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Food safety practices and associated factors among food handlers in food establishments in Adama town, Central Ethiopia

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Introduction: Foodborne infections caused by a variety of variables pose serious public health risks, resulting in significant morbidity and mortality in poor nations like Ethiopia. However, the study contains a deficit in information about food safety practices and associated factors. Thus, this study assessed food safety practices and influencing factors among food handlers in public food establishments in Adama town, Central Ethiopia.

Methods: An institution-based cross-sectional design was used for this study. A total of 319 food handlers were selected through systematic random sampling, with data collected through face-to-face interviews using the Kobo tool. The data were analyzed using descriptive statistics, binary and multivariate logistic regressions using SPSS V-27. Significant factors associated with food safety practices were determined based on Adjusted Odds Ratios (AOR), 95% Confidence Intervals (CI), and a significance level set at $p < 0.05$.

Results and discussion: The findings revealed that 64.79% of food handlers exhibited commendable food safety practices. Factors significantly associated with the food safety practices included knowledge (AOR = 2.106, 95% CI: 1.23–3.606), attitude (AOR = 2.0, 95% CI: 1.169–3.334), ownership status of the establishment (AOR = 2.65, 95% CI: 1.48–4.98), and monthly salary (AOR = 0.516, 95% CI: 0.293–0.906). Food safety practices among food handlers in public food establishments rank as medium compared to other studies conducted in the country. These findings indicates the vital role of education, awareness campaigns, and training programs in promoting safe food handling practices. Therefore, to ensure safe and healthy food, there is a need for targeted interventions, mainly focusing on improving food handler knowledge and attitudes, to enhance food safety standards in public food establishments. It is recommended that authorities and organizations prioritize significant factors identified in this study to reduce foodborne illnesses, ensure public health, and foster a culture of responsible food-handling practices.

KEYWORDS

food handling, food safety, practices, public food establishment, Ethiopia

Introduction

Food safety practices are crucial for protecting people from illnesses caused by contaminated food. This includes a set of procedures that should be followed in food establishments to ensure safe food consumption (Abegaz, 2022; Hassauer and Roosen, 2020). A key aspect of food safety is proper food handling, which includes all steps in preparing, storing, serving food and also from its arrival at an establishment to when it is consumed. Every stage, from production to consumption, requires careful attention to ensure the food is free from harmful contaminants (Holban and Grumezescu, 2018).

World Health Organization emphasized food safety as a critical global concern and has identified five key practices: maintaining cleanliness, separating raw and ready-to-eat food, thorough cooking, proper temperature control, and rigorous raw materials inspection (Haddad et al., 2020). However, foodborne illnesses remain a significant threat, often stemming from inadequate food handling practices within the food supply chain and establishments. These outbreaks can impact large populations simultaneously, posing a major public health challenge (Islam et al., 2023; Grace, 2015). The impact of foodborne diseases is particularly acute in low-and middle-income countries, especially those in Africa and sub-Saharan regions. Beyond the immediate health risks, poor food safety practices obstruct progress toward sustainable development goals focused on ending hunger and poverty, while also promoting overall health and wellbeing (Hoffmann et al., 2019; Morse et al., 2018).

Annually, 420,000 deaths, 600 million illnesses, and 33 million lost years of healthy life are attributed to foodborne diseases, affecting one in 10 people worldwide (World Health Organization, 2022; Faour-Klingbeil and Todd, 2020; Lee and Yoon, 2021). In the United States alone, the Centers for Disease Control and Prevention (CDC) report approximately 48 million annual cases of illness, with 128,000 hospitalizations and 3,000 deaths attributed to foodborne diseases (Mattia and Manikonda, 2018; Kim, 2023). In Africa, microbiological and chemical food contamination results in 91 million acute illnesses and 137,000 deaths annually, contributing to 1,200 Disability Life Years (DALYs) per 100,000 people in Eastern and Southern Africa (World Health Organization, 2016). Ethiopia also faces a similar challenge as a foodborne bacterial illnesses account for a significant proportion of reported illnesses and drug resistance. These diseases result in a substantial economic loss of at least 723 million USD annually and cause an estimated 1,570 deaths and 3.1 million illnesses per year (Ayana et al., 2015; Tesfaye, 2023).

Although food safety practices and associated factors in public food establishments are a global concern, implementation of these practices varies significantly across countries. In California, a meta-analysis reported an 80.0% implementation rate of general food safety practices in public food establishments (Insfran-Rivarola et al., 2020). Similar findings emerged from Brazil, with self-reported and observational methods revealing rates of 80.71 and 75.40%, respectively (Souza et al., 2018). In South Asia, food safety practices among food handlers in Lahore, Pakistan, were reported at 65.34% (Ahmed et al., 2021). A meta-analysis of Asian low-and middle-income countries revealed an average food safety practice rate of 59.8% in public food establishments (Kwoba et al., 2023). African countries show diverse rates, ranging from 71% in South Africa to 56% in Malaysia, 62.9% in Ghana, and 59% in Egypt (Nyawo et al., 2021; Tuglo et al., 2021; Abd Lataf Dora-Liyana et al., 2018; Allam et al., 2016).

Similarly, Ethiopian government has established regulations and guidelines for food handling in public food establishments, including licensing requirements and health inspections. However, implementing food safety standards effectively in the country faces challenges. These include a lack of training, financial resources, and limited knowledge about food safety among food handlers and consumers. Additionally, some traditional food preparation practices may not align with modern food safety standards. Previous research in Ethiopia has emphasized the significant variability in food safety practices across different regions. For instance, two meta-analyses reported prevalence rates of food safety issues in public food establishments at 50.72 and 47.14%, respectively (Tamene et al., 2022; Tadele et al., 2022). Furthermore, regional studies demonstrate this variability, with rates ranging from 53.1% in Makelle Town, Tigray, to 49.5–72.4% in various areas of the Amhara region (Azanaw et al., 2019; Chekol et al., 2019; Adane et al., 2018; Lalit et al., 2015). Towns like Adama, Addis Ababa Bole Subsite, Fitche, and Bishoftu also show diverse levels of implementation of food safety practices (Girmay et al., 2022; Abdi et al., 2020; Teferi, 2020).

Foodborne illnesses are a significant public health problem in Ethiopia, mainly due to widespread unsafe food handling practices and different factors. These practices, which occur at every stage of the food chain from farm to table, lead to contamination by harmful bacteria (Chen and Alali, 2018). For or example, a study conducted in Sharjah, United Arab Emirates, found that mothers' lack of awareness of microbes was substantially connected with foodborne infections (Saeed et al., 2021). In Kenya, being female, possessing a valid medical examination certificate, and not boiling or sanitizing water before delivering it to consumers were all risk factors for foodborne pathogen infections (Kimemia et al., 2023). In Indonesia, the risk factors for foodborne disease were nail hygiene, knowledge level, nail trimming activity, and hand-washing behavior (Lubis et al., 2019). Therefore, placing greater emphasis on safe food handling practices can significantly reduce the risk of foodborne illnesses, thereby protecting consumer health.

Food establishments that adhere to safe handling practices build trust with customers, encouraging repeat business and contributes to economic growth by ensuring the safety and quality of food products, promoting tourism, and supporting the local food industry. While previous studies in Ethiopia, identified multiple factors influencing food safety practices including food handler knowledge, manager supervision, and sanitation facilities, training, attitude, education, income, and work experience (Tamene et al., 2022; Teferi, 2020), these studies have primarily relied on quantitative and cross-sectional approaches, A significant gap remains in understanding these factors comprehensively through a mixed-methods approaches. Thus, this study aims to address this gap by offering a comprehensive understanding of the factors influencing food safety practices in Adama town. It seeks to fill important information gaps and provide valuable insights to improve food safety measures in Ethiopia.

This finding will contribute to developing practical solutions to enhance food safety practices and protect consumers' health. Beyond identifying factors contributing to food safety risks, the study uses its findings to inform practical interventions to improve food safety practices. This finding analyzed the interplay of various factors and identified specific areas where food handlers require additional training, support, and resources to improve their practices. The result

of this study will also inform food establishments and relevant authorities about developing effective policies and strategies that promote better food safety practices within food establishments. Ultimately, this contributes to public health by protecting consumers' health and reducing the incidence of foodborne illnesses.

Methods

Study setting and design

The study employed an institution-based cross-sectional design. The study was conducted in Adama town from July 15, 2023, to October 23, 2023, aimed to gather information through both primary and secondary data sources. Primary data was collected through surveys, interviews with key informants, and site visits/field observations. Secondary data sources included a review of existing literature and archived data from the district health offices. Adama was established in 1916 to support the Addis Ababa-Djibouti railway line. Adama town was chosen for this study because of its strategic location and economic significance. It is located in the East Shewa Zone, 99 kilometers southeast of Addis Ababa's capital. According to the town's Tourism and Culture office, the town is home to a thriving food service industry, with 1,110 establishments, including hotels, restaurants, and cafeterias. The town also serves as a key agricultural hub and a significant industrial center, which makes the town a strong representation of the challenges and opportunities many towns face in Ethiopia's development trajectory.

Population and eligibility

The source population included all public food establishments recognized in Adama town at the time of the survey. The survey considered 319 respondents from from three categories of food establishments (hotels, restaurants, and cafeterias) in Adama town. Food handlers, irrespective of sex and employment status, who were at least 18 years old and had been actively engaged in the preparation, butcher shops, and food service areas within food establishments during the study period were included. Food handlers who faced hearing, speaking, or overall communication challenges were excluded from the study inorder to get more details and valid data.

Sample size determination and procedures

The single population proportion formula was used to determine the sample size needed to assess the level of food safety practices among food handlers in public food establishments. Based on a prevalence of food safety practices observed in a study in Bishoftu town (51.0%), with a 95% confidence level and a 5% margin of error, the initial calculation yielded a sample size (n) of 384 (Kim, 2023).

$$n = \frac{\left(\frac{Z\alpha}{2}\right)^2 p(1-p)}{d^2} \quad n = \frac{(1.96)^2 \times (0.51) \times (1-0.51)}{(0.05)^2} = 384$$

Where:

- N is the minimum possible sample size
- $Z_{\alpha/2}$ is the standard score value for 95% confidence level
- P is the population proportion (prevalence)
- d is the margin of error (5%)

As the total population is less than 10,000, a correction was applied using the formula:

$$\mathrm{Nf} = \frac{\mathrm{n}}{1+\frac{\mathrm{n}}{\mathrm{N}}} = \frac{384}{1+\frac{384}{1110}} = \text{Where; Nf} = \text{the desired sample size} = 284.$$

The sample size was calculated using the double population proportion to identify factors associated with food safety practices among public food establishments. The calculation considered a confidence level of 95%, a power of 80%, and a ratio of 1 (unexposed: exposed). In the unexposed group (those with training), the proportion of good food safety practices was 0.18, while in the exposed group (those without training), it was 0.33. The calculation yielded a sample size of 290. By considering a 10% non-response rate, the total sample size for the second objective was 319, with the following assumptions.

The Adama Town Tourism and Culture Office provided 1,110 public food establishments, categorized as 210 hotels, 354 restaurants (including butcher shops), and 546 cafeterias (including juice houses and Shiro houses). Sample proportional allocation and a systematic random sampling technique were employed to select representatives: 60 hotels, 102 restaurants, and 157 cafeterias. The lottery method determined the starting point, and the interval (K) was set at 4 K were added to the starting point to identify the selected establishments until the required sample size was reached. If more than two food handlers were present, the lottery method was applied to select one kitchen worker, waiter, or butcher.

Methods of data collection and quality assurance

The survey employed questionnaires developed through literature review and standard guidelines, translated into local languages (Afaan Oromo and Amharic) and back-translated to ensure consistency. After questionnaire development, four trained health professionals, including two nurses, one clinical nurse, and one environmental health professional, were recruited as enumerators. Enumerators underwent twodays training session emphasizing impartiality, responsibilities, and respondent rights, ensuring standardized and unbiased data collection.

Data cleaning procedures were developed to detect and correct outliers or anomalies in the collected data, ensuring accuracy and reliability. The reliability of knowledge, attitude, and food safety practice questionnaires was assessed using a Cronbach-alpha test, and consistency scores of 0.722, 0.846, and 0.79, respectively. Since the value of Cronbach alpha is greater than 0.7, the reliability in the collected data was good.

Similarly, for the food hygienic practices data, 23 questions were used to categorize their practices into good and poor depending on their answer. Therefore, for every correct answer, the score is one (Abegaz, 2022) point and for every wrong answer, the score zero (0) point. Then, an individual could score a minimum of zero and a maximum of 23 points. Thus, the respondents who scored less than mean out of 23 questions had poor food safety practices and those who scored greater than or equal to mean had good food practices.

Study variables

The dependent variable for this study was food safety practice. Independent variables included sociodemographic factors like sex, monthly income, service years, age, marital status, educational status, Job description, food safety training medical certificate and other factors like level of food establishment, ownership of food establishments, knowledge status, attitude status, environmental factors like liquid waste disposal, functional latrine, dishwashing system, work clothes, pip water in a cooking area, pip water for customers, shower room, refrigerator and legal license.

Statistical analysis

In the quantitative analysis, data from the Kobo tool were transferred to Microsoft Excel and imported into SPSS version 27. Cleaning procedures were implemented to ensure accuracy and consistency and address missing values, utilizing descriptive statistics like frequencies and proportions. Variables related to food safety knowledge, attitudes, and practices were dichotomized, employing coding such as "yes = 1" and "no = 0" for some and a five-scale measurement of attitudes. Collinearity effects were examined using tolerance values and variance inflation factor (VIF), excluding violating variables. Non-collinear covariates were incorporated into a binary logistic regression model. Simple binary logistic regression identified significant variables ($p < 0.2$) included in the multivariate binary logistic regression. The model's fitness was evaluated using the Hosmer-Lemeshow goodness-of-fit test. Inferential statistics, including binary logistic regression analysis, determine variables related to the dependent variable. Significance was reported based on the adjusted odds ratio (AOR), 95% confidence interval (CI), and a *p*-value less than 0.05.

Results

Sociodemographic characteristics

In this study involving 319 respondents with a 100% response rate, a diverse demographic profile of food handlers in public food establishments was observed. The demographic snapshot of individuals in this study reveals a predominantly female presence, accounting for 63% of the participants, underscoring the substantial contribution of women. The mean age of the participants was 30.17 ± 6.36, with the highest frequency observed among those aged 25 years. Employment-wise, the majority were on monthly contracts (65.8%), and the mean monthly salary stood at 4,018.50 ± 3561.50 birr, with 61.4% earning less than 3,142 Ethiopian birr. Regarding work experience, 50.2% had 3–5 years of experience, and 31.3% had received food safety practice training. Additionally, a significant percentage of establishments were rented (66.1%) (Table 1).

Food handlers' knowledge toward food safety practices

The mean knowledge score of respondents to the food safety knowledge questionnaire was 25.7981 ± 4.014. Handwashing knowledge was universally high (100%), with 75.2% recognizing critical times, especially after using the toilet. Knowledge of protective equipment usage was observed by 58.5%, while understanding food contamination sources and safe handling practices was reported by 65.4 and 74%, respectively. Recognition of different types of food contamination (51.2%) and foodborne diseases (29.8%) varied (Table 2). The poor knowledge and good knowledge toward food safety practices among food handlers were 33.45 and 66.6%, respectively (Figure 1). While all food establishments provided soap and other personal protective materials, a significant number of food handlers demonstrated inadequate knowledge about their proper use, posing a potential risk to food safety.

Food handlers' attitude toward food safety practices

The mean attitude score of participants was 41.30 ± 4.99, indicating that 66.1% held favorable attitudes toward food safety practices. Regarding food handling, 70.5% supported separate handling to decrease contamination, and 62.4% endorsed using different cutting boards for meat and vegetables. Awareness of adequately cooked food was high (70.8%), and 54.5% believed in temperature controls to reduce contamination (Table 3).

Food handlers' food safety practice status

An analysis of food safety practices revealed a mean score of 11.21 ± 1.49, with 64.97% demonstrating commendable practices. Notably, 99.4% of establishments sourced food legally, and 94% of handlers maintained proper personal hygiene. However, only 19.1% used thermometers for cooked food, and 35.7% monitored refrigerator temperatures. Effective pest control (94.7%) and color-coded chopping boards (71.8%) were positive aspects, while 89% discarded unsafe foods, and 69% reported managerial oversight (Table 4).

The finding of this study reveals that good and poor practices among food handlers were 65 and 35%, respectively (Figure 2).

Inspection of resources or infrastructure status of food establishments

The inspection checklist analysis revealed robust infrastructure in public food establishments. Notably, 94.7% had

TABLE 1 Socio-demographic characteristics of food handlers.

Variables		Frequency (n)	Percent (%)
Gender	Males	115	36.1
	Females	204	63.9
Age categories	18–24	56	17.6
	25–34	173	54.2
	35–44	77	24.1
	>45	13	4.1
Marital status	Single	145	45.5
	Married	165	51.7
	Widowed	3	0.9
	Divorced	6	1.9
Educational level	Read and write	19	6.0
	Primary school	105	32.9
	Secondary school	115	36.1
	College graduated	67	21.0
	University Graduated	13	4.1
Role or job description of food handlers in public food establishments	Kitchen worker or cooker	195	61.1
	Waiter	87	27.3
	Slaughterer or butchery	37	11.6
Categories of public food establishments	Hotel	60	18.8
	Bar and Restaurant	62	19.4
	Butcher shop	38	11.9
	Shiro House	30	9.4
	Cafeteria/dining house	96	30.1
	Juice House	33	10.3
Ownership status of food establishment or premises	Private (owners)	108	33.9
	Rent	211	66.1
Employment status of food handlers	Contract per month	210	65.8
	Permanent	55	17.2
	Owner	54	16.9
Monthly income of food handlers by Ethiopian birr	<3,142	196	61.4
	>3,143	123	38.6
Work experience of food handlers	Below 2 years	85	26.6
	3–5 years	160	50.2
	6–10 years	68	21.3
	Above 11 years	6	1.9
Food safety practice training	Yes	100	31.3
	No	198	62.1

functional refrigerators, and 91.5% possessed legal trading licenses. Facilities demonstrated commitment to waste management (94.7%) and sanitation with functional latrines (91.2%). Access to piped water for cooking (76.8%) and customer handwashing facilities (75.2%) contributed to overall hygiene. However, only 28.5% of establishments reported managerial training in food safety, suggesting a potential area for improvement (Table 5).

Factors associated with food safety practice

The multivariable logistic regression analysis, knowledge (AOR = 2.106, 95% CI: 1.23–3.606), attitude (AOR = 2.0, 95% CI: 1.169–3.334), ownership status of the establishment (AOR = 2.65, 95% CI: 1.48–4.98), and monthly salary (AOR = 0.516, 95% CI: 0.293–0.906) were identified as the key factors significantly associated with

TABLE 2 Knowledge toward food safety practices among food handlers.

Variables		Frequency (n)		Percent (%)
Knowledge of hand washing during working time		Yes	319	100
		No	0	0
Knowledge of critical times for hand washing to keep food safe.	After using a toilet	No	2	0.6
		Yes	317	99.4
	After handling raw food such as meat	No	133	41.7
		Yes	186	58.3
	After touching animals' pets	No	94	29.5
		Yes	225	70.5
	After handling waste or touching garbage	No	89	27.9
		Yes	230	72.1
	After coughing or sneezing	No	236	74.0
		Yes	83	26.0
	Before starting food, preparation, or serving customers	No	12	3.8
		Yes	307	96.2
	After cleaning the table	No	200	62.7
		Yes	119	37.3
Knowledge of hand washing with soup in a food establishment to keep food safe.	Use liquid soap or detergents	Yes	1	0.3
		No	318	99.7
	Use hard soap or detergents	No	2	0.6
		Yes	317	99.4
	I do not use any of them	No	319	100.0
		Yes	0	0.0
Knowledge of the use of protective equipment in a food establishment	Apron or gown	No	56	17.6
		Yes	263	82.4
	Facemask or face shield	No	233	73.0
		Yes	86	27.0
	Hand gloves	No	254	79.6
		Yes	65	20.4
	Use a cap or cover hair with garments	No	119	37.3
		Yes	200	62.7
	I do not know	No	284	89.0
		Yes	35	11.0
Knowledge of when foods get contaminated with microbes or foreign bodies	During farm or unsafe source	No	171	53.6
		Yes	148	46.4
	During transportation	No	142	44.5
		Yes	177	55.5
	During store-in food establishments	No	115	36.1
		Yes	204	63.9
	During the slaughter	No	169	53.0
		Yes	150	47.0
	During food preparation or cooking	No	87	27.3
		Yes	232	72.7
	I do not know	No	290	90.9
		Yes	29	9.1

(Continued)

TABLE 2 (Continued)

Variables		Frequency (n)		Percent (%)
Knowledge of food handling while preparing to reduce the risk of contamination and keep it safe.	Use safe water to clean food	No	7	2.2
		Yes	312	97.8
	Use different-colored cutting boards for raw meat and vegetables separately	No	180	56.4
		Yes	139	43.6
	Washing the knife and cutting board with hot water and soap after using them	No	179	56.1
		Yes	140	43.9
	Cook food thoroughly	No	32	10.0
		Yes	287	90.0
	I do not know	No	317	99.4
		Yes	2	0.6
Knowledge of food contamination types	Biological contamination (bacteria, virus, and fungus)	No	57	17.9
		Yes	262	82.1
	Physical contamination (hair, broken glass, wood, and stone)	No	152	47.6
		Yes	167	52.4
	Chemical contamination (pesticides cleaning products)	No	284	89.0
		Yes	35	11.0
	I do not know	No	298	93.4
		Yes	21	6.6
Knowledge of food-borne disease types	Campylobacter infection	No	308	96.6
		Yes	11	3.4
	Typhoid fever	No	6	1.9
		Yes	313	98.1
	Hepatitis A virus	No	306	95.9
		Yes	13	4.1
	Clostridium botulinum	No	275	86.2
		Yes	44	13.8
	I do not know	No	313	98.1
		Yes	6	1.9
Knowledge of foodborne illness signs and symptoms	Vomiting	No	29	9.1
		Yes	290	90.9
	Fever	No	23	7.2
		Yes	296	92.8
	Diarrhea	No	30	9.4
		Yes	289	90.6
	I do not know	No	314	98.4
		Yes	5	1.6
Knowledge of safe temperature ranges for warm and cold foods	Keep hot foods at hot (>60°C) and	No	245	76.8
		Yes	74	23.2
	Keep cold foods at cold (<5°C)	No	241	75.5
		Yes	78	24.5
	I do not know	No	85	26.6
		Yes	234	73.4

(Continued)

TABLE 2 (Continued)

Variables		Frequency (n)		Percent (%)
Knowledge of properly storing food	Separate raw food input from vegetable and fruit	No	68	21.3
		Yes	251	78.7
	Place cooked or ready-to-eat foods at the top of the shelf	No	61	19.1
		Yes	258	80.9
	I do not know	No	284	89.0
		Yes	35	11.0
Knowledge of clean utensils after use to prevent cross-contamination or keep food safe	Clean all utensils with soup or chemicals in the dishwashing basin	No	26	8.2
		Yes	293	91.8
	Wash and clean food-contact surfaces with water, and soap, and sanitize after service	No	59	18.5
		Yes	260	81.5
	I do not know	No	313	98.1
		Yes	6	1.9
Knowledge of clean work facilities or food establishments keeps food safe.	Clean the entire cooking & and service area regularly and thoroughly	No	12	3.8
		Yes	307	96.2
	Eradicate insects and pests, as they carry germs	No	28	8.8
		Yes	291	91.2
	Stop overloading the refrigerators or shelf	No	144	45.1
		Yes	175	54.9
	I do not know	No	316	99.1
		Yes	3	0.9
Overall knowledge status (n, %)	Good knowledge		212	66.6
	Poor knowledge		107	33.4

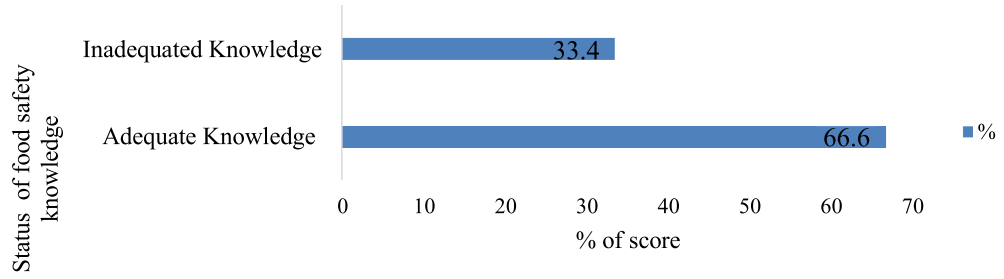

FIGURE 1
Food safety knowledge status of food handlers.

food safety practices among food handlers in public establishments (Table 6).

Discussion

The study revealed that 64.79% of food handlers in public food establishments in Adama town exhibit medium food safety practices. The study's results align with findings from similar studies conducted in Bahir Dar, 67.6% (Chen and Alali, 2018) and Asosa, 67.8% (Saeed et al., 2021). This similarity may be attributed to shared sociodemographic characteristics, including comparable educational levels among respondents and adherence to national regulatory guidelines for food safety in towns of a similar nature. However, the observed percentages in this study are lower than those reported in studies from Dassie town of Ethiopia, 72.4% (Adane et al., 2018), South Africa, 71% (Teffo, 2017) and Indonesia, 82% (Putri and Susanna, 2021). The variance in results could be attributed to differences in environmental factors influencing food safety practices, the effectiveness of food safety training programs, the level of regulatory activities by governing bodies, and the concerted efforts of the respondents. Sociodemographic disparities, particularly the higher educational levels of food handlers in studies abroad, may contribute to variations in food safety practices.

In the study, food handlers with adequate food safety knowledge were 2.1 times more likely to practice good food safety than those with

TABLE 3 Attitude toward food safety practices among food handlers.

Variables		Strongly disagree	Disagree	Natural	Agree	Strongly agree
The attitude was critical to use a face mask, and gloves, and cover your hair to reduce the risk of food contamination.	No	10	16	94	182	17
	%	3.1	5	29.5	57.1	5.3
The attitude the protective clothing (a gown or an apron) reduces the risk of food contamination.	No	8	17	110	172	12
	%	2.5	5.3	34.5	53.9	3.8
The attitude that washing hands before handling food reduces the risk of food contamination	No	4	4	14	264	33
	%	1.3	1.3	4.4	82.8	10.3
The attitude that raw and cooked foods should be handled separately to reduce the risk of food contamination	No	7	39	84	173	16
	%	2.2	12.2	26.3	54.2	5.0
The attitude that using a different cutting board and knife for foods such as meat, poultry, and fruit and vegetables?	No	5	44	130	124	16
	%	1.6	13.8	40.8	38.9	5.0
The attitude that properly cooked food can be free of contamination	No	5	34	101	160	19
	%	1.6	10.7	31.7	50.2	6.0
The attitude that temperature controls are an effective way to reduce food poisoning or contamination during	No	9	46	138	97	29
	%	2.8	14.4	43.3	30.4	9.1
The attitude that all food handlers should have food safety training	No	8	57	73	161	20
	%	2.5	17.9	22.9	50.5	6.3
The attitude that a lack of food safety training affects safe food handling	No	4	60	83	150	22
	%	1.3	18.8	26	47	6.9
The attitude that the absence of the authority's body monitoring would have an impact on food safety practice	No	5	54	83	156	21
	%	1.6	16.9	26	48.9	6.6
The attitude that a lack of managerial inspection has an impact on safety practices	No	9	44	85	164	17
	%	2.8	13.8	26.6	51.4	5.3
The attitude that safe food handling is an important part of your job responsibilities	No	3	29	61	201	25
	%	0.9	9.1	19.1	63.0	7.8
The attitude that eggs must be washed immediately after purchased	No	19	149	74	67	10
	%	6.0	46.7	23.2	21.0	3.1
Overall attitude status (n, %)	Positive					179 (56.13)
	Negative					87 (16.16)
	Neutral					53 (27.24)

poor knowledge. The study findings are in line with studies conducted in Addis Ababa Bole sub-city (Abdi et al., 2020), Fitche town of Ethiopia (Teferi et al., 2021), and Namibia (Hakwenye, 2019). The similarity in results may stem from shared sociodemographic characteristics such as educational status, monthly income, and cultural factors among the respondents. Additionally, the comparable national economic status could impact the food safety knowledge of food handlers domestically and abroad. However, it is dissimilar to studies done in Debre Markos town (Alemayehu et al., 2021), Mettu and Bedelle towns (Tamiru et al., 2022), and Gondar town of northern Ethiopia (Yenealem et al., 2020). These disparities may arise from variations in the study settings, the developmental status of the researched sites, and differences in the sociodemographic profiles of respondents, including work experience and exposure to food safety training. These results reinforce the evidence that adequate knowledge of food safety plays a crucial role in encouraging and supporting food handlers to practice good food safety in public food establishments.

The study identified a significant association between the attitudes of food handlers toward food safety practices. The research revealed that having a positive attitude toward food safety practices increases the likelihood of food handlers practicing good food safety, making them twice as likely as those with negative attitudes. This finding is in line with studies conducted the Addis Ababa Bole sub-city (Abdi et al., 2020), Batu town (Abe and Arero, 2021) and Walkite town of the southern Ethiopia (Oumer, 2019). The similarity of study findings could be due to the culture of food safety practices among respondents and data management methods. However, it is dissimilar to study findings from Northwest Ethiopia, Deblek town (Chekol et al., 2019) and western parts of Ethiopia, Mettu and Bedelle towns (Tamiru et al., 2022). The variation may be attributed to social desirability bias, study setting differences, and measurement tool variations. This might also be the level of food safety practices increases if food handlers have positive attitudes toward food safety practices.

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TABLE 4 Food safety practices among food handlers.

Variables		Frequency (n)	Percent (%)
Had purchased food inputs from the legal market or reputable suppliers	No	2	0.6
	Yes	317	99.4
Slaughter premises for all slaughtered animals	No	165	51.7
	Yes	154	48.3
Ensured the health status of all slaughtered animals by an authorized body	No	155	48.6
	Yes	164	51.4
Food handlers did not handle or process any food or meat when they had injuries to their hands.	Yes	194	60.8
	No	125	39.2
Food handlers wear face masks or shields in public food establishments.	No	232	72.7
	Yes	87	27.3
Food handlers reported washing their hands with soap for at least 20 s at key moments during work time	No	55	17.2
	Yes	264	82.8
Food handlers reported regularly trimming their nail and had seen the trimmed beard	No	27	8.5
	Yes	292	91.5
Food handlers wear a cap or head covering while selling meat, cooking, or serving food	No	169	53.0
	Yes	150	47.0
Food handlers wear a work cloth uniform or apron while working	No	107	33.5
	Yes	212	66.5
Food handlers had removed jewelers (hand and ring jewelers) while butchering, serving, or cooking food	No	57	17.9
	Yes	262	82.1
Food handlers use a thermometer to measure cooked food's internal temperature	No	265	83.1
	Yes	54	16.9
Food establishments use refrigerator temperature monitors or tag	No	240	75.2
	Yes	79	24.8
Food handlers reported always cleaning and sanitizing areas of food establishments (kitchen, a place where meat is sold and stored).	No	50	15.7
	Yes	269	84.3
Food handlers reported keeping pests away from the food processing area (kitchen service, store, etc.).	No	25	7.8
	Yes	294	92.2
The food handler used different color-coded chopping boards for raw meat and fresh produce (vegetables and fruit).	No	164	51.4
	Yes	155	48.6
Food handlers reported double-checking the expiration dates of packed food input.	No	46	14.4
	Yes	273	85.6
Food handlers never washed raw meats in the sink before cooking.	No	39	12.2
	Yes	280	87.8
Food handlers reported sanitizing utensils after washing them.	No	141	44.2
	Yes	178	55.8
Food handlers reported did not come to work when they had pain and diarrhea	Yes	219	68.7
	No	100	31.3
Food handlers reported clean cutting boards after each use.	No	101	31.7
	Yes	218	68.3
Food handlers reported discarding unsafe foods held at 40°F (9°C) for more than 2 h.	No	58	18.2
	Yes	261	81.8
Food handlers reported food establishment managers monitor workers for food safety practices.	No	115	36.1
	Yes	204	63.9
Public food establishments were supervised by authority bodies for their food safety practices.	Yes	260	81.5
	No	59	18.5

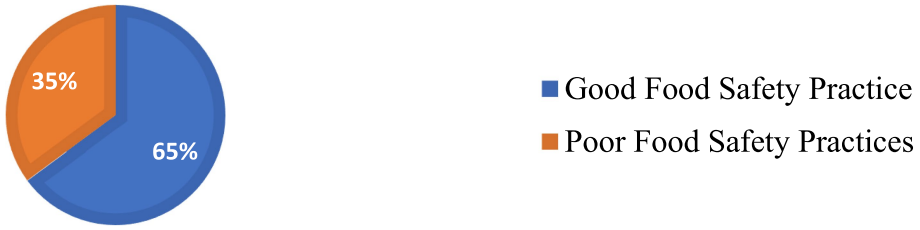

FIGURE 2
Food safety practice status among food handlers.

TABLE 5 Resources or infrastructure status of public food establishments.

Variables		Frequency (n)	Percent (%)
Food establishments had a separate waste disposal for liquids	No	17	5.3
	Yes	302	94.7
The food establishment had a functional latrine	No	28	8.8
	Yes	291	91.2
The food establishment had a three-compartment dishwashing system	No	90	28.2
	Yes	229	71.8
Food establishments prepared work clothes or gowns for workers to wear during food handling	No	105	32.9
	Yes	214	67.1
Food establishments had functional pipe water in the cooking area	No	74	23.2
	Yes	245	76.8
Food establishments had running water for customers to use for hand washing	No	79	24.8
	Yes	240	75.2
The food establishment had a manager	No	151	47.3
	Yes	168	52.7
Food establishment managers had trained in food safety practices or Proper food handling	No	228	71.5
	Yes	91	28.5
The food establishment had a functional shower room	No	120	37.6
	Yes	199	62.4
The food establishment had a functional refrigerator & used in the kitchen or store	No	17	5.3
	Yes	302	94.7
The food establishment had a legal license	No	27	8.5
	Yes	292	91.5

Moreover, the study revealed that food handlers working in private premises were 2.65 times more likely to exhibit good food safety practices than those in rental premises. This finding contradicts with a study conducted in Mekelle town (Lalit et al., 2015). The variability in results across studies may stem from differences in study settings, interviewer bias, and data management methods. This could be due to the fact that ensuring well-maintained private facilities could create a more conducive environment for implementing and sustaining food safety protocols.

Furthermore, those food handlers who had a lower monthly salary were 48.4% less likely to practice food safety than those with higher earnings. The study findings align with research conducted in Woldia town (Bantie et al., 2023) and Bahir Dar City of Ethiopia (Reta et al., 2021). However, it differs from a study in Ghana (Tuglo et al., 2021) and Dessie town of Ethiopia (Adane et al., 2018). This disparity could be due to differences in sociodemographic characteristics and sample size related to the country's economics.

Conclusion

The research findings indicated that the food safety practices of food handlers in public food establishments are at a moderate level when compared to similar studies conducted nationwide. Key factors

TABLE 6 Bivariate and multivariate logistic regression analysis.

Food Safety practices						
Variables		Good n (%)	Poor n (%)	COR 95% CI	AOR 95% CI	*p*-value
Ownership status of a building	Private	60 (55.6%)	48 (44.4%)	11.31 (6.274, 20.387)*	2.65 (1.48–4.98)*	0.001
	Rent	21 (10.0%)	190 (90.0%)	1	1	
Monthly income in ETB	>3,143	69 (32.1%)	146 (67.9%)	1	1	
	<3,142	12 (11.5%)	92 (88.5%)	3.623 (1.861, 7.054)*	0.516 (0.293–0.906)*	0.004
Trained managers	Yes	58 (63.0%)	34 (37.0%)	15.13 (8.269, 27.686)*	4.902 (0.893, 12.689)	0.21
	No	23 (10.1%)	204 (89.9%)	1	1	
Functional shower room	Yes	73 (36.7%)	126 (63.3%)	8.111 (3.744, 17.571)*	2.939 (0.08, 4.572)	0.068
	No	8 (6.7%)	112 (93.3%)	1	1	
Knowledge status	Good knowledge	68 (46.9)	77 (53.1%)	10.937 (5.695, 21.003)*	2.106 (1.23, 3.606)*	0.011
	Poor knowledge	13 (7.5%)	161 (92.5%)	1	1	
Attitude status	Positive	64 (55.7)	51 (44.3%)	13.804 (7.441, 25.608)*	2.0 (1.169, 3.334)*	0.006
	Negative	17 (8.3%)	187 (91.7)	1	1	

NB: * significant at a *p* value less than 0.05, 1: reference, AOR: adjusted odds ratio, COR: crude odds ratio.

influencing food safety practices include knowledge, attitude, ownership of food establishments, and monthly income. It is imperative for all relevant authorities to prioritize providing food safety training to both owners and employees to enhance their understanding and approach toward food safety practices, ultimately safeguarding the wellbeing of the public.

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 Institutional Ethics Review Board of Salale University (SLU Protocol Approval 2023/242) granted ethical approval for this study and written consent to participate were obtained before inclusion.

Author contributions

NG: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. TY: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. MM: Data curation, Funding acquisition, Investigation, Methodology, Project administration, Software, Writing – original draft. CK: Conceptualization, Data curation, Formal analysis, Methodology, Software, Validation, Writing – original draft, Writing – review & editing.

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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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