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Food handling practices among street food vendors and their associated factors in the town administration of Gamo Zone, Southern Ethiopia

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Introduction: Food handling practice is a serious issue that can increase the risk of contracting foodborne illnesses unless it is well-practiced by street food vendors. Food sold on the street is currently very popular in Ethiopia and is contaminated with various sources of infections due to the poor handling practices of street food vendors that can cause foodborne illnesses. However, there has been little research on the food handling practices of street food vendors in the Gamo zone. Thus, we aimed to assess food handling practices among street food vendors and their associated factors in the town administration of the Gamo Zone.

Methods: A cross-sectional study design was conducted from October to December 2021. A simple random sampling technique by the lottery method was used to select 421 participants. The data were collected through interviews and observations, entered into EpiData version 7, and transported to STATA version 13 for analysis by logistic regression. Statistical significance was set at $p < 0.05$.

Results and discussion: The magnitude of good food handling was 40%. Male gender [AOR = 7.03, 95% CI: 3.36–14.71], ages 19–25 [AOR = 9.34, 95% CI: 3.11–28.07] and 26–35 [AOR = 4.80, 95% CI: 1.54–14.99], married participants [AOR = 6.48, 95% CI: 1.69–24.89], college diploma and above [AOR = 5, 95% CI: 1.46–23], monthly income of 1,001–2,000 ETB [AOR = 3.46, 95% CI: 1.50–7.96], and availability of hand washing facility [AOR = 2.68, 95% CI: 1.24–5.77] were significant predictors of good food handling practices.

Conclusion: Above half of the food vendors had poor food handling practices. Gender, ages, marital and educational status, monthly income, and handwashing

Abbreviations: FBD, foodborne disease; DALYs, disability-adjusted life years; FERG, foodborne epidemiology reference group.

facility were factors associated with food handling practice. Therefore, improving the monthly income and educational status of the food handlers, counseling, and periodic inspections may improve their good food handling practices.

KEYWORDS

street food, food safety, vendors, Gamo, Ethiopia

1 Introduction

Foodborne diseases (FBDs) are a major public health concern in both the developed and developing worlds, which is a risk to billions of people, and millions fall ill every year; many die as a result of consuming unsafe food (Kirk et al., 2015; Moipone et al., 2018; Akabanda et al., 2017). However, the extent of the health problem varies by region and sub-region (Havelaar, 2019). The global burden of FBDs is considerable and affects individuals of all ages, particularly children <5 years of age and persons living in low-income regions of the world (Kirk et al., 2015). Due to the consumption of unhygienic and unsafe food, people develop foodborne illnesses, also known as FBDs, which are caused by pathogenic microorganisms and toxic chemicals (Kirk et al., 2015; Moipone et al., 2018; Augustin et al., 2020). According to WHO estimates of the global burden of FBDs and a study report, using unsafe water for cleaning and processing food, poor food production processes and food handling, the absence of adequate food storage infrastructure, and the hygiene level of food handlers or vendors are some of the causes that can aggravate the burden of FBDs (Kirk et al., 2015; Augustin et al., 2020; Fung et al., 2018). These are also the characteristics of the environmental conditions of street food vendors in low-income countries like Ethiopia (Adane et al., 2018).

Street food vendors are people who handle and sell ready-to-eat food to the public on the streets and in other public places for immediate consumption or consumption at a later time without further processing or preparation (Scallan et al., 2011; Imathiu, 2017). When street food vending is operated under poor sanitary conditions near the street, it can be contaminated with many pathogens that can expose consumers to various FBDs (County et al., 2017).

Findings by the Foodborne Epidemiology Reference Group (FERG) in 2015 mentioned approximately 31 foodborne hazards that caused 600 million illnesses and 420,000 deaths (Havelaar, 2019). Diarrheal diseases cause more than 50% of the global foodborne disability-adjusted life years (DALYs) (Bhaskar, 2017) and arise from 31 foodborne hazards (Augustin et al., 2020). Although developed countries suffer less than developing countries, still, 2,483 illnesses due to diarrheal diseases were related to contaminated food, according to WHO estimates of European food disease burden (Kirk et al., 2015). A study conducted in France revealed that 60% and 30% of the populations suffer from FBD burdens that were attributed to *Campylobacter* spp., as well as non-typhoidal *Salmonella* and 11 other hazards, including bacteria, viruses, and parasites, respectively, especially in children under 5 years, with at least 125,000 deaths every year (Augustin et al., 2020).

In total, children under 5 years of age carry 40% of the FBD burden and account for 1/3 of the deaths from FBDs, with the

illnesses and deaths registered being due to pathogenic microorganisms in unsafe food (Fontannaz-Aujoulat et al., 2019).

FBDs are problematic particularly for developing countries due to difficulties in securing their optimal hygienic food handling practices (Ifeadike et al., 2014). Data from limited areas show that the incidence rate and burden of FBDs in developing countries are incomparably higher than that in developed nations (Moipone et al., 2018). Beyond the individual level, preventable FBDs are causing effects on the socio-economic development in a multitude of ways in the low-income world (Augustin et al., 2020; Fung et al., 2018). Moreover, studies have shown that the increase in foodborne illnesses could be linked to improper food safety practices (Ifeadike et al., 2014).

The highest incidence of FBDs burden and the highest death rates among all ages were recorded in the African region, which is evidenced by the report from WHO (Moipone et al., 2018). According to the most recent WHO estimates, approximately 700,000 deaths per year in Africa are due to food- and water-borne-related diseases (Mama and Alemu, 2016). This is because typhoid fever, foodborne cholera, and diarrhea caused by pathogenic *E. coli* are much more common in low-income countries, which make up 41% of the world population (Moipone et al., 2018; Havelaar, 2019; Augustin et al., 2020; Adane et al., 2018). Studies conducted in some towns of Africa, like Kenya, Nigeria, and Ghana, show that food handlers of street food shops were less likely to wear a gown during food handling, and the majority of the vendors prepared food in unsafe environments with many flies around the food that increase the risk of the food being contaminated (County et al., 2017; Length et al., 2014; Monney et al., 2014). In Ethiopia, FBD was notably seen, and existing study findings showed concerns about food safety due to poor food handling practices observed among street food vendors, which may increase the chance of food getting contaminated by pathogenic microorganisms (Adane et al., 2018; Amaami et al., 2017; Ayaliew et al., 2023; Chekol et al., 2019).

In addition to the hygiene levels of the street food vendors, the marital status, monthly income, knowledge status, level of education, food safety training, and food vending experience also have a significant influence on vendors' food handling practices (Fung et al., 2018; Ayaliew et al., 2023; Chekol et al., 2019).

Food safety and hygiene practices are the backbones for the reduction of FBDs (Kirk et al., 2015). The EU and WHO recommend that community measures (such as food safety, food hygiene, and water safety) be reassessed in light of scientific knowledge, which is crucial in addressing FBD prevention (Kirk et al., 2015; Food Safety and Quality Series, 2016; Van der Meulen and Van de Weerd, 2013).

In our time, street foods are thriving in the main towns of Ethiopia, including urban areas in the Gamo zone. It has become a common sight to see street food vendors around schools, bus

stations, and other places where several people are congested. In Ethiopia, all age groups consume street foods. The demand for relatively inexpensive and 'ready-to-eat' food has increased as people have less time to prepare meals. These situations require an evaluation of the safety and hygiene level of the street foods being served in urban areas in order to prevent them from developing foodborne illnesses. Moreover, in urban areas of the Gamo Zone, dining out in street shops is common among consumers. However, to our awareness, no study has been undertaken on the food handling practice of street food vendors, particularly in the Gamo Zone and generally in southern Ethiopia. In the absence of such data, planning successful intervention methods for improving the level of food hygiene and safety among food handlers is impossible. Therefore, this study was intended to assess the status of food handling practices among street food vendors and its associated factors in the town administrations of the Gamo Zone, Southern Ethiopia.

2 Methods and materials

2.1 Study area descriptions

The study was conducted in four town administrations of the Gamo Zone, namely, Geresse town, Selamber town, Birbir town, and Kemba town, Southern Nations, Nationalities, and Peoples' Region of Ethiopia. The study areas are generally categorized in the climatic zone that is locally known as Woina Dega (subtropical zone).

2.2 Study design and period

The study was cross-sectional in design and conducted from October to December 2021.

2.3 Source population

Street food vendors serving foods near the street in all town administrations of the Gamo Zone were chosen as the source population.

2.4 Study population

Street food vendors serving foods near the street in selected town administrations of the Gamo Zone were chosen as a study population.

2.5 Sample size determination

The sample size was obtained using a single population proportion sample size estimation method using the formula:
$$N = \frac{z_{\alpha/2}^2 P(1-P)}{D^2}$$

Here, N = sample size, $z_{\alpha/2}$ = level of confidence 95% or reliability coefficient = 1.96, P = proportion of the population = 53% food hygiene and safety measures among food handlers in street food shops and food establishments of Dessie town, Ethiopia (Adane

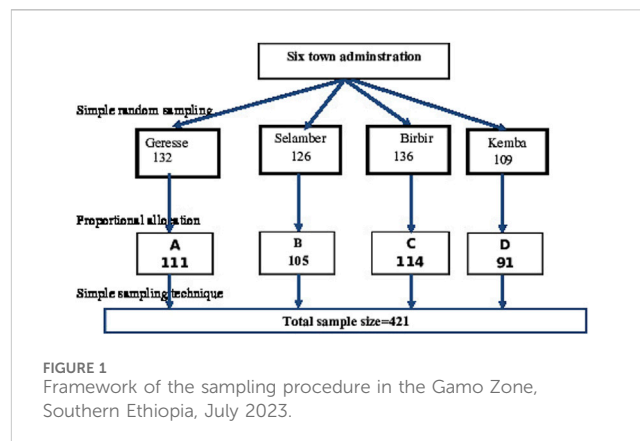


FIGURE 1
Framework of the sampling procedure in the Gamo Zone, Southern Ethiopia, July 2023.

et al., 2018), D = allowable error (0.05), and $n = (1.96)^2 \times 0.53(1-0.53)/(0.05)^2 = 382.7$. With the above inputs, the minimum sample required was 383 individuals. Taking 10% contingency, the final sample size included 421 street food vendors.

2.6 Sampling technique and procedures

There are six town administrations in the Gamo Zone, and from these, four town administrations, namely, Geresse, Selamber, Birbir, and Kemba, were selected by simple random sampling using the lottery method. After knowing the number of street food vendors in each vending site, proportional allocation was done to each town administration. All street food vendors within the sampling frame were given an equal chance of selecting a "yes" or a "no" from a ballot box. Those who picked "yes" were enrolled in the study (Figure 1).

2.7 Inclusion and exclusion criteria

2.7.1 Inclusion criteria

All street food vendors who were available at the vending site during the study period were included.

2.7.2 Exclusion criteria

Mobile food vendors (hawkers) within the sampling frame were excluded from the study.

Street food vendors who were unwilling to participate were excluded.

2.8 Study variables

2.8.1 Dependent variable(s)

Food handling practices.

2.8.2 Independent variables

Socio-demographic characteristics (age, sex, marital status, religion, ethnicity, educational status, monthly income, work experience, operation time, recent training, sanitary inspection, medical check-up and license for operation, and availability of handwashing facilities) and knowledge on food safety.

2.9 Data collection tools and procedure

2.9.1 Questionnaire and observation checklist

A structured questionnaire composed of socio-demographic factors, food safety knowledge, working environment characteristics, and food handling practices was employed to collect the data via face-to-face interview and observation. The questionnaire was designed from standardized food and drink establishments' inspection checklists by reviewing different literature reports. To maintain its consistency, the questionnaire was originally prepared in English, translated to the local language, and then retranslated back to English.

Public health and environmental health experts were recruited as data collectors and field supervisors. One day of training regarding the objective of the study, interview and inspection techniques, and confidentiality of information was provided to data collectors and supervisors.

The questionnaire was pretested on 5% of the total sample in the study area, which included 20 street food vendors. To maintain the quality of the data, the investigators and supervisors carried out regular supervision, spot-checking, and reviewing the completeness of the questionnaire on a daily basis.

2.10 Data processing and analysis

Data were cleaned, coded, and entered into Epi Info version 7 and exported to STATA version 13 for analysis. Simple descriptive statistics were used to present the sociodemographic characteristics of the participants. Categorical variables were presented as numbers and percentages, while continuous variables were presented as mean \pm standard deviation. Descriptive statistics were carried out to assess the basic study participants' characteristics. Bivariate analysis using the logistic regression technique was carried out to identify the candidate variable for multiple logistic regressions between each independent variable and the dependent variable. Variables that had a p -value less than 0.25 in bivariate analysis were entered into multiple logistic regression models for controlling the confounding factors and identifying significant factors associated with good food handling practices. The strength of the statistical association was measured by adjusted odds ratios, 95% confidence intervals, and p -value <0.05 . Model fitness was assessed using the Hosmer and Lemeshow goodness-of-fitness test (p -value = 0.9).

2.11 Operational definitions

The level of food handling practice was determined using the 17 food hygiene practice questions complemented with direct observation based on [Derse et al. \(2017\)](#) and [Ma et al. \(2019\)](#). The food handling practice was computed with a maximum score of 17. By considering the mean score, the food hygiene practices of street food vendors were categorized as follows:

Poor food handling practice: if their score was below the mean score.

Good food handling practice: if their score was greater than or equal to the mean score.

Food safety knowledge of street food vendors was determined by using 18 food safety knowledge questions based on [Ma et al. \(2019\)](#).

It was computed with the maximum score of 100 or 100%. Finally, by considering the mean score, the street food vendors' knowledge was categorized as follows:

Poor food safety knowledge: if their score was below the mean score.

Good food safety knowledge: if their score was greater than or equal to the mean score.

2.12 Ethical consideration

Ethical approval and clearance was obtained from the Institutional Review Board (IRB) of Arba Minch University with the reference number of IRB/1176/2021, College Medicine and Health Sciences. Permission was also obtained from the concerned bodies of the Gamo zone and, then, from the study towns' administrations health office. Verbal consent was obtained from vending sites or study subjects. Each respondent was assured that the information provided by them would be kept confidential and used only for the purpose of this research.

3 Result

3.1 Socio-demographic characteristics of street food vendors

A total of 416 street food vendors responded to the questionnaires from the selected 421, generating a response rate of 98.8%. The age of the study participants was between 15 and 51 years, with a mean (\pm SD) age of 27.66 ± 7.95 years. The proportion of married street food vendors in this study accounts for 47.8% (199/416). Concerning educational status, it was observed that 45.7% (190/416) of the respondents can read and write ([Table 1](#)).

3.2 Behavioral and wash-related characteristics of street food vendors

This study found that the majority of the street food vendors, which is 93.5% (300/416), did not undergo training on food safety. Approximately 57% (237/416) of the participants had served 2–5 years in the food vending site. Regarding knowledge, 58.4% (243/416) and 41.6% (173/416) of the street food vendors had poor and good knowledge on food safety, respectively ([Table 2](#)). Regarding wash-related characteristics, it was observed that 78.6% (327) of the street food vendors had access to potable water. The result of this study also showed that 74.3% (309/416) of the street food vendors had a handwashing area.

3.3 Magnitude of food handling practices among street food vendors

As can be seen from [Figure 2](#), out of the total 416 respondents, 40% (141/416) of them had good food handling practices, while the rest of the participants did not have good food handling practices, which accounts for 66% (275/416).

TABLE 1 Sociodemographic characteristics of street food vendors in the Gamo Zone, Southern Ethiopia (n = 416).

Variable	Category	Number	Percentage
Gender	Male	160	38.5
	Female	256	61.5
Age (in years)	≥18	27	6.5
	19 to 25	191	45.9
	26 to 35	115	27.6
	≥36	83	20
Marital status	Single	183	44
	Married	199	47.8
	Divorced	12	2.9
	Widowed	22	5.3
Educational status	Cannot read and write	36	8.7
	Can read and write	40	9.6
	Primary	190	45.7
	Secondary	96	23
	≥ College diploma	54	13
Monthly income (in ETB)	Less than or equal to 1,000	179	43
	1,001–2,000	165	39.7
	2,001–3,000	51	12.3
	≥3,001	21	5
Vending site ownership	Yes	277	66.6
	No	139	33.4

Note: results are analyzed using descriptive analysis; ≤, less than or equal to; ≥, greater than or equal to.

TABLE 2 Behavioral and wash-related characteristics of street food vendors in the Gamo Zone, Southern Ethiopia (n = 416).

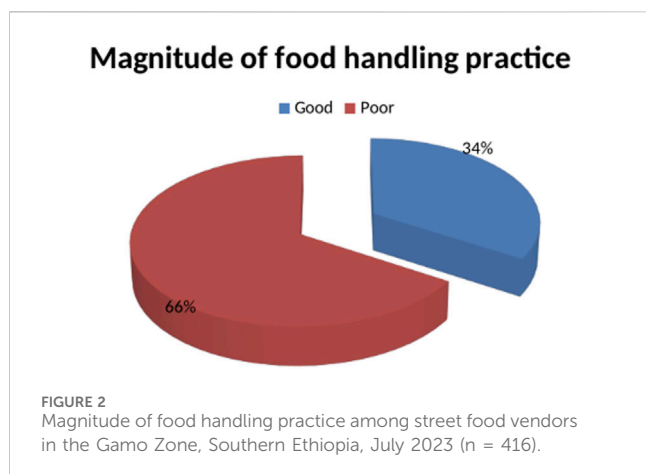
Variable	Category	Number	Percentage
Training on food safety	Yes	27	6.5
	No	389	93.5
Service years in the food vending site	≤1	130	31.3
	2 to 5	237	57
	≥6	49	11.8
Sanitation inspection by health workers	Yes	57	13.7
	No	339	86.3
Visit to health institutions	Yes	10	2.4
	No	406	97.6
Knowledge on food safety	Good	173	41.6
	Poor	243	58.4
Access to potable water	Yes	327	78.6
	No	89	21.4
Handwashing area	Yes	309	74.3
	No	107	25.7

Note: results are analyzed using the descriptive analysis method; ≤, less than or equal to; ≥, greater than or equal to.

3.4 Factors associated with the food handling practice among street food vendors

Variables scored p -value <0.25 in the bivariate logistic regression model, and factors such as sex, age, marital status, educational status, monthly income, ownership of the vending site, training status, service years, knowledge on food safety, and availability of hand washing area were candidate variables for multiple logistic regression (displayed by Table 3 below). In multiple logistic regression, the likelihood of performing good food handling practice among male street food vendors [AOR = 7.03, 95% CI:

3.36–14.71] was seven times higher than that among female street food vendors. Street food vendors in the age group of 19–25 [AOR = 9.34, 95% CI: 3.11–28.07] and 26–35 years [AOR = 4.80, 95% CI: 1.54–14.99] were nine and five times, respectively, more likely to have good food handling practices than those in the age group of less than or equal to 18 years old. It was also seen that the chance of performing good food handling practice was 6.5 times higher for married participants than for their counterparts [AOR = 6.48, 95% CI: 1.69–24.89]. Street food vendors who were college diploma holders and above had five times more likely to have good food safety practice than their counterparts [AOR = 5, 95% CI: (1.46–23)]. The likelihood of performing good food handling



practices was higher in participants who earned a monthly income of 1,001–2,000 ETB than in participants who earned a monthly income of less than or equal to 1,000 ETB birr [AOR = 3.46, 95% CI: 1.50–7.96]. Street food vendors that had handwashing areas were three times more likely to perform good food handling practices than those with no handwashing areas [AOR = 2.68, 95% CI: 1.24–5.77].

4 Discussion

This quantitative cross-sectional study was attempted to assess food handling practices among street food vendors in the Gamo Zone, Southern Ethiopia. The result of this study revealed that the magnitude of good food handling practices was 40%, which is consistent with a cross-sectional study conducted on food hygiene practices among street food vendors in urban areas of the Gedeo Zone, Southern Ethiopia, and Gonder that reported the magnitude of good food handling practice to be 31.5% (Negassa et al., 2023) and 30.3% (Town, 2014), respectively; the finding of this study is higher than what was reported from Bole sub-city of Addis Ababa, which was 27.4% (City et al., 2020), and Plateau State of Nigeria, which was 24% (North et al., 2015). This variation might be due to differences in the study setting and population. However, it is lower than previous studies conducted in other parts of Ethiopia, like in Dangila, Dessie, Debarq, and the University of Gondar, which were 53%, 49.6%, 52.5%, and 46.7%, respectively (Fung et al., 2018; Adane et al., 2018; Dagne et al., 2019; Lema et al., 2020). The possible justification for this variation might be due to differences in the sample size among the studies conducted. Furthermore, these differences could be attributed to differences in training provided and the supply of food hygiene information and education delivered for vendors.

The study found that the likelihood of performing good food handling practice was higher for male street food vendors than for female vendors. The study finding also shows that street food vendors in the age group 19–25 and 26–35 showed a higher chance of performing good food handling practice than those who were less than or equal to 18, which was in line with a cross-sectional study conducted on food hygiene practices and associated factors among street food vendors in urban areas of the Gedeo Zone, Southern Ethiopia (Negassa et al., 2023).

Moreover, in this study, marital status was significantly associated with food handling practice. The likelihood of performing good food-handling practice in married participants was 6.5 times higher than in their counterparts (unmarried participants); this finding was in line with a cross-sectional study conducted on food hygiene practices and associated factors among street food vendors in urban areas of the Gedeo Zone, Southern Ethiopia (Negassa et al., 2023).

The chance of performing good food handling practice was five times more likely in street food vendors who were college diploma holders and above than in their counterparts. This finding is supported by a study conducted in Northwest Ethiopia on food safety practice and its associated factors among mothers (Dagne et al., 2019).

The likelihood of performing good food handling practice in participants who got a monthly income of 1,001–2,000 ETB birr were 3.5 times higher than in participants who earned a monthly income of less than or equal to 1,000 ETB birr. This finding was in line with a study conducted on food safety practices and associated factors in City Administrations of West Gojjam Zone, Northwest Ethiopia, 2021 (Town and Oromia, 2021).

This study also revealed a significant association between handwashing facilities and food handling practices. The odds of performing good food handling practice in vendors who had a handwashing facility were 2.7 times higher than in those that had no handwashing facility. This finding is supported by a cross-sectional study conducted on food hygiene practices and associated factors among food handlers in the Bole Sub City, Addis Ababa, Ethiopia, in 2017 G.C (City et al., 2020).

The limitations of this study were recall bias and social desirability bias, which might have led to under- or over-reporting. This study was cross-sectional, so it could not show the cause-and-effect relationships. Moreover, parasitic and microbiological laboratory analyses were not considered in this study.

5 Strengths

The data collectors were nurses and spoke local languages.

6 Conclusion and recommendation

In general, the study demonstrated that the overall magnitude of good food handling practices was low in the study area. Participants who were male individuals, within the age group of 19–25 and 26–35, married, held college diploma and above, had a monthly income of 1,001–2,000 Ethiopian birr, and had a handwashing facility were identified as significant predictors of good food handling practice. A great effort should be made to address the availability of handwashing facilities and health education programs. Health professionals and health extension workers should provide appropriate counseling to strengthen food handlers with income opportunities and education up to the level of college. Further research should be conducted on large-scale sampling supported by qualitative data in order to identify parasitological and microbiological analyses of the food.

TABLE 3 Factors associated with food handling practice among street food vendors in the Gamo Zone, Southern Ethiopia (n = 416).

Variable	Category	Food handling practice N (%)		Binary	Multivariable	
		Yes	No	COR (95% CI)	AOR (95% CI)	p-value
Gender	Male	77 (48.1)	83 (51.9)	2.78 (1.83–4.24)	7 (3.36–14.71)	0.01
	Female	64 (25)	192 (75)	1	1	
Age (in years)	≤18	15 (55.6)	12 (44.4)	1	1	1
	19 to 25	50 (26.2)	141 (73.8)	3.53 (1.55–8.04)	9 (3.11–28.07)	0.01
	26 to 35	36 (31.3)	79 (68.7)	2.74 (1.17–6.45)	5 (1.5–14.99)	0.07
	≥36	40 (48.2)	43 (51.8)	1.34 (0.56–3.22)	2 (0.66–6.95)	0.2
Marital status	Widowed	16 (72.7)	6 (27.3)	1	1	1
	Divorced	10 (83.3)	115 (62.8)	0.53 (0.09–3.18)	0.36 (0.05–2.79)	10.3
	Single	68 (37.2)	152 (76.4)	4.51 (1.68–12.08)	2 (0.52–8.34)	0.3
	Married	47 (23.6)		8.62 (3.19–23.29)	6.5 (1.69–24.89)	0.07
Educational status	Cannot read and write	14 (38.9)	22 (61.1)	1	1	1
	Can read and write	24 (60)	16 (40)	0.42 (0.17–1.01)	0.58 (0.16–2.15)	0.42
	Primary	41 (21.6)	149 (78.4)	2.31(1.09–4.92)	2.02 (0.65–6.33)	0.23
	Secondary	26 (27.1)	70 (72.9)	1.71(0.76–3.84)	1.01 (0.30–3.37)	0.99
	≥ College diploma	36 (66.7)	18 (33.3)	3.14 (1.2–19)	5 (1.46–23)	0.01
Monthly income (in ETB)	≤1,000	74 (41.3)	105 (58.7)	1	1	1
	1,001–2,000	47 (28.5)	118 (71.5)	1.77 (1.13–2.78)	3.46 (1.5–7.96)	0.04
	2,001–3,000	11 (21.6)	40 (78.4)	2.56 (1.23–5.32)	3.01 (0.95–9.49)	0.06
	≥3,001	9 (42.9)	12 (57.1)	0.94 (0.38–2.34)	1.54 (0.26–9.06)	0.63
Vending site ownership	No	46 (33.1)	93 (66.9)	1	1	1
	Yes	95 (34.3)	182 (65.7)	0.95 (0.62–1.46)	0.49 (0.22–1.08)	0.08
Training on food safety	No	137 (35.2)	252 (64.8)	1	1	1
	Yes	4 (14.8)	23 (85.2)	3.13 (1.06–9.22)	1.89 (0.33–10.87)	0.48
Service years in the food vending site	≤1	53 (40.8)	77 (59.2)	1	1	1
	2 to 5	72 (30.4)	165 (69.6)	1.58 (1.01–2.46)	1.89 (0.90–3.97)	0.09
	≥6	16 (32.7)	33 (67.3)	1.42 (0.71–2.84)	3.21 (0.96–10.75)	0.06
Sanitation inspection by health workers	No	134 (37.3)	225 (62.7)	1		
	Yes	7 (12.3)	50 (87.7)	4.25 (1.88–9.65)		
Health institutions visit	No	139 (34.2)	267 (65.8)	1		
	Yes	2 (20)	8 (80)	2.08 (0.44–9.94)		
Knowledge on food safety	Poor	75 (30.9)	168 (69.1)	1	1	1
	Good	66 (38.2)	107 (61.8)	0.72 (0.48–1.09)	1.46 (0.71–3.02)	0.3
Access to potable water	No	137 (41.9)	190 (58.1)	1		
	Yes	4 (4.5)	85 (95.5)	15.32 (5.5–42.8)		
Handwashing area	Yes	56 (52.3)	51 (47.7)	2.89 (1.84–4.56)	2.68 (1.24–5.77)	0.01
	No	85 (27.5)	224 (72.5)	1	1	

Note: results are analyzed using binary and multivariable logistic regressions; ≤, less than or equal to; ≥, greater than or equal to. Abbreviations: AOR, adjusted odd ratio; COR, crude odd ratio; N (%), number and percent.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material; further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by the Institutional Review Board (IRB) of Arba Minch University with the reference number of IRB/1176/2021. The studies were conducted in accordance with the local legislation and

institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

ZG: conceptualization, methodology, software, writing–review and editing, data curation, formal analysis, funding acquisition, investigation, project administration, resources, supervision, validation, visualization, and writing–original draft. KT: formal analysis, methodology, validation, and writing–review and editing. AD: formal analysis, conceptualization, data curation, and writing–original draft. NW: conceptualization, methodology,

software, and writing–review and editing. MJ: conceptualization, formal analysis, and writing–review and editing. MW: writing–review and editing, data curation, software, and supervision.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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