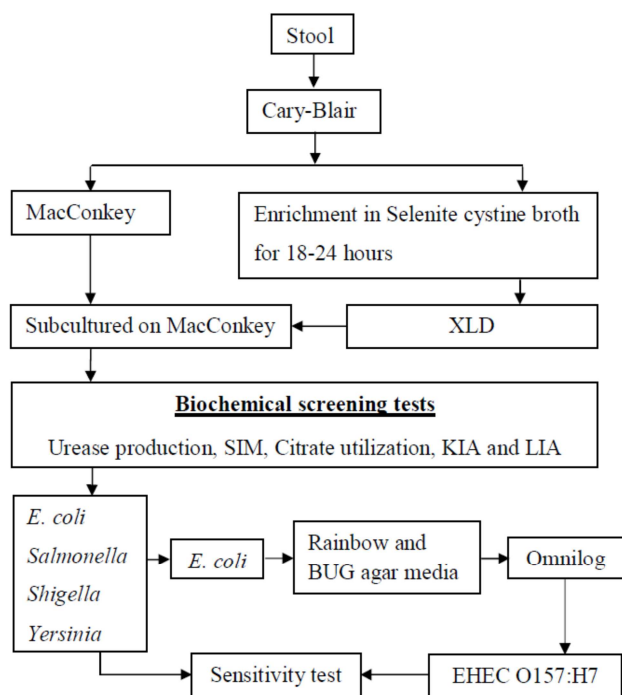

Figure 1. *Flow diagram showing culture and identification procedures followed for enteric bacterial pathogens isolated from food handlers, Jimma, Southwest Ethiopia, 2012.*
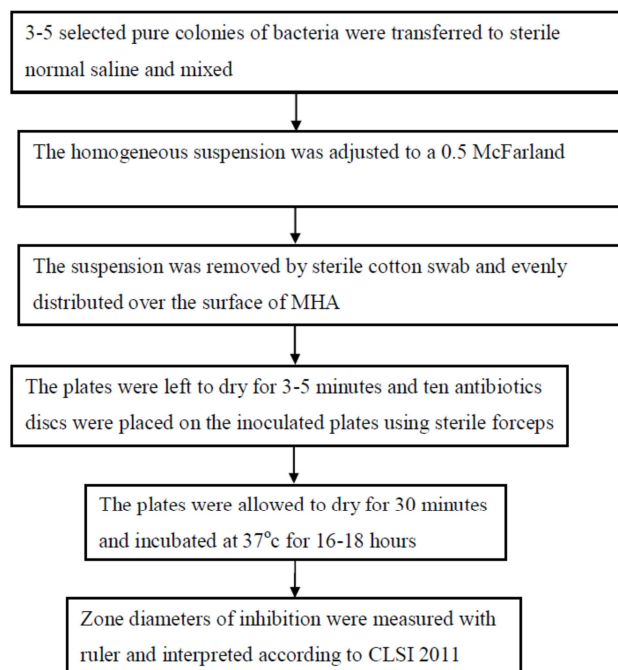

Figure 2. *Antimicrobial sensitivity test procedures followed for enteric bacterial pathogens isolated from food handlers, Jimma, Southwest Ethiopia, 2012.*

2.6. Data Analysis

Data were coded, checked for completeness and cleaned for any inconsistencies. The data were then entered and analyzed using SPSS version 16.0. Descriptive statistics were used and 5% level of precision was used for checking the association between dependent and independent variables.

2.7. Ethical Clearance

Approval was secured from the Ethical Clearance Committee of Jimma University. Formal letter was also written from the Municipality of the town to food establishments and informed consent was obtained from each study participant. Individuals who were found positive for the detected organisms were treated by the effective antibiotics.

3. Results

3.1. Socio-demographic Characteristics

A total of 218 food handlers were participated in this study and their socio-demographic characteristics were presented below (Table1).

Table 1. *Socio-demographic characteristics of selected food handlers, Jimma, Southwest Ethiopia, 2012.*

Characteristics		Frequency	Percent (%)
Sex			
	Male	63	28.9
	Female	155	71.1
Age category (Years)			
	15-24	71	32.6
	25-34	114	52.3
	35-44	23	10.6
	45-52	10	4.6
Educational Status			
	Illiterate	29	13.3
	Read and write	22	10.1
	Literate	167	76.6
	1-8	84	38.5
	9-12	63	28.9
	Above 12	20	9.2

3.2. Isolation Rates of Enteric Bacterial Pathogens

As presented on figure3, the status of infection with enteric bacterial pathogens among the subjects in this study consists of the following types of isolates; 1.8% (4/218) EHEC O157:H7, 2.7% (6/218) *Salmonella* species, 1.4% (3/218) *S. typhi*, and 0.9% (2/218) *Shigella* species giving a total of 6.9% (15/218) isolates. Therefore, the prevalence of enteric bacterial pathogens among food handlers participated in this study was 6.9%. Multiple infections were not detected in any of the processed samples. In describing the prominent isolates of the total enteric bacterial pathogens detected, the dominant species were found to be untyped *Salmonella* species consisting of 40% (6/15) followed by EHEC O157:H7 which accounts 26.7% (4/15), *S. typhi* 20% (3/15) and *Shigella* species 13.3% (2/15).
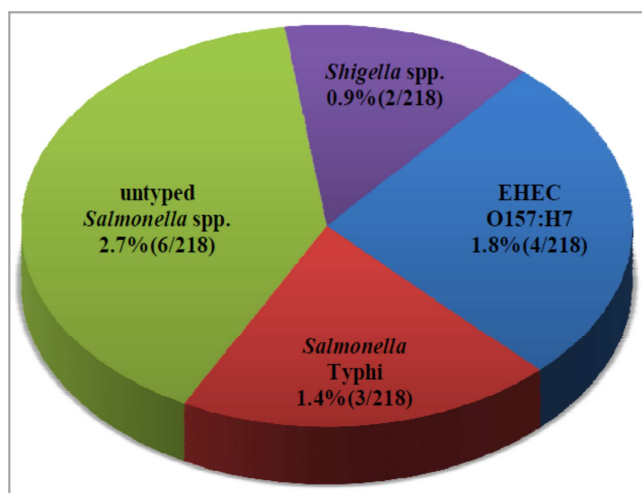
Figure 3. *Species and strains of enteric bacterial pathogens isolated from food handlers, Jimma, Southwest Ethiopia, 2012.*

3.3. Antimicrobial Sensitivity Patterns of Enteric Bacterial Pathogens

Ten antimicrobial discs were used for sensitivity tests of the isolated enteric bacterial pathogens following standard procedures. Accordingly, the isolates showed varied sensitivities to the tested antimicrobials and the results were interpreted and presented in tables for each of them as; resistant (R), intermediate (I) and sensitive (S) according to the CLSI 2011 guideline.

3.3.1. Antimicrobial Sensitivity Patterns of S. typhi and Untyped Salmonella Species

As presented on Table 2 all the three (100%) *S. typhi* isolates showed resistance to two antimicrobials; amoxicillin-clavulanic acid and streptomycin. But, only one (33.3%) isolate showed resistance to ampicillin. However, all (100%) of the isolates showed sensitivity to the rest antimicrobials; ceftriaxone, chloramphenicol, ciprofloxacin, gentamicin, trimethoprim-sulfamethoxazole and nalidixic acid. Unlike *S. typhi*, 83.3% (5/6) *Salmonella* species were resistant to amoxicillin-clavulanic acid followed by 66.7% (4/6) of the isolates which showed resistance to ampicillin. Referring the above species, 50% (3/6) of the isolates showed resistance to streptomycin and tetracycline and 33.3% (2/6) were resistant to trimethoprim-sulfamethoxazole. No resistance was observed by any of the *Salmonella* species as well as *S. typhi* isolates to ciprofloxacin and nalidixic acid.

Table 2. *Antimicrobial sensitivity patterns of S. typhi and untyped Salmonella species isolates from selected food handlers, Jimma, Southwest Ethiopia, 2012.*

Amc	*Salmonella typhi*			*Untyped Salmonella* species		
	R%	I%	S%	R%	I%	S%
AML	100(3/3)	0(0/3)	0(0/3)	83.3(5/6)	0(0/6)	16.7(1/6)
AMP	33.3(1/3)	0(0/3)	66.7(2/3)	66.7(4/6)	0(0/6)	33.3(2/6)
CRO	0(0/3)	0(0/3)	100(3/3)	16.7(1/6)	0(0/6)	83.3(5/6)
C	0(0/3)	0(0/3)	100(3/3)	16.7(1/6)	16.7(1/6)	66.6(4/6)
CIP	0(0/3)	0(0/3)	100(3/3)	0(0/6)	0(0/6)	100(6/6)
TS	0(0/3)	0(0/3)	100(3/3)	33.3(2/6)	0(0/6)	66.7(4/6)
CN	0(0/3)	0(0/3)	100(3/3)	16.7(1/6)	0(0/6)	83.3(5/6)
NA	0(0/3)	0(0/3)	100(3/3)	0(0/6)	0(0/6)	100(6/6)
S	100(3/3)	0(0/3)	0(0/3)	50(3/6)	0(0/6)	50(3/6)
TET	0(0/3)	66.7(2/3)	33.3(1/3)	50(3/6)	16.7(1/6)	33.3(2/6)

Key: Amc = Antimicrobial, AML = Amoxicillin-Clavulanic acid, AMP = Ampicillin, CRO = Ceftriaxone, C = Chloramphenicol, CIP = Ciprofloxacin, TS = Trimethoprim-Sulfamethoxazole, CN = Gentamicin, NA = Nalidixic Acid, S = Streptomycin, TET = Tetracycline, R = Resistant, I = Intermediate, S = Sensitive, and% = Percent

Table 3. *Antimicrobial sensitivity patterns of EHEC O157:H7 and Shigella species isolates from selected food handlers, Jimma, Southwest Ethiopia, 2012.*

Amc	*Shigella* species			EHEC O157:H7		
	R%	I%	S%	R%	I%	S%
AML	50(1/2)	0(0/2)	50(1/2)	75(3/4)	0(0/4)	25(1/4)
AMP	50(1/2)	0(0/2)	50(1/2)	50(2/4)	0(0/4)	50(2/4)
CRO	0(0/2)	0(0/2)	100(2/2)	25(1/4)	25(1/4)	50(2/4)
C	50(1/2)	0(0/2)	50(1/2)	25(1/4)	25(1/4)	50(2/4)
CIP	0(0/2)	0(0/2)	100(2/2)	0(0/4)	0(0/4)	100(4/4)
TS	50(1/2)	0(0/2)	50(1/2)	50(2/4)	0(0/4)	50(2/4)
CN	0(0/2)	0(0/2)	100(2/2)	25(1/4)	0(0/4)	75(3/4)
NA	0(0/2)	0(0/2)	100(2/2)	0(0/4)	0(0/4)	100(4/4)
S	50(1/2)	0(0/2)	50(1/2)	25(1/4)	0(0/4)	75(3/4)
TET	50(1/2)	0(0/2)	50(1/2)	75(3/4)	0(0/4)	25(1/4)

Key: Amc = Antimicrobial, AML = Amoxycillin-Clavulanic acid, AMP = Ampicillin, CRO = Ceftriaxone, C = Chloramphenicol, CIP = Ciprofloxacin, EHEC = Enterohaemorrhagic *E. coli*, TS = Trimethoprim-Sulfamethoxazole, CN = Gentamicin, NA = Nalidixic Acid, S = Streptomycin, TET = Tetracycline, R = Resistant, I = Intermediate, S = Sensitive, and% = Percent

3.3.2. Antimicrobial Sensitivity Patterns of Shigella Species and EHEC O157:H7

As presented on the table 3 half (50%) of *Shigella* isolates showed resistance to six antimicrobials; Amoxycillin-Clavulanic acid, Ampicillin, Chloramphenicol, Trimethoprim-Sulfamethoxazole, Streptomycin, and Tetracycline. However, 100% of the isolates were found to be sensitive to the remaining four antimicrobials; Ceftriaxone, Gentamicin, Ciprofloxacin, and Nalidixic Acid.

Regarding enterohaemorrhagic *Escherichia coli* (EHEC) O157:H7 strains, three (75%) of the isolates were resistant to two antimicrobials; amoxicillin-clavulanic acid and tetracycline. Two (50%) of the strains showed sensitivity to four antimicrobials; ampicillin, ceftriaxone, chloramphenicol and trimethoprim-sulfamethoxazole. Three (75%) of the strains showed sensitivity to gentamicin and streptomycin. But, all the four (100%) strains were sensitive to two antimicrobials; ciprofloxacin and nalidixic acid.

3.3.3. Multidrug Resistance Pattern of Enteric Bacterial Pathogens

Two (50%) of the EHEC O157:H7 strains were multidrug resistant each of them showing resistance to four and eight antimicrobials. Regarding *S. typhi*, one (33.3%) of the isolates showed multidrug resistance showing resistant to three of the antimicrobials. However, five (83.3%) untyped *Salmonella* isolates showed multidrug resistance of which two (33.3%) showed resistance to four antimicrobials; and the remainder showed resistance to three (16.7%), five (16.7%) and eight (16.7%) antimicrobials. One (50%) *Shigella* showed multidrug resistance to four antimicrobials as it is summarized on table 4.

3.4. Associated Factors for Enteric Bacterial Infection Among Food Handlers

Based on chi-square statistical test there was a significant association between enteric bacterial infection and not getting training in food handling and preparation (p=0.034), not knowledgeable about food borne infection (p<0.001) and inconsistent hand washing practice (p=0.033) (Table 5).

Table 4. *Multidrug resistance of enteric bacterial pathogens isolates from selected food handlers, Jimma, Southwest Ethiopia, 2012.*

Organism	Resistance (%)				Antimicrobial agents
	R_3	R_4	R_5	R_8	
EHEC O157:H7		25(1/4)			AML, AMP, TS and TET
				25(1/4)	AML, AMP, CRO, C, TS, CN, S and TET
S. typhi	33.3 (1/3)				AML, AMP and S
	16.7(1/6)				C, S and TET
Untyped *Salmonella* species		33.3(2/6)			AML, AMP, TS and TET
			16.7(1/6)		AML, AMP, C, S and TET
				16.7 (1/6)	AML, AMP, CRO, C, TS, CN, S and TET
Shigella species		50(1/2)			AML, AMP, S and TET

Key: AML = Amoxicillin-Clavulanic acid, AMP = Ampicillin, CRO = Ceftriaxone, C = Chloramphenicol, EHEC = Enterohaemorrhagic Escherichia coli, TS = Trimethoprim-Sulfamethoxazole, CN = Gentamicin, S = Streptomycin, TET = Tetracycline, R_3 = resistant to three antimicrobials, R_4 = resistant to four antimicrobials, R_5 = resistant to five antimicrobials, R_8 = resistant to eight antimicrobials and% = Percent

Table 5. *Associated factors Enteric Bacterial Pathogens from asymptomatic Food Handlers, Jimma, Southwest Ethiopia, 2012.*

Variables		Entericbacterial infection		Total	P- value
		+Ve	-Ve		
Training	Trained	6 (4.2%)	136 (95.8%)	142 (100%)	X^2 = 4.48
	Not trained	9 (11.8%)	67 (88.2%)	76 (100%)	0.034
Medical check up	Yes	5 (4.2%)	113 (95.8%)	118 (100%)	X^2 = 2.8
	No	10 (10%)	90 (90%)	100 (100%)	0.094
Knowledge about FBI	Yes	9 (4.6%)	188 (95.4%)	197 (100%)	X^2 = 17
	No	6 (28.6%)	15 (71.4%)	21 (100%)	<0.001
Consistency of hand washing	Consistent	4 (3.4%)	112 (96.6%)	116 (100%)	X^2 = 4.56
	Inconsistent	11(10.8%)	91 (89.2%)	102 (100%)	0.033

Key: FBI = Foodborne infection, +Ve = Infected, -Ve = Not infected, X^2 = calculated value

4. Discussion

During the five month study period, 218 asymptomatic food handlers were enrolled from selected food establishments. A total of 15 (6.9%) enteric bacterial pathogens were isolated and their antimicrobial sensitivity patterns were determined. In addition, associated factors for enteric bacterial infection among food handlers were assed and all the results were compared with the findings of other studies.

In this study 1.4% *Salmonella typhi* was isolated from food handlers and this is in agreement with the Study conducted from Bahir Dar [8] in which its isolation rate was found to be 1.6%. In the contrary, higher prevalence of *Salmonella typhi* from India [14] and Nigeria [11] was isolated. In the present study, untyped *Salmonella* species were also isolated and they account 2.7%. Correspondingly, study done in North India found that 2.5% *Salmonella* species were recovered from the stools of food handlers. However, incomparable result was

obtained from Sudan that found 3.8% *Salmonella* species [15]. On the other hand, studies done in Gondar and Egypt revealed that no *Salmonella* species were isolated from the stools of food handlers [16], [17]. The reason for the difference in the existence of *Salmonella* species as well as other enteric bacterial pathogens in the stools might be due to variation in climate, geography and study settings.

In this study, isolation rate of *Shigella* species was found to be 0.9%, and it is lower than the results of Gondar (3.1%), and India (9.33%) [7], [16]. Regarding enterohaemorrhagic *Escherichia coli* (EHEC) O157:H7 1.8% strains were isolated and this in agreement with the study conducted from Kenya which was 2.1% [18].On the other hand, higher isolation rate was reported from Japan (8.25%) [17].

As far as antimicrobial sensitivity patterns of enteric bacterial pathogens is concerned; generally, the isolates showed varied sensitivities to ten tested antimicrobials. Hence, there was variation in drug sensitivity patterns among *S. typhi* isolates compared to other studies done somewhere else. For instance, study done in Bahir Dar found that only one (16.7%) *S. typhi* isolate showed resistance to six antimicrobials; ampicillin, trimethoprim-sulfamethoxazole, tetracycline, chloramphenicol, gentamicin and norfloxacin [8]. However, in the current study, 33.3% *S. typhi* showed resistance to three antimicrobials; amoxicillin-clavulanic acid, ampicillin and streptomycin. On the other hand, study conducted in India reported that 78.4% *S. typhi* showed resistance to three antimicrobials; ampicillin, chloramphenicol and trimethoprim-sulfamethoxazole which are conventionally used to treat typhoid fever. Least resistance to norfloxacin, ciprofloxacin, gentamicin and nalidixic acid was observed by most isolates, as reported in the above study. However, multidrug resistance in this study showed by 33.3% of the isolates differs from the above study where 83.3% of the isolates were found to be multidrug resistant [14]. The variation might be due to sample size difference.

All untyped *Salmonella* species were sensitive to ciprofloxacin and nalidixic acid where as five (83.3%) were found to be multidrug resistant. In coherent with the present findings, sensitivity to ciprofloxacin and nalidixic acid and frequent resistance to amoxicillin-clavulanic acid, ampicillin and tetracycline among *Salmonella* species was also reported from studies conducted somewhere. For instance, study done in Nigeria found that 96% and 27.6% *Salmonella* species were found to be sensitive to ciprofloxacin and chloramphenicol, respectively. However, the isolates showed complete resistance to tetracycline, ampicillin and amoxicillin [11]. According to the study conducted in Sudan, 93.1% *Salmonella* species were found to be resistant to the above mentioned antimicrobials and 47.1% isolates showed multidrug resistance [19].

As the antimicrobial sensitivity test results imply, 100% of the *Shigella* isolates were sensitive to two antimicrobials; ciprofloxacin and nalidixic acid. Differently, result reported from China found that 96.4% Shigella isolates were resistant to nalidixic acid. Multidrug resistance observed on 50% of the isolates in this study also differs from the report of the same

study where 91% of the isolates showed multidrug resistance [20]. Sensitivity to ciprofloxacin and gentamicin *Shigella* isolates in the present study agrees with the result found from Gondar University where 91.1% and 92.1% were found to be sensitive to ciprofloxacin and gentamicin, respectively. Resistance to at least three antimicrobials reported from the above study also agrees with the present finding where 50% of the isolates showed resistance to four antimicrobials [21]. Similarly, result reported from a separate study done in Gondar University found all *Shigella* isolates which were sensitive to ciprofloxacin but most of them found to be resistant to ampicillin [5].

Concerning the sensitivity patterns of EHEC O157:H7 isolates, least sensitivity to amoxicillin-clavulanic acid and tetracycline agrees with the finding reported from Iran where 89.7% shiga toxin producing E. coli (STEC) and ETEC were resistant to tetracycline [22]. In agreement with the present finding, study done in Nigeria found that 91.4% EHEC O157:H7 were resistant to tetracycline [23].

As far as associated factors are concerned, the present study not getting training in food handling and preparation was a significant factor for enteric bacterial infection and it was found that only 15.6% food handlers have formal certificate of training in food handling and preparation. Correspondingly, studies conducted in Bahir Dar and Mekelle University reported that 14% and 12.3% of the food handlers have six months formal certificate of training in food handling and preparation respectively [8], [24]. Differently, study conducted in Gondar University found that only 3% of the food handlers have formal certificate of training in food handling and preparation [5].

Regarding medical checkup, the present study found that more than half of the food handlers (54.1%) undergo medical checkup. However, only 13.8% of them undergo regularly. Similarly, study done in Gondar University found that 53.5% food handlers undergo medical checkup [5].In addition, results obtained from Mekelle University and Mekelle town reported that 36.8% and 22.7% respondents undergo medical checkup respectively [24], [25]. On the other hand, study conducted in Bahir Dar town reported that none of the food handlers undergo medical checkup including stool examination previously [8]. The reason for the variation regarding medical checkup in this study and studies done somewhere else might be due to differences in awareness about food born infections among the owner/managers of food establishments.

Most 90.4% food handlers had knowledge about food borne infection (FBI), and this is comparable with report from Nigeria (90%) [11]. Although 90.4% of study participants in the present study were knowledgeable, insufficient knowledge about food born infection among food handlers was also found to be significant associated factor for enteric bacterial pathogens.

Inconsistent hand washing practice was the other significant associated factor. However, 96.8% of the food handlers participated in this study always washes their hands before handling food.This finding is in agreement with those

reported from Bahir Dar town (90.6%) and Gondar University (94%)]5], [8]. Differently, this finding is higher than that found from Nigeria where 72.3% food handlers wash their hands before preparing food [11]. The reason for the difference in hand washing might be due to variation in hygienic practices that people adhere with from country to country as well as from region to region depending on social and economic development.

5. Limitations of the Study

This study was limited to certain enteric bacterial pathogens and other medically important enteric organisms such as *Campylobacter* and *Yersinia enterocolitica* were left unidentified due to some constraints. Confirmation of some strains of pathogenic *Escherchia coli* was also left in this study due to scarcity of Omnilog Microplates. Finger nail samples which might indicate the status of contamination with enteric bacterial pathogens were also not considered in this study.

6. Conclusions

The 6.9% (15/218) prevalence of enteric bacterial pathogens in this finding emphasizes that food handler harboring enteric bacterial pathogens asymptomatically are the potential sources food borne infections. All the isolates showed sensitivity to only two antimicrobials; ciprofloxacin and nalidixic acid. Moreover, 33.3%, *Salmonella typhi*, 83.3% untyped *Salmonella* species, 50% *Shigella* species and 50% EHEC O157:H7 strains showed multidrug resistance. The findings point out that the rise in antimicrobial resistance is still an ongoing public problem in treating enteric bacteria associated infections.Thus, health education is essential to create awareness about food borne infection linked with unhygienic food handling and preparation, Moreover, Continuous supervision and follow up should be undertaken.

Authors' Contributions

TW conceived the study, involved in the study design, data analysis.BW and SK involved in the design, supervised data collection and analysis.AJ drafted and critically reviewed the manuscript. All authors read and approved the final manuscript.

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