Understanding Domestic Food Safety: An Investigation into Self-Reported Food Safety Practice and Associated Factors in Southern Ethiopian Households

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ABSTRACT

BACKGROUND: According to available studies, 12%-20% of reported foodborne outbreaks start in the household. It is projected that 1 out of every 10 persons will become ill as a result of consuming tainted food. Poor food handling practices cause 600 million foodborne illnesses each year. In a given year, this leads to 420 000 deaths. In Ethiopia, there is a scarcity of studies on home-food-safety practices and the factors that affect them. This has resulted in a shortage of relevant information on the status of home-food-related illnesses in the country.

METHODS: A community-based cross-sectional study was carried out from May to June 23, 2021. A standardized and pre-tested questionnaire was used to collect data from 622 households. The total plate count method was used to analyze bacteria on cleaned plates. Epi data version 3.1 was used to enter data, while SPSS version 25 was used to analyze the data. Descriptive statistics and multivariable regression were used to characterize the data and identify factors associated with food safety practices.

RESULT: 51.1% of the study participants had a safe food handling practice. The mean total plate count was 2.34 CFU/cm^2. In the multivariable regression, Household wealth (AOR = 2.05, 95% CI [1.01-3.16]), Education (AOR = 3.33, 95% CI [1.41-6.31]), Training (AOR = 2.85, 95% CI: [1.31–3.19]), Knowledge of safe practices (AOR = 1.95, 95% CI [1.23-3.08], and Attitude (AOR = 2.04, 95% CI [1.09, 3.82]) were associated with safe food handling practices.

CONCLUSION: Although data gathering systems for food-borne diseases typically overlook a large number of home-based outbreaks of sporadic infection, it is now widely understood that many episodes of food-borne sicknesses are caused by individuals' inappropriate food handling and preparation in their kitchens. In the current study, educational status, household wealth, food safety training, attitude, and knowledge about FBDs were found to be strongly associated with safe practices. This implies that public education is a key factor in improving food safety practices at home.

KEYWORDS: Food safety practice, domestic food handling, food-borne diseases

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Introduction

Food safety is defined as the conditions and measures that must be in place during the production, processing, storage, distribution, and preparation of food to ensure that it is safe, sound, wholesome, and fit for human consumption.[1] People's health improves when they have access to safe food. Safe food promotes health and productivity. Safe food is also a solid foundation for development and poverty reduction.[2] Food safety, however, has become a major health challenge in both developed and developing countries in recent years.[3]

One, out of every 10 people, gets sick from eating contaminated food. Poor food handling practices cause 600 million food-borne diseases. These food-borne diseases result in 420 000 deaths each year.[4] According to studies, 10% to 20% of food-borne outbreaks are caused by food handler contamination.[5] Food-borne illnesses are estimated to be the most common illness in Africa and Southeast Asia. Although individuals of all ages can fall victim to foodborne diseases in Africa, children under the age of 5 (40%) and people who live in low-income homes are believed to suffer the brunt of the burden.[4]

The World Health Organization's 2021 to 2025 Strategic Plan outlines that reduction in food-borne illnesses is among the priorities of the organization, with a focus on pathogens that cause the most severe and greatest number of cases.[6] The home is an important part of this strategy. In contrast to the outbreaks in commercial or public facilities, food-borne illness outbreaks in private residences are less likely to be reported.[7] Evidence suggests that 12% to 20% of reported foodborne outbreaks originate in the home.[8] "The one area where most food-borne illnesses occur is the private household," according to the World Health Organization.[9] Failure to follow safe food processing, storage, and preparation practices in the home poses many public health risks. People's knowledge, attitude, and practices (KAP) of safe food handling methods have, however, the greatest impact on food safety at home.[10] The "KAP Theory," which divides human behavior change into 3 stages:

knowledge acquisition, attitude formation, and behavior adoption is a health behavior change theory.[11] In previous studies, a person's KAP level has been associated with optimal sickness prevention and management, as well as personal health promotion. KAP deficiency, on the other hand, has been associated with poor health and ineffective disease prevention.[11-13]

Ethiopia is one of Africa's fastest-urbanizing countries, with an annual urbanization rate of more than 5.3%. Similarly, Shashamane town has a population of around 250 000 people and is expanding at a rate of roughly 4.5% per year. This puts pressure on city officials to provide services, housing, infrastructure, and utilities to urban residents.[14] All of this jeopardizes food safety at home. Furthermore, Ethiopia lacks a foodborne disease surveillance system at the national and regional levels. The Ethiopian Health and Nutrition Research Institute, which is part of the Federal Ministry of Health, is the country's only public health laboratory that can test for microbiological and chemical pollutants in foods.[15] According to health records, an Ethiopian kid has 5 to 12 diarrhea episodes per year on average, and more than 250 000 children under the age of 5 die each year as a result of diseases caused by poor sanitation and hygiene.[16]

Foodborne disease reduction relies heavily on research to address food safety and hygiene standards.[17] Several institution-based cross-sectional studies have been conducted in Ethiopia. As per the many studies conducted in commercial settings, safe food handling practices in food businesses range from 20% to 70%. Food handler hygiene, food safety training, facility sanitary conditions, absence of waste disposal services, and environmental hygiene were all identified as major determinants of safe food handling.[18-20] Home food safety practices are, however, seldom researched. Because of this, our knowledge about the factors that influence the practices leaves much to be desired. The limited literature on Ethiopian food safety in the home reveals that we still lack suitable models for standards and approaches that can work at scale to ensure food safety in settings where risks are pervasive, compliance costs are high, and enforcement capability is poor. Given the very different food systems and regulatory environments, the approaches used successfully in developed countries cannot be directly applied to developing countries.[17]

The goal of this study was, therefore, to investigate the food safety practice and associated factors among households in Shashamane, Ethiopia. The findings will assist stakeholders in improving food safety protocols and their application, as well as possibly informing policy in this rapidly emerging field.

Materials and Methods

Study area and setting

A community-based cross-sectional survey was conducted in Shashamane, Oromia Region, Ethiopia, from May to June 23, 2021. The town is located on the Cairo-Cape Town Trans-African Highway, some 150 miles from Addis Ababa, Ethiopia's capital. It is located at 7°12′ north latitude and 38°36″ east longitude. Shashamane consists of 8 sub-cities, namely Arada, Abosto, Burka Gudina, Alelu, Kuyera, Awasho, Bulchana, and Dida Boke (Figure 1). One hundred thirty-two restaurants, 34 hotels, 49 cafes, and 3 juice houses, as well as 2 government hospitals, 1 private hospital, 4 health centers, and 71 private clinics, serve the town.[21] According to the census carried out in Shashamane 279, 814 people (141 150 men and 138 665 women) was the population size of the Town.[22]

Sample size and sampling procedure

Using Epi Info Version 7.2 software, the sample sizes for Objectives 1 (assessing the prevalence of safe food handling) and 2 (identifying factors associated with safe food handling) were calculated individually, using a formula for a single population, based on the following distinct assumptions

- Total population of 279 814 people
- A hypothesized proportion of safe food practices at home = 0.496[18]
- 95 % level of confidence ($Z = 1.96$)
- a design effect of 1.5 to allow clustering effect
- 10% non-response

The sample size ($n = 634$) was found to be the largest. A multi-stage sampling technique was used to accomplish the study's objective. In the first phase, the lottery method was used to choose 3 Kebeles (the lowest level of administration) from a total of 8 Kebeles (representing 35%) in the town. The entire sample size, 634, was allocated to the sampled Kebeles proportionally. The sample food handlers were randomly chosen from each household. The Sampling interval (K) was computed by dividing the total number of dwellings in each Kebele by the sample size allocated, Simple random selection (lottery method) was used to select the initial sample household. Every (*K*th) household was chosen for data collection until the requisite sample was obtained in each selected Kebeles. (Figures 1 and 2).

Data collection and quality control

Two data gathering tools, namely, interview and observation, were used for data collection. Face-to-face interviews were conducted with the study participants, using pretested (S1 Tool), closed-ended questions. The mothers of the households or other adults who were frequently involved in food handling were interviewed in each home (only 1 person was interviewed per home). Afan Oromo, (ie, the major medium of communication in the town), was the language used during the interview. The interview questions were originally written in English. Later, they were translated into Affan Oromo by 1 environmental health practitioner. The forward-translated version was then reverse-translated by an independent translator.

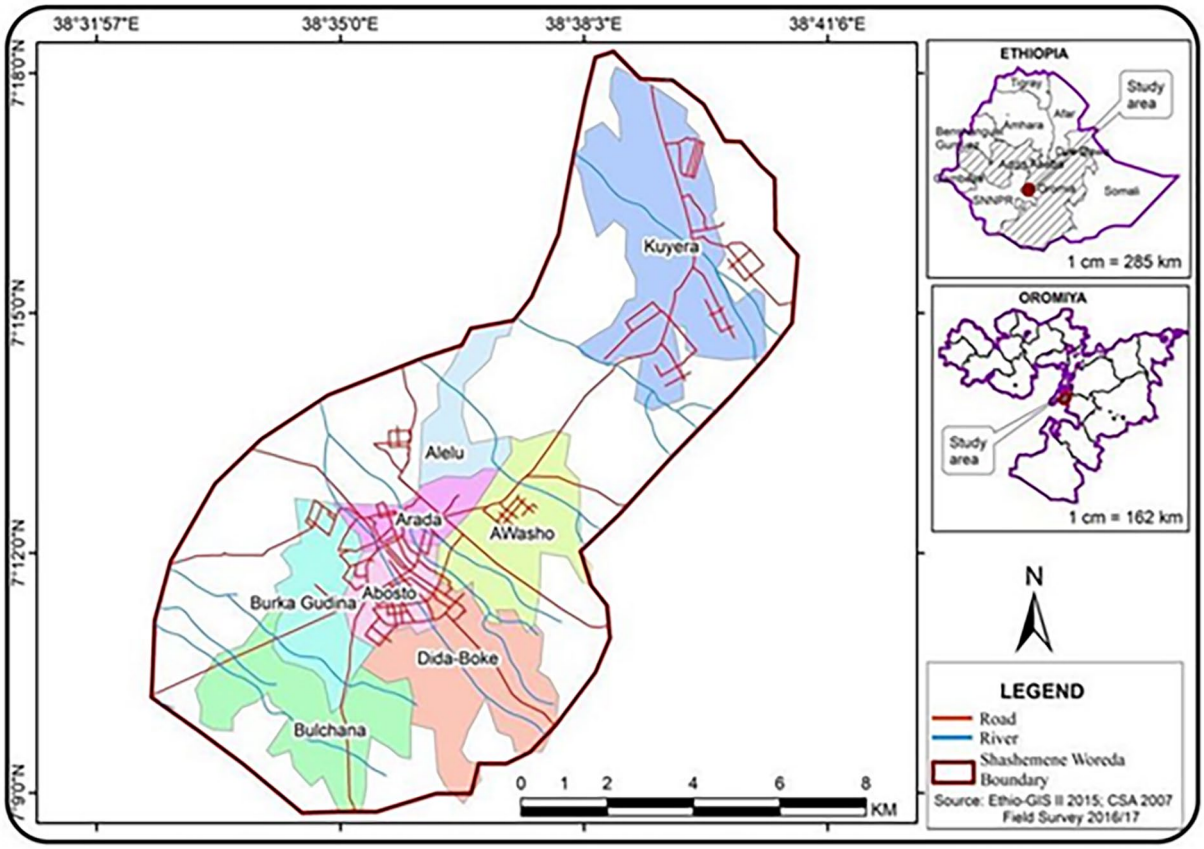

Figure 1. Location map of the study area, Shashamane city.[21]

The meanings of the terminologies and the contents of the interview questions of the original version were compared against their translated versions to see if there were differences in meaning before using the items for data collection.

The internal consistency of the questions was investigated using reliability analysis. Cronbach's Alpha values for knowledge (0.878), practice (0.881), and attitude (0.858) were reported in the reliability statistics table, indicating that the instrument was consistent and reliable in fulfilling the study objectives. Moreover, studies highly recommended applying content validity while a new instrument is developed.[23] Accordingly, an exhaustive literature review was conducted to extract the related items. Afterward, a content validity survey was generated (each item was assessed using a 3-point scale (not necessary, useful but not essential, and essential). The survey was then sent to 6 experts in the same field of the research. Finally, the content validity ratio (CVR) was calculated for each item by employing Lawshe's method.[24]

$$CVR = \frac{ne - \frac{N}{2}}{\frac{N}{2}}$$

Where CVR is the content validity ratio, ne is the number of panel members indicating "essential," and N is the total number of panel members. The final CVI Value was 0.99. Well above the minimum required value for CVR.

The observation was the other data gathering instrument used in this research. After the interviews, observations of the physical layout of the areas where food was prepared were made. The observation mainly focused on kitchen hygiene (presence of dust, dirt, spider webs, and smoke particles on kitchen walls and ceilings) and traces of kitchen insects and rodents.

The data gathering tools were pilot-tested on 5% of the overall sample (32 houses) in an adjacent town called Bishan Guracha before the beginning of the survey. The data was collected by 6 experienced data collectors. The data collection team had 1 supervisor (an environmental health practitioner). Two-day training was given to the data collectors a few days before data collection. The training focused on data collection strategies, questionnaire filling, ethical consideration, etc. In addition, the training also involved a practical session during which the data collectors visited homes and rehearsed carrying out some of the activities.

Laboratory procedures for the bacteriological examination of food utensils

The plate was chosen for the swab test because the food plate is a major source of contamination from either the cracks or the inner surfaces. Swab samples were collected from 20% of the households, per the Center for Disease Control's (CDC)

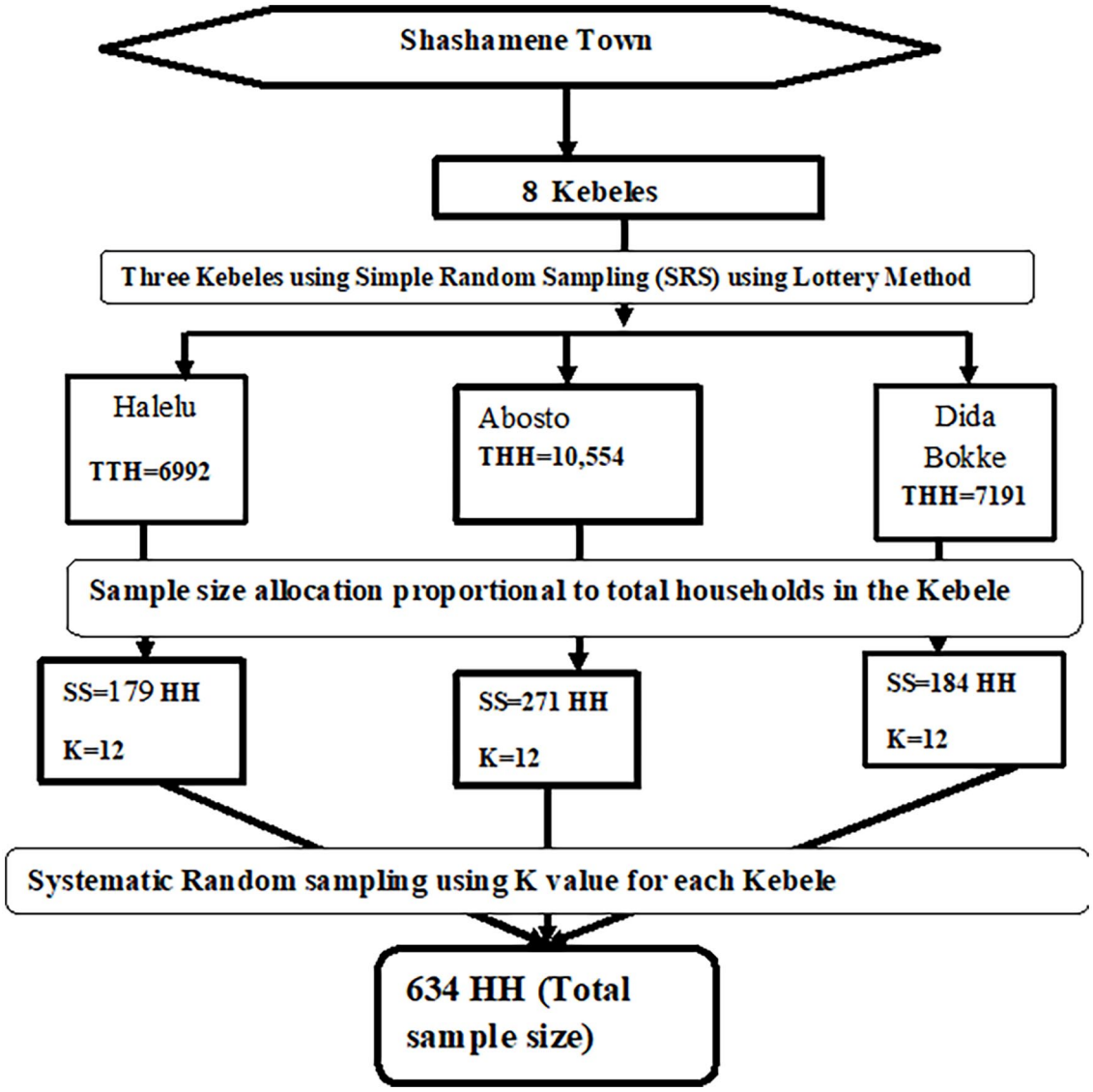

Figure 2. Diagrammatic presentation of the sampling procedure of households in Shashamane town, Southern Ethiopia, 2021.

recommendations (126 swaps).[25] For regulatory purposes, a minimum of 5 sample units from a lot is generally specified for examination.[26] Accordingly, 5 plates were selected from each household. For each food utensil, 1 sterilized cotton swab on a wooden applicator stick was used. The sterilized cotton stick was dipped in 10 ml of peptone water, before swabbing. An approximately 25 cm^2 (a path of 2.5 cm by 10 cm or 12.5 cm by 2 cm or other dimensions to cover an equivalent area) of the selected plates were rubbed slowly and firmly 3 times reversing the direction each time. After the swabbing process, the swabbed cotton sticks were returned to the universal bottles containing the 10 ml peptone water. The swabbed samples were then labeled and transported to the Hawassa University, Microbiology laboratory.

Plate count agar (PCA) was then used to enumerate the aerobic mesophilic bacteria in the sample. The amount of bacteria in a sample is a key indicator of the overall microbiological quality and safety.[27] For the total plate count method, 10-fold serial dilution was prepared to a dilution factor of 10^3 and 1 ml of each dilution was pour plated against the 15 ml of the PCA in labeled Petri dishes in triplicates. The labeled Petri dishes were incubated at 30°C for 72 ± h. After the incubation, plates with 30 to 300 colonies were counted on a standard colony counter (Galaxy 230, Rocker). Calculation and recording of colony growth was then carried out in colony-forming unit per ml (CFU/ml) using the formula

$$\text{CFU/ml} = \frac{Number\ of\ Colonies\ X\ TDF}{VPC}$$

Where: TDF = Total dilution factor (10^3)

VPC = Volume plated per culture 1ml

For each plate, the calculation of the CFU/m^2 was then obtained as follows:

$$\text{CFU/m}^2 = \frac{\frac{Average\ CFU}{Plate}\ X\ Volume\ of\ original\ suspension}{\left(Total\ surface\ area\ X\ swabs\right)X\ DF}$$

Where: CFU= Colony-forming unit

Table 1. Interpretation guidance on surface sampling with environmental sponges and swabs.

INTERPRETATION	COUNTS ON THE SURFACE BASED ON 25 CM^2 SURFACE AREA SAMPLED
Clean	Less than 5 CFU per cm^2
Contaminated	≈ 5 to 10 CFU per cm^2
Very Contaminated	Greater than 10 CFU per cm^2

Total surface = 25 cm^2
Number of swabs = 5

The findings were then compared with the Environmental Hygiene guideline for dishes, cutting boards, cutting blades, aprons, and any cleaned/sanitized surface in the kitchen.[28] The following Table 1 was used as the guideline for interpretation:

Study Variables

Dependent variables

Food safety practice (Poor/Safe).

Independent variables

Socio-demographic factors (age, marital and educational status, average monthly income, food safety training, and family size), knowledge, attitude, and environmental factors (handwashing facility, water supply availability, water source, solid waste disposal, liquid waste disposal, latrine availability, type of latrine, distance from home, distance from kitchen, kitchen cleanliness and protection of the kitchen area from insects and others animals).

Operational definitions. **Food safety practice:** The food handlers who scored less than or equal to the mean value of their responses to 16 food safety practice-related questions with a 3-scale Likert (3-always, 2-sometimes, and 1-never) were considered as having "poor level of practice." Those who scored more than the mean value were considered as having a "safe level of practice.[29,30]

Food safety knowledge level: The food handlers who scored less than or equal to the mean value of their responses to 12 food safety knowledge-related questions with a response (Yes/No/I don't know) were considered as having a "poor level of knowledge." Those who scored more than the mean value were considered as having a "safe level of knowledge."[11,30]

Food safety attitude level: On a 5-point Likert scale, food handlers were asked 10 attitude-related questions. The food handlers' score was then computed by adding all of the questions together, and the food handlers' score was dichotomized as favorable (>mean) or unfavorable (<mean).[31]

Improved latrine: Pit latrine with a slab; ventilated pit latrine; composting toilet; flush and pour/flush facility connected to a piped sewer system/septic tank/pit.[32]

Unimproved latrine: Pit latrine without a slab/open pit; hanging latrine/bucket latrine; flush or pour/flush facility not connected to a piped sewer system/septic tank/pit.[32]

Signs of kitchen bugs and insects: Focus was placed on evidence of the presence of the items listed below during observation: the presence of ants, cockroaches, rodents, flies, and pantry pests in the kitchen; holes chewed through the walls and floor; rodent droppings in the cabinets, under the sink and food packages; holes, or signs of chewing on food packages, nets made from material like fabric and shredded paper.[33]

Data entry and analysis. The data was coded and entered into Epi Info version 7.2 using a data entry template. To illustrate descriptive findings for the first specific objective, determining the prevalence of safe food practices, frequency tables, percentages, and proportions were used.

A 3-scale Likert questionnaire was used to measure food safety knowledge and practice. Extreme responders (the most favorable and least favorable reactions) tend to be better predictors of behavior, thus attitude was evaluated using a 5-point Likert scale. As per studies, regardless of the number of steps originally employed to collect the data, conversion to dichotomous or trichotomous measures does not result in any significant decrement in reliability or validity.[34] Furthermore, the increase in reliability and validity by adding more points to a scale doesn't go on forever and it isn't linear. This means that, given that it is not essential to be able to reproduce the original data array, with more items in a questionnaire, the number of scale points matters less.[35] Thus, in the end, the responses on food safety knowledge, practice, and attitude were dichotomized.

The wealth status of households was determined by applying a principal components analysis (PCA). Initially, 32 items were used and grouped into 6 components, namely, crop production in quintal, household properties, the average estimated monthly income, livestock ownership, hectares of agricultural land, and housing conditions. The fulfilment of assumptions for PCA such as overall sampling adequacy, sampling adequacy of individual variables, and Bartlett's Test of Sphericity was checked. In each step, these variables with communalities less than 0.5 and complex structures were removed before the criteria were met by the iterations. Finally, 3 components were extracted from the PCA that clarified the maximum explained variation, and the first component, which took part in the maximum variation (64.1%) was used to rate the study participants' household wealth status. The poorest households were in the first category, while the wealthiest were in the third. The Hosmer–Lemeshow goodness-of-fit test was used to test model fitness ($P > .05$). Multicollinearity between the explanatory variables was checked using the variance inflation factor (VIF > 10).

The researchers applied binary logistic regression to identify characteristics associated with unsafe food handling practices. The analysis started with a crude analysis, in which each independent variable was looked at separately for an association to the outcome. To select the potential variables for multivariable analysis, a *P*-value of less than .25 was employed as a cut-off criterion. The cut-off point was chosen to limit the number of variables in the multivariable logistic regression and the likelihood of an unstable estimate. In the multivariable analysis, variables with a *P*-value of less than .05 were considered statistically significant and reported as an Adjusted Odds Ratio (AOR) with a 95 % confidence interval.

The institutional review board of Hawassa University's College of Medicine and Health Sciences granted ethical approval and permission. The Oromia Regional Health Bureau granted permission letters. Before each interview, each respondent was given a detailed explanation of the study's purpose. All interviews were conducted after the interviewees signed a consent form. All study participants received food safety training in their homes.

Results

Socio-demographic characteristics of food handlers

A total of 622 food handlers were interviewed, with a response rate of 98.1%. The mean age of the food handlers was 33, with a range of 20 to 58 years. In terms of educational background, 81 food handlers (13%) had no formal education. Around 555 (89%) of the participants shared a home with their partner (married). There were less than 5 family members in 527 (84.80%) of the households investigated. Although 487 (78.3%) had heard of food safety practices, 85.4 % of them had not attended any food safety training. The majority of food handlers, 487 (78.3%), have heard about foodborne diseases. The most prevalent source of information (48.3%) was health extension workers (community health workers who are commonly used to offer care for a wide range of health problems) (Table 2).

Table 2. Socio-demographic characteristics of food handlers in Shashamane Town, Ethiopia, 2021 (n = 622).

SOCIO-DEMOGRAPHIC VARIABLES	FREQUENCY	PERCENT
Age in year		
⩽25	192	31.00
26-35	205	33.00
36-45	124	20.00
⩾46	101	16.00
Educational status		
No formal education	81	13.00
Primary education	228	36.80
Secondary education	233	37.40
Diploma and above*	80	12.80
Marital status		
Without partner	67	11.00
With partner	555	89.00
Family size		
⩽5	527	84.80
>5	95	15.20
Wealth index		
Lower	207	33.30
Middle	207	33.30
Upper	208	33.30
Ever heard about food safety		
Yes	487	78.30
No	135	21.70
Source of information about food safety (n = 487)		
Health Extension Worker	231	49.6
Health professionals	48	10.3
Media (TV/Radio/News Papers)	29	1.7
Other**	25	5.4
Ever attended food safety training		
Yes	91	14.60
No	531	85.40

*Technical and Vocational Colleges, Universities.
Other**=Women's development army, Family members,

Environmental Factors

Six hundred of the food handlers had access to a latrine. Four hundred thirty-five (69.94%) of them had improved latrines. In this study, 292 (47%) and 218 (35%) of the investigated homes had solid and liquid waste disposal facilities. 30.06% did not have access to a handwashing facility, while 302 (48.5%) had piped water delivered to their homes. About 531 (85.4) of the households had clean kitchens that were free from insects and other animals. Only 23% of the households in the survey had a toilet that was more than 6 m away from the kitchen, as recommended by the national hygiene and sanitation strategy (Table 3).

Knowledge of food safety

More than three-quarters of the food handlers, that is, 512 (82.32%), were aware that food-borne diseases (FBDs) can be transmitted through contaminated food, and 375 (60.3%) had the knowledge that inappropriate food handling can put consumers' health at risk. Similarly, 538 (86.5%) food handlers were aware that food-borne illnesses can be contracted through

Table 3. Environmental factors regarding food safety practices among food handlers working in households in Shashamane Town, Ethiopia, 2021 (n = 622).

ENVIRONMENT-RELATED VARIABLES	FREQUENCY	PERCENT
Solid waste disposal present		
Yes*	292	47.00
No	330	53.00
Liquid waste disposal present		
Yes+	218	35.00
No	404	65.00
Latrine present		
Improved	435	69.94
Unimproved	187	30.06
Water supply		
Private (piped in to dwelling)	320	51.50
Public	302	48.50
Hand washing present at latrine		
Yes	435	69.94
No	187	30.06
Kitchen cleanliness		
Clean kitchen	518	83.30
The kitchen is not clean	104	16.70
Kitchen distance from the latrine		
⩽6	477	76.70
>6	145	23.30
Signs of kitchen insects and bugs		
No	378	60.80
Yes	244	39.20

*Public/private collection services, composting, reuse.
+Public/private collection services, composting, dewatering.

the ingestion of contaminated food. A roughly similar number of food handlers (ie, 524 (84.24%) were aware that hand washing is vital in the prevention of foodborne sickness.

Five hundred thirty-one (85.37%) of the food handlers understand that properly cooked food kills disease-causing microorganisms. Food preservation methods were known by 541 food handlers (87%). Food separation/cross-contamination was known by 538 (86.5%) of the food handlers in the study. On the other hand, less than half (48%) were aware that diseased food handlers can contaminate food. Furthermore, 54.34% were unaware that germs can be present on cutting boards and other kitchen utensils (Table 4).

Attitude toward food safety

Only 142 (22.8%) of the food handlers strongly agreed that improper food storage is harmful to one's health. Over a half (342; 55%) of all food handlers agreed that keeping work surfaces and utensils clean minimizes the risk of diseases. One hundred eight (17.4%) strongly disagreed that using different knives and cutting boards for raw and cooked foods is worth an extra effort. And nearly half of the food handlers (40.35 %) agreed that leaving perishable food out of the refrigerator for more than 2 hours is unsafe. Finally, no one in the study disagreed with the need for discarding spoiled food (Table 5).

Self-reported food safety practice

To avoid FBDs, more than half of the food handlers (62%) washed their hands before handling food. All food handlers reported always washing their hands after using the restroom. More than one-third (34.5%) of the food handlers, always wore jewellery like rings and bracelets while cooking food. About half of the households (335; 53.86%) had refrigerators in their homes. Of the families who had a refrigerator, 281 (83.88%) always refrigerated all cooked and perishable food promptly.

In connection with temperature control, none of the food handlers utilized a thermometer to monitor the food's internal temperature. Furthermore, 73 (11.7%) reported never separating raw meat from other foods. Similarly, 300 (48.23) of the food handlers reported always using separate equipment and utensils for raw and cooked food. The current survey also revealed that 113 (18.2%), food handlers never covered their hair while preparing food. More than two-fifths (295; 44.9%) of the food handlers considered in this study reported making food, even when, they were experiencing symptoms of infectious diseases. More than a half (63.45%) reported using detergents to clean and sanitize equipment and/or utensils (Table 6).

Overall level of knowledge, attitude, and practice

The results of the knowledge assessment revealed that 348 (55.9%) of the food handlers had good knowledge of food safety. Knowledge had a mean score of 26.21 and a standard deviation of 1.22. More than half of the food handlers (320; 51.4%) had a positive attitude toward food safety. The mean attitude score was 35.2, with a standard deviation of 0.98. 318 (51.1%) of the food handlers had safe practices (Table 7).

Bacteriological examination of food utensils

The bacterial population was counted using the total plate count (TPC) technique on nutrient agar media in a petri-dish, and the raw data was converted into CFU/cm^2. For this purpose, a total of 126 cleaned plates kept in the residence were examined. TPC levels on plates in the houses studied ranged from 0.156 CFU/cm^2 to 6.56 CFU/cm^2. 2.34 CFU/cm^2 was

Table 4. Knowledge of food safety practice of food handlers working in households Shashamane town, Ethiopia, 2021 (n = 622).

KNOWLEDGE ITEM REPORTED	YES		NO	
	FREQUENCY	%	FREQUENCY	%
FBDs can be caused by contamination of food during processing and preparation	512	82.32	110	17.68
Improper handling of food poses health hazards to consumers	375	60.30	247	39.70
Food-borne illnesses can be acquired from the consumption of contaminated food	538	86.50	84	13.50
Hand washing is important to prevent food-borne diseases	524	84.24	98	15.76
Food separation/cross-contamination is important to prevent food-borne diseases	538	86.50	84	13.50
Properly cooking food kills disease-causing microorganisms	531	85.37	91	14.63
Know of at least one food preservation method	541	87.00	81	13.00
Infected food handlers can cause food contamination	299	48.00	323	52.00
Germs can be found on cutting boards and other food utensils	284	45.66	338	54.34
High temperature or freezing is a safe method to destroy bacteria that cause food-borne diseases	523	84.00	99	16.00
Spoiled foods pose health risks	559	89.87	63	10.13
The use of safe water for cooking purposes reduces the risk of FBDs	578	92.93	44	7.07

Table 5. Attitude of food handlers working in households in Shashamane Town, Ethiopia, 2021(n = 622).

ATTITUDE ITEM REPORTED	STRONGLY AGREE		AGREE		NEUTRAL		DISAGREE		STRONGLY DISAGREE	
	#	%	#	%	#	%	#	%	#	%
Storing foods improperly is dangerous to health	142	22.80	390	62.70	80	13.00	10	1.60	0	0
It is important to wash hands as often as necessary during food preparation	171	27.50	295	47.40	113	18.2	36	5.80	7	1.20
Keeping working surfaces and utensils clean reduces the risk of illness	113	18.17	342	55	153	24.60	14	2.30	0	0
Leaving perishable food out of the refrigerator for more than 2 hours is unsafe	102	16.40	251	40.35	156	25.10	87	14.00	26	4.15
Separating utensils for raw and cooked foods is worth the extra effort	109	17.50	173	27.81	160	25.72	77	12.37	103	16.60
Using potable water to wash working surfaces and cutting tools is important for health	175	28.13	382	61.41	62	10.00	3	0.40	0	0
Temperature controls are an effective method of reducing the number of cases of FBD	134	21.54	371	59.64	109	17.50	8	1.32	0	0
Keeping raw and cooked food separate helps to prevent illness	120	19.30	335	54	138	22.2	29	4.80	0	0
Lack of food safety training affects safe food practice	179	28.80	407	65.40	31	5.00	5	0.80	0	0
It is important to throw away foods that have passed their shelf life	342	55.00	261	42	19	3.00	0	0	0	0

Table 6. Self-reported safety practices of food handlers working in households in Shashamane town, Ethiopia, 2021(n = 622).

ITEM REPORTED PRACTICES	ALWAYS		SOMETIMES		NEVER	
	#	%	#	%	#	%
Wash hands before handling food	385	62	237	38	0	0
Wash hands after the latrine	622	100	0	0	0	0
Cover hair regularly during preparing food	244	39.23	265	42.6	113	18.20
Wear accessories like rings, bracelets when cooking food	215	34.5	193	31	214	34.4
Clean and sanitize all surfaces and equipment used for food preparation and eating	266	42.76	309	49.68	47	7.56
Wash fruits and vegetables	360	57.88	248	39.87	14	2.3
Separate raw food like meat from other foods	291	46.78	258	44.5	73	11.70.
Use separate equipment for raw food	300	48.23	242	39.91	80	12.86
Store food in containers to avoid contact between raw and prepared	513	82.5	109	17.5	0	0
Refrigerate all cooked and perishable food promptly	281	83.88	47	14.03	7	2.09
Buy fresh and wholesome food from markets	549	88.3	73	11.7	0	0
Use food beyond its expiration date	0	0	0	0	622	100
Use water from protected sources/	622	100	0	0	0	0
Use thermometer to check temperature	0	0	0	0	622	100
Prepare food when ill with symptoms from an infectious condition	295	47.4	87	14	240	38.58

Table 7. Score obtained in the evaluation of the knowledge, attitudes, and practices of the food handlers.

KAP DIMENSION	MEAN ± STANDARD DEVIATION	ADEQUATE (ABOVE THE MEAN SCORE)	RANGE [MIN-MAX]
Knowledge	26.21 ± 1.22	348 (55.9%)	12-36
Attitude	35.2 ± 0.98	320 (51.4%)	10-50
Practice	32.2 ± 3.80	318 (51.1%)	16-48

the average total plate count. The results of 93 (74%) samples examined were below 5 CFU/cm^2 (considered clean as per the guideline for on-surface sampling with environmental sponges and swabs), while the remaining proportion was between 5 CFU/cm^2 and 10 CFU/cm^2 (Considered contaminated).

Factors associated with food safety practice

Food handlers with a secondary level education were more likely to have safe food handling practices than food handlers with no formal education (AOR = 2.91, 95%CI [1.20-4.01]). Households in the upper wealth index were more likely than those in the lower wealth index to have safe food handling practices (AOR = 2.18, 95% CI [1.21, 3.93]). Similarly, food handlers who received food safety training were 2.85 times more likely than the non-trained food handlers to have safe practices (AOR = 2.85, 95% CI [1.31-3.19]). Food handlers with good food safety knowledge were 1.95 times more likely than those with poor knowledge to have safe food handling practices (AOR = 1.95, 95% CI [1.23-3.08]). Food handlers with a positive attitude toward food safety were 2.04 times more likely than those with a negative attitude to practice safe food handling (AOR = 2.04, 95 % CI [1.09-3.82]). Food handlers who had a handwashing facility next to their latrines had 2.61 times greater odds of safe food handling than those who didn't (AOR = 2.61, 95% CI: [1.86-3.02]) (Table 8).

Discussion

Food safety is very important in protecting people's health at every stage of the food supply chain. Serious foodborne disease outbreaks have occurred on every continent in the past decade, typically exacerbated by poor food handling.[36] In this study, 51.1% of the households surveyed practiced safe food handling (95% C.I. [46.1, 61.2]). A similar survey in the country's north found that 49.6% of household food handlers had safe food handling practices.[18] Another study in South-Western Ethiopia

Table 8. A bivariate and multivariable logistic regression of factors associated with food safety practice in Shashamane town, Ethiopia, 2021.

VARIABLES (N = 622)	FOOD SAFETY PRACTICE		COR WITH 95% CI	AOR WITH 95% CI
	SAFE (N)	POOR (N)		
Age				
⩽25	118	74	3.03 (1.74-4.28)	1.20 (0.56-2.60)
25-35	113	92	2.33 (1.35-3.01)	1.16 (0.57-2.33)
36-45	52	72	1.30 (0.73-2.34)	0.81 (0.40-1.64)
⩾46	35	66	1	1
Education				
Informal education	25	56	1	1
Primary education	99	129	1.68 (0.84-2.30)	1.43 (0.76-3.40)
Secondary education	139	94	3.03 (1.54-3.95)	2.91 (1.20-4.01)*
Diploma and above+	55	25	4.53 (2.37-5.91)	3.33 (1.41-6.31)**
Attended food safety training				
Yes	67	24	4.13 (2.03-5.51)	2.85 (1.31-3.19)**
No	251	280	1	1
Wealth status				
Lower	30	177	1	1
Middle	41	168	1.4 (0.84, 2.33)	0.97 (0.54, 1.73)
Upper	99	109	5.25 (3.29, 8.38)	2.18 (1.21, 3.93)**
Knowledge				
Good	215	133	2.83 (2.08-3.85)	1.95 (1.23-3.08)*
Poor	103	171	1	1
Attitude				
Favorable	260	160	2.28 (1.27-4.04)	2.04 (1.09-3.82)*
Not favorable	60	242	1	1
Source of water				
Private	170	150	2.31 (1.41-3.78)	1.24 (0.67-5.45)
Public	146	156	1	1
Solid waste disposal is available				
Yes	175	117	2.22 (1.49-3.32)	1.29 (0.77-2.16)
No	143	187	1	1
Liquid waste disposal is available				
Yes	158	60	2.89 (1.30-6.42)	0.92 (0.24-3.54)
No	160	244	1	1
Hand washing facility near the latrine				
Yes	294	141	4.57 (3.06-5.12)	2.61 (1.86-3.02)**
No	24	163		

(Continued)

Table 8. (Continued)

VARIABLES (N = 622)	FOOD SAFETY PRACTICE		COR WITH 95% CI	AOR WITH 95% CI
	SAFE (N)	POOR (N)		
Type of latrine				
Improved	220	215	2.31 (1.41-3.78)	1.24 (0.67-5.45)
Unimproved	98	89	1	1
Cleanliness of kitchen				
Yes	297	221	1.8 (1.15-2.87)	1.37 (0.87–2.88)
No	21	83	1	1
Signs of kitchen insects and bugs				
Yes	229	149	2.22 (1.42-3.46)	1.51 (0.88-2.59)
No	89	155	1	1

[+]Technical and vocational certificate, tertiary education.
*Significant at *P* value <.05 to 0.01.
**Significant at *P* value <.01 to .001.

revealed that good food hygiene practice among studied households was 36.70%.[37] The difference in the results of the studies could also be linked to the differences in the food handlers' socio-cultural, economic, demographic characteristics, and methodological differences.

In the present study, the result of the bacteriologic examination identified that 7% of the swabbed utensils were in fact contaminated. While there is evidence of a link between utensil contamination and food safety practices,[38,39] in this study, the hypothesized correlation between bacterial contamination of plates and safe food handling practices was insignificant. It should be noted, however, that in addition to washing and sanitizing dishes, the context of safe food handling is shaped by several elements, including personal hygiene, cultural features, resource availability, and environmental conditions.[11,40,41] Home kitchens, unlike commercial kitchens, are utilitarian spaces that serve many purposes other than food preparation and storage. In most home kitchens, it's common to find pets, old newspapers, dirty laundry, house plants, and soil.[7] Hand washing, produce washing, dishwashing, soaking clothing, washing children and pets, and wetting mops are all done in kitchen sinks.[42] In residential refrigerators, raw unwashed vegetables, dripping raw meat, and cooked ready-to-eat items are typical. In addition to utensil hygiene, the numerous uses of home kitchens provide a window of opportunity to introduce a variety of germs that can spread to foods, multiply, and cause illness.[43] Therefore food handlers must get effective and frequent food safety training as a first step in guaranteeing that, food safety concepts are at least introduced.

Education is a key social determinant of health. Educated food handlers have previously stated that being able to understand written food safety warnings from a variety of sources had a good impact on their safety procedures.[44] As one's educational level rises, the possibility of safe practices rises as well.[45] This was also true in the current study, with educated food handlers having a higher likelihood of practicing safe food handling. However, not all learning takes place in schools. This means that lack of a formal education may not be an insurmountable barrier to safe food handling. Encouraging food handlers to follow recommendations and educating them on their universal vulnerability to food-borne infections may also raise their awareness of safe food handling.[46]

Safe food handling practices are more likely in higher-income homes, and Shashamane town was no exception. Households in the upper socioeconomic class were more likely than those in the lower socioeconomic class to have safer food handling practices. Risks connected with transportation, sanitation, and refrigeration systems have been thoroughly documented in resource-constrained environments. Due to overcrowded households, lack of improved water supply, lack of improved sanitary facilities, and smaller kitchens, food safety problems may be exacerbated in low socioeconomic settings.[47,48]

Similarly, food safety training for handlers has become a core pillar in the control of food contamination risks, with the recognition that poor food hygiene practices among food handlers are still a leading source of food safety incidents.[46] Food handlers who received food safety training had a higher likelihood of safe food handling practice in the current study. Similar studies from Jamaica and Malaysia confirm this conclusion.[49,50] Food handlers who got professional training were found to follow prescribed safety regulations and to be more aware of FBD prevention in these studies.

Studies provide evidence that, when communities do not recognize FBDs as a major public health issue, food-safety driven ailments become difficult to control and eventually eliminate.[51] Food handlers should have the appropriate information to set

realistic expectations and implement the necessary preventative and control measures to accomplish this.[46] Food safety knowledge and attitude, in particular, determine the context of safe food handling. People who have awareness and concern about FBDs and their causes can engage in more effective protective activities.[11] This was also true in the current study, where good knowledge and a favorable attitude toward safe food handling were positively associated with the practice.

In Shashamane, food handlers who had a handwashing station close to their latrines were more likely to have safer food handling practices than those who did not. Whether food is produced or handled in a factory, prepared in a restaurant, or cooked at home, handwashing is an important part of ensuring food safety.[18] Hands become soiled while working, thus handwashing stations must be readily situated for food handlers. If there is a long walk to a handwashing station, there is a considerable likelihood for a person to forfeit handwashing.[40]

There are some limitations to this study. The swab test sample used in the study was obtained only from one type of food utensil. Due to resource restrictions, only 20% of the entire sample size was used for the swab test. There is also a likelihood of over, under or misreporting of findings in self-reported studies. Participant responses may be biased as a result of social desirability to provide sociably preferred answers more than the answers that reflect their real experiences. However, efforts were made to reduce social desirability through ensuring only study participants were present during the time of data collection and maintaining data confidentiality after data collection was complete. The potential of recall bias related to the time elapsed between the event and data collection time should also be considered even though respondents were allowed as much time as they needed for an adequate recall of long term memory.

Future research

To help inform managers and policymakers, a review of the costs associated with FBDs should be conducted. Moreover, serological identification of bacterial species and antimicrobial susceptibility tests for potential food-borne bacterial contaminants should also be conducted. The current study evidenced training as an important determinant of safe food handling practices, but it should be pointed out that the study was carried out in a broader context. Future research may need to further investigate the type, frequency, and content of training that needs to be delivered.

Conclusions

Over the last few decades, there has been an increasing awareness of the home's role in a variety of public health and hygiene issues. The significance of home in the transmission and acquisition of food-borne diseases is perhaps the most well-known of the concerns. Food-borne illness has become a common problem around the world. Although data gathering systems for food-borne diseases typically overlook a large number of home-based outbreaks of sporadic infection, it is now widely understood that many episodes of food-borne sickness are caused by individuals' inappropriate food handling and preparation in their kitchens.

In the current study, educational status, wealth status, food safety training, food safety attitude, and knowledge about FBDs were all found to be strongly associated with safe practices. This implies that public education is a key factor in improving food safety practices at home. While ongoing food safety education is required across all media, the findings of this study identified that regular interpersonal contact and assistance from health extension workers are still key in the adoption and maintenance of safe practices. Future programs can benefit from such factors being emphasized. It may also be advantageous to provide health extension staff with additional training to improve their ability to encourage community members across, a wide range of households or levels of readiness, to handle food safely, as well as to provide social support for such behaviors.

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Author contribution

Both BY and AT were equally involved in the study leading from the conception, design and supervising the data collection process to the final analysis and preparation of the manuscript. All authors read and approved the final manuscript.

Availability of Data and Materials

All the data supporting the findings are included in this paper.

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