

## Knowledge, attitude, and hygiene practices of food handlers related to food safety in Al-Suwaira City, Wasit Province in Iraq

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### Abstract

**Background and Aim:** Food safety and hygiene are global health concerns, particularly in underprivileged nations, due to the increased incidence of foodborne diseases (FBDs) and associated mortality. This study aimed to evaluate the food handlers' knowledge, attitude, and hygiene practices toward food safety in Al-Suwaira City, Wasit governorate, Iraq.

**Materials and Methods:** In this cross-sectional study, researchers interviewed 130 food handlers to assess their knowledge, attitude, and hygiene regarding food safety in Al-Suwaira, Wasit governorate, Middle Eastern Iraq, from October 2022 to March 2023. The data regarding their age, sex, place of residence, education, employment history, marital status, and monthly income were collected through a questionnaire, as were details on their knowledge, attitudes, and hygiene habits about food safety.

**Results:** Overall, most participants demonstrated poor knowledge of food hygiene and preservation but showed good knowledge of personal hygiene. Knowledge gaps were identified about the healthy ways to clean and use cooking utensils (35.38%), storage of food in the refrigerator (33.85%), and the possible exposure to foodborne pathogens when utensils are reused to cook vegetables and meat (12.31%). Nearly all participants in this study had positive attitudes toward food safety. Most participants (n = 100, 76.7%) agreed that separating raw and cooked food is the best way to avoid spreading germs. Moreover, 109 respondents (83.85%) agreed that washing hands before preparing food efficiently reduces the spread of FBDs. Furthermore, 117 participants (90%) disagreed that disposing of expired perishable foods is necessary, while 91.54% disagreed that monitoring meals for cleanliness and health is important. Our findings showed that 57.15% of the participants had low-to-intermediate competence in food safety procedures, such as avoiding cross-contamination, checking food temperatures, and washing hands thoroughly before and after handling food.

**Conclusion:** The participants in this study exhibited poor compliance and awareness of food safety procedures and practices, respectively. Therefore, educational opportunities and training are necessary to enhance their knowledge, attitudes, and cleanliness levels.

**Keywords:** food handlers, food safety, Iraq, knowledge, attitude, and hygiene practices, Wasit province.

### Introduction

Foodborne infections, a global public health concern, have become increasingly prevalent [1, 2], resulting in extreme morbidity and mortality [3, 4]. Improper food handling makes millions of people sick every year, of which thousands die [5].

An increasing number of working women are forced to rely on convenience meals and pay less attention to food safety and cleanliness because of modern life. Foodborne diseases (FBDs) are rising due to a lack of focus on food safety and hygiene [6, 7]. Foodborne diseases are transmitted by ingesting live

microorganisms or their toxins sufficiently to induce sickness [8]. Food handlers, people who are directly involved in preparing and processing cooked foods [9, 10], have been implicated in 12%–18% of all cases of food poisoning [11, 12] because of contamination, poor food safety measures, and improper hygiene standards [13, 14]. Street food companies improve the economy and the lives of low-income individuals in low- and middle-income nations [15]. However, in many nations, authorities have little to no influence over the food processing methods [16]. Therefore, the quality and safety of prepared retail food are major concerns, particularly regarding the awareness of FBDs among food handlers.

Both theoretical and experiential understanding gained through education or training and actual usage are important to ensure food safety [16]. Food handlers' insufficient knowledge, bad attitude, and inadequate sanitation procedures significantly threaten food safety applications [17], which is why

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knowledge, attitude, and hygiene practices (KAP) of food safety contribute significantly to the prevalence of food poisoning and FBDs among consumers [18]. Inadequate KAP among food handlers is linked to food poisoning [19–21]. The mindset of those who work with food also influences how they do their jobs [8]. Multiple investigations conducted in Iraq have found evidence of food contamination with dangerous FBDs [22–36]. As workers in the food industry play a crucial role in food contamination and FBDs, studying the KAP of food safety among this population is important.

In Al-Suwaira city, the KAP of food safety among food handlers who prepare regularly consumed foods has not yet been investigated. This study was conducted in Al-Suwaira city, Wasit governorate, Middle Eastern Iraq, to determine the knowledge, attitudes, and self-reported behaviors among food handlers to provide a basis for promoting food safety and hygiene practices throughout this province and beyond. This will help reduce the incidence of FBDs in Iraq, specifically in the Wasit governorate.

## Materials and Methods

### Ethical approval and Informed consent

In accordance with the principles outlined in the Helsinki Declaration of 1975, the Ethics Committee of the Middle Technical University in Baghdad, Iraq, approved this study (September 1, 2022). All participants provided written permission after receiving appropriate information.

### Study period and location

The study was conducted from October 2022 to March 2023 at Al-Suwaira, which is located in the Wasit governorate in the Middle East of Iraq.

### Study design

We conducted a descriptive, cross-sectional study involving 130 food handlers. Al-Suwaira, located on the west bank of the Tigris River and 35 km south of Baghdad, is one of the largest cities in Wasit governorate. Unfortunately, after the terrorist incidents in many Iraqi governorates in 2016, a large number of families moved from these governorates to the Wasit governorate, especially Al-Suwaira, after losing their homes. This exacerbated the spread of poverty and poor living conditions. This city is replete with street vendors, cafeterias, popular restaurants, and cooked foods that are fully prepared in homes and delivered to families on request. Moreover, a significant proportion of people earning low wages, including construction and transport workers along with school pupils, mainly depend on street food, making this area suitable for research due to the possibility of a significant public health risk associated with street food.

Participants were selected using a rigorous random selection process. At first, researchers went wherever they could get the most information quickly (such as busy intersections, parks, restaurants, cafes,

street sellers, and student organizations) and enlisted 142 food workers from these locations using a random lottery. Then, the data collectors assigned a unique identifier to each sample/participant. The numbers were written on a sheet of paper, which was folded and stored in a box alongside the identifiers of the other samples. The researcher assigned each participant a random number from a box and rated them accordingly. After being informed of the study's goals, all food handlers, who gave their informed permission, were included in the study. There were 12 withdrawals from the study for several reasons, including the participants' lack of time ( $n = 5$ ), disinterest ( $n = 4$ ), and inability to see the value in the study ( $n = 3$ ). Finally, 130 food handlers were included in this study. The data collectors were also tasked with answering any questions the participants may have about the self-administered questionnaires.

### Questionnaire and data collection

A food safety KAP questionnaire was designed based on surveys conducted to establish foundational gaps for improving food safety KAP within communities [8, 37–39]. The questionnaire has an introduction that outlines the study's goals, how participants may opt out at any moment, and how long it will take to complete. After thoroughly validating the assessment's content, the questionnaire's initial draft was sent to three experts for feedback on its appropriateness, clarity, and significance.

The questionnaire was divided into four parts: First, the researchers recorded the participants' basic information, such as their gender, age, education level, employment history, marital status, place of residence, income level, and level of food safety training. The second part had 16 questions to test the participants' awareness of food safety issues and their general knowledge using knowledge questions. The multiple-choice responses were yes/no and did not know. Responses were scored as a 1 if they were right or a 0 if they were wrong or not answered. The third part consisted of 15 attitude-based questions to test their perspective on food safety. The respondents might answer as "agree," "neutral," or "disagree" on each question, which were then given scores of 3, 2, and 1, respectively. The scores ranged from 15 to 45. The last section, consisting of 14 questions, tested the respondents' methods for maintaining food safety. Responses were recorded on a four-point scale, ranging from "never" to "always," which were assigned scores of 0 and 3, respectively. The range of possible points was from 0 to 42. Lower scores were considered as "bad" or "unsatisfactory," whereas higher scores were adjudged as "excellent" if the total was  $\geq 50\%$  of the highest possible score on the KAP.

### Statistical analysis

Statistical package for the social sciences version 26.0 (IBM SPSS, NY, USA) was employed to analyze the participants' responses. Descriptive

statistics, such as frequencies, percentages, mean values, and standard deviations, were used to explain the demographic data and assess the participants' food safety measures.

## Results

### Demographics of the participants

Table-1 summarizes the characteristics of the participants. Most of the 130 participants were male (74.62%). Over half of the participants were aged <25 years (n = 73, 56.15%), while the lowest number of participants were aged >50 (n = 8, 6.15%). Regarding educational qualifications, most participants were undergraduates (n = 35, 26.92%), while few were graduates (n = 16, 12.31%). However, when considering years of experience and food safety training (n = 59, 45.38%) were experience of work <5 years, 37.69% did not have food safety training. Over half of the participants were unmarried (n = 68, 52.31%). Furthermore, 30% of the respondents were from the countryside (n = 39), whereas 70% were from urban areas (n = 91). Moreover, 54.62% of the participants were satisfied with their monthly income, whereas 45.38% were not (Table-1).

### Participants' knowledge of food safety

Table-2 summarizes the contributors' awareness of food safety. Most of the participants displayed poor knowledge about food hygiene and preservation as approximately one-third of the participants (35.38%) knew about the healthy ways to clean and use cooking utensils. In addition, only 33.85% of the participants knew about proper ways to store and refrigerate food, while a very small percentage (12.31%) knew that using the same knife to cut vegetables and meat increases exposure to foodborne pathogens. Few of the participants knew about the harmful effects of insect vectors as a pathogen carrier as only 23.85% correctly answered about the presence of cockroaches and flies in kitchens. Besides, half of the participants did not know the food contamination risk zone (40°F–140°F). Nonetheless, most participants showed good knowledge of personal hygiene, of which 72.31% and 81.54% knew how to properly wash their hands and wear gloves, respectively.

### Participants' attitudes toward food safety

Table-3 shows the results of the handler's perspective on food safety. Most of the participants (n = 108, 84.08%) were ambivalent about the necessity of frequent hand washing while preparing food; n=84 (64.62%) agreed that cleaning the kitchen shelves can reduce the risk of infection; and n = 100 (76.08%) agreed that separating raw and cooked foods prevents infection. Furthermore, n = 109 (83.85%) of the participants believed that infections can spread through utensils used for food preparation and that in the absence of a towel or paper, it is feasible to cough or sneeze within the elbow. Most respondents (n = 92; 70.77%) agreed that most foodborne germs

**Table-1:** Demographic information of the contributors.

Demographic information	Number	Percentage
Gender		
Male	97	74.62
Female	33	25.38
Total	130	100%
Age groups		
<25	73	56.15
25–50	49	37.69
>50	8	6.15
Total	130	100%
Qualifications		
Unable to read and write	20	15.38
Primary school	31	23.85
Secondary school	28	21.54
Under graduation	35	26.92
Graduated	16	12.31
Total	130	100%
Experience of work (years)		
<5	59	45.38
5–9	27	20.77
10–20	25	19.23
>20	19	14.62
Total	130	100%
Marital status		
Married	49	37.69
Unmarried	68	52.31
Divorced, separated or widowed	13	10
Total	130	100%
Residence		
Rural	39	30
Urban	91	70
Total	130	100%
Monthly income		
Unsatisfied	59	45.38
Satisfied	71	54.62
Total	130	100%
Food safety training		
Yes	81	62.31
No	49	37.69
Total	130	100%

are present on human hands, while (n = 76; 58.46%) approved that food workers with abrasions on their hands are unfit to handle food. However, most respondents (n = 119; 91.54%) did not believe that inspecting prepared foods for signs of contamination or illness is necessary, and nearly as many (n=117; 90%) disagreed that it is important to discard expired food. Furthermore, 54.6% of respondents (n = 71) disagreed that keeping cooked food at room temperature (25°C) beyond 2 h is harmful. Table-3 shows the participants' perspectives.

### Participants' hygiene practices for food safety

Table-4 displays the individuals' healthy habits. While 67.69% of participants (n = 88) reported that they washed cooking utensils between uses, 66.15% (n = 86) of them washed their hands after handling dirty items, 56.15% (n = 73) separated uncooked and prepared meals in containers for storage, and 56.15% (n = 73) used hot, soapy water to disinfect countertops after preparing food. In addition, only 31.54% (n = 41) washed their hands before cooking, 46.15% (n = 60) used separate bowls and chopping materials for fresh

**Table-2:** Food handlers' knowledge toward food safety.

Questions	Participant's responses n (%)		
	Correct (%)	Incorrect (%)	I do not know (%)
Before handling food, wash hands thoroughly with soap and water for 1 min	94 (72.31)	18 (13.85)	18 (13.85)
Cross-contamination occurs when foods that have been cooked or are raw come into contact with each other	85 (65.38)	14 (10.77)	31 (23.85)
It is better for food safety if workers wear gloves	106 (81.54)	6 (4.62)	18 (13.85)
Only water from the sink should be used to clean the utensils used for preparing food	46 (35.38)	61 (46.92)	23 (17.69)
It is important to separate raw ingredients from cooked ones	90 (69.23)	20 (15.38)	20 (15.38)
Uncooked meat should be stored in the lower part of the refrigerator	44 (33.85)	63 (48.46)	23 (17.69)
Reusing a contaminated knife for cutting potentially hazardous foods like produce and meat	16 (12.31)	79 (60.77)	35 (26.92)
Before serving, a prepared food should maintain its heat (at least 60°C)	54 (41.54)	34 (26.15)	42 (32.31)
When there is food left over after a meal, it should be stored in the refrigerator at the appropriate temperature and consumed at the next meal	41 (32.31)	55 (42.31)	34 (26.15)
Cooking should be done with treated water	72 (55.38)	35 (26.92)	23 (17.69)
It's OK to let bugs like cockroaches and houseflies inside the kitchen	31 (23.85)	82 (63.08)	17 (13.08)
Microorganisms and diseases may be transferred through wiping rags	88 (67.69)	14 (10.77)	28 (21.54)
Senses are ineffective at detecting food contamination	63 (48.46)	37 (28.46)	30 (23.08)
The features of contaminated foods are continually evolving	73 (56.15)	21 (16.15)	36 (27.69)
Food contamination risk zone (40°F–140°F)	49 (37.69)	16 (12.31)	65 (50)
Cleaning the surfaces that come into touch with food on a regular basis helps keep it safe to eat	87 (66.92)	6 (4.62)	37 (28.46)

**Table-3:** Study participant s' attitudes toward food safety.

Questions	Participant's responses n (%)		
	Agree (%)	Neutral (%)	Disagree (%)
It is unnecessary to repeatedly wash your hands when preparing food	9 (6.92)	108 (83.08)	13 (10)
Do you prefer to wear a ring or a watch while preparing food?	21 (16.15)	87 (66.92)	22 (16.92)
Cleaning kitchen surfaces lessens the danger of infection	84 (64.62)	25 (19.23)	21 (16.15)
The food handler should wash his/her hands after contacting his/her body	80 (61.54)	30 (23.08)	20 (15.38)
It is important to separate raw and cooked foods during processing	100 (76.92)	10 (7.69)	20 (15.38)
Long and painted fingernails contaminated foodstuffs with pathogens	93 (71.54)	18 (13.85)	19 (14.62)
Food poisoning may be avoided by practicing good hand hygiene	109 (83.85)	10 (7.69)	11 (8.46)
Pathogens can be sourced from food utensils	109 (83.85)	7 (5.38)	14 (10.77)
Prepared food should not touched by workers who have cuts and scrapes	76 (58.46)	20 (15.38)	34 (26.15)
If a towel or paper is not available, cough or sneeze inside the elbow	109 (83.85)	13 (10)	8 (6.15)
Before starting work, food handlers' health should be evaluated	81 (62.31)	18 (13.85)	31 (23.85)
The vast majority of germs and bacteria are spread by human hands	92 (70.77)	14 (10.77)	24 (18.46)
It is vital to inspect food for cleanliness and safety before eating it	5 (3.85)	6 (4.62)	119 (91.54)
It is not safe to leave prepared food out of the fridge for longer than 2 h	38 (29.23)	21 (16.15)	71 (54.62)
Past their use-by date, perishable foods must be thrown away	10 (7.69)	3 (2.31)	117 (90)

and prepared meals, 13.18% (n = 17) thawed frozen meat in the morning before cooking it, 6.92% (n = 9) stored cooked food on the counter until the next day, and 14.62% (n = 19) used a thermometer to determine whether the food was fully cooked. Furthermore, 22.31% of the participants (n = 29) cleaned their hands after counting money.

#### Level of assessment

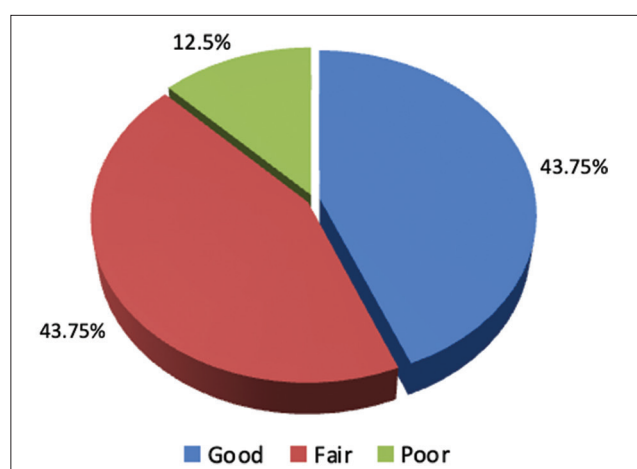
Regarding the level of assessment of KAP toward food safety, our results found that 56.25% of respondents had poor to fair knowledge, 40% had a negative to neutral attitude, and 57.15% reported poor to moderate hygiene practices (Figures-1–3).

#### Discussion

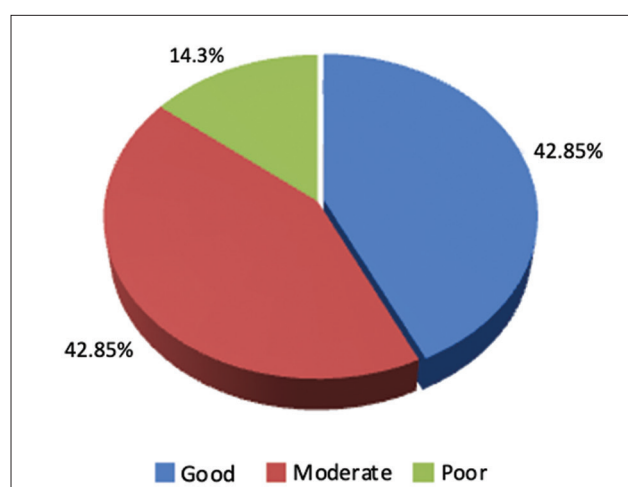
Foodborne illnesses majorly contribute to morbidity and mortality worldwide [40]. The spread of foodborne infections has increased because of improper food handling and insufficient hygiene practices while manufacturing, preparing, and serving food [8]. The use of proper food handling techniques by food handlers maintains food quality and safety [41], limiting the risk of FBDs. According to our findings, most participants (56.25%) had a poor to fair knowledge of food safety (Figure-1), which increases the risk of contracting food poisoning and FBDs through contaminated foods, putting the consumers in

**Table-4:** Study participant s’ practices toward food safety.

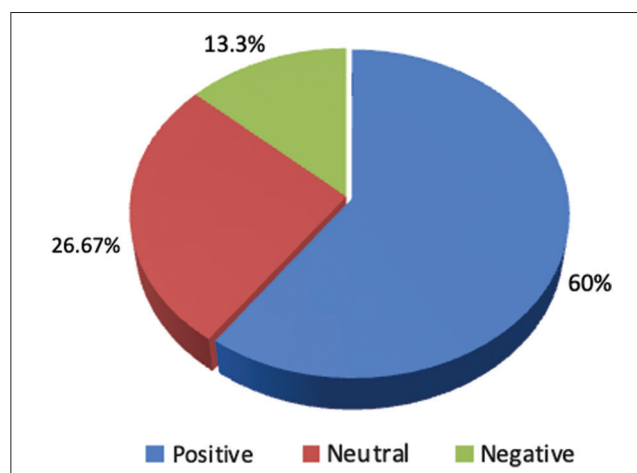
Questions	Participant’s responses n (%)			
	Never (%)	Rarely (%)	Sometimes (%)	Always (%)
Clean your hands throughout meal cooking	12 (9.23)	36 (27.69)	41 (31.54)	41 (31.54)
Wash dishes used to prepare raw meat, poultry, and fresh meals before utilizing cooked food	9 (6.92)	15 (11.54)	18 (13.85)	88 (67.69)
When preparing a freshly prepared dish, use various cooking basins, and chopping materials	14 (10.77)	22 (16.92)	34 (26.15)	60 (46.15)
Using meat that was frozen the night before and thawed in the morning for dinner	35 (26.92)	34 (26.15)	44 (33.85)	17 (13.08)
Dispersed uncooked and prepared meal before preservation	13 (10)	20 (15.38)	24 (18.46)	73 (56.15)
Cooked food was left near the counter to be utilized the following day	99 (76.15)	15 (11.54)	7 (5.38)	9 (6.92)
Store eggs at room temperature	41 (31.54)	14 (10.77)	39 (30)	36 (27.69)
After meal preparation, disinfect worktops with hot, soapy water	13 (10)	21 (16.15)	23 (17.69)	73 (56.15)
Use the thermometer to determine the temperature of the refrigerator	60 (46.15)	27 (20.77)	17 (13.08)	26 (20)
Using a thermometer to determine if the meal is thoroughly cooked	49 (37.69)	33 (25.38)	29 (22.31)	19 (14.62)
Do you wash your hands after counting money?	49 (37.69)	28 (21.54)	24 (18.46)	29 (22.31)
Do you wash your hands after touching filthy things?	17 (13.08)	14 (10.77)	13 (10)	86 (66.15)
Clean shells and hands with a similar kitchen towel	82 (63.08)	24 (18.46)	5 (3.85)	19 (14.62)
Check to see whether a food has been grilled by touching it	22 (16.92)	9 (6.92)		90 (69.23)



**Figure-1:** Overall knowledge of the contributors toward food safety. M.s. = Mean of score, level of assessment: Poor (M.s. = 1–1.66), Fair (M.s. = 1.67–2.33), Good (M.s. ≥2.34).



**Figure-3:** Overall hygiene practices of the contributors toward food safety. M.s. = Mean of score, level of assessment: Poor (M.s. = 1–1.66), Moderate (M.s. = 1.67–2.33), Good (M.s. ≥2.34).



**Figure-2:** Overall attitudes of the contributors toward food safety. M.s. = Mean of score, level of assessment: Negative (M.s. = 1–1.66), Neutral (M.s. = 1.67–2.33), Positive (M.s. ≥2.34).

a precarious position. The previous studies by Ayaz *et al.* [13], Lema *et al.* [42], and Odonkor *et al.* [43] showed that as knowledge of food safety is important for food handlers, training programs on food safety should be conducted to promote awareness of hygienic practices. However, our findings disagree with those reported in a study conducted in Jordan [44] but are consistent with the findings of studies conducted in Ghana and Malaysia [39, 40]. This might be due to differences in the type of food safety training, sample size, grading system, and comprehension level. This study indicates that most participants had good knowledge about personal hygiene, as 72.31% and 81.54% of respondents were familiar with proper hand washing and the use of gloves, respectively. These findings are consistent with those reported in studies from Bangladesh [41], China [45], Vietnam [46],

and Iran [47]. Good personal hygiene and regular hand washing potentially reduce the spread of FBDs by decreasing the likelihood of cross-contamination between hands, utensils, and cooking surfaces.

Unlike in the United Arab Emirates [48], where 97% of the samples showed an association between insects and FBDs, 23.85% of our participants were unaware that insects might spread germs that cause food poisoning, which is consistent with a previous study by Latif *et al.* [3] from Egypt.

Our findings revealed that most participants had poor knowledge about food hygiene and preservation as only approximately one-third of the participants (35.38%) knew how to clean and use cooking utensils properly. For example, participants incorrectly stated that fresh meat can be refrigerated in any position after it has been cooled. These findings are consistent with the earlier research in Ghana [39], where only 33.85% of participants knew the proper methods to store and refrigerate food. Our results also disagreed with a study from Malaysia, which found that most people knew about the fourth World Health Organization Five Keys to Safer Food and how to store food at an appropriate temperature for consumption [49]. As food storage at improper temperatures increases the risk of contamination and even microbial multiplication, maintaining foods at temperatures low enough to inhibit microbial growth or high enough to kill them is necessary to prevent FBDs [8].

People's attitude toward food safety significantly impacts their behavior, which, in turn, affects the incidence of FBDs [14]. Most respondents in this study had a positive outlook on food safety, indicating that they realized the importance of maintaining food safety. This is encouraging as they are the primary conduits for transmitting contagious microorganisms into the food supply. Our findings are consistent with several previous reports by Tuglo *et al.* [39], Samapundo *et al.* [50], Akabanda *et al.* [51], and Werkneh *et al.* [52], but in contrast with those conducted in Ethiopia [5], where the overwhelming majority of contributors exhibited a negative outlook on food safety. This variation might be because of the differences in times, locations, or research methods used in these studies.

Similar to a study conducted in Ghana [39], almost all the participants in our study ( $n = 100$ , 76.92%) agreed that keeping raw and cooked foods in separate containers or different areas in the kitchen prevents contamination and reduces the risk of FBDs. This is strongly recommended as a public health precaution to avoid contamination [53]. Consistent with prior findings [39], our results indicated that most participants ( $n = 109$ ; 83.85%) agreed that, without a towel or paper, they coughed or sneezed into their elbows.

A recent study in Ethiopia [5] found that 25% of respondents ( $n = 107$ ) believed that covering one's mouth while coughing and sneezing prevents

contamination; however, our results contradict these findings. Furthermore, our results disagree with studies conducted in Malaysia and the United States, where almost all respondents said that they sneezed directly into their hands and never cleaned them [49, 54]. Sneezing and coughing might spread droplets carrying potentially pathogenic germs to nearly 7–8 m [5], which can contaminate food and cause FBDs. Hence, this attitude compromises public health. To prevent the transmission of respiratory illnesses, it is recommended to cough or sneeze into the elbow or use hands to cover both mouth and nose and wash them immediately.

While previous findings from Ethiopia [5] suggested that poor hand sanitization contributed to the prevalence of FBDs, most of the respondents in this study ( $n = 109$ ) disagreed. However, our findings showed that 91.54% of the participants ( $n = 119$ ) disagreed that inspecting meals is essential for hygiene and 90% of them ( $n = 117$ ) disagreed that expired foods should be discarded, which is in contrast with another study conducted in Ghana [4]. Consistent with the previous studies from Ethiopia, we found that over half of our sample size ( $n = 71$ ) disputed that storing cooked meals at 25°C for over 2 h is harmful.

Practice refers to the actions taken by individuals based on their knowledge [55]. Our survey found that 57.15% of food handlers had either poor or moderate levels of food safety awareness (Figure-3), which contradicts those shown in the previous studies by Al-Shabib *et al.* [56], Tegegne and Phyto [57], and Jianu and Goleț [58]. These discrepancies might be due to changes in the sample size, the quality of food safety education offered, and the strength of enforcement policies. Poor hand hygiene, a major risk factor for food contamination [5], results in improper food handling of food and increases the risk of FBDs. Therefore, attention has been focused on preventing cross-contamination, determining food temperature, and ensuring personal cleanliness, especially hand hygiene. Therefore, food handlers must wash their hands before handling food, after feeding animals, and after touching any potentially contaminated surfaces [56].

However, only a minority of respondents (31.54% and 22.31%) reported regularly washing their hands during meal preparation and after handling money, respectively. In addition, almost two-thirds of the respondents reported washing their hands after handling potentially unsanitary items. Compared to Dubai, where 92.2% and 90.1% of food handlers claimed that they always wore gloves and washed their hands before and after food preparation, respectively [6], our findings are much lower. A study conducted in Malaysia showed that only 44.4% and 86.4% of participants reported that they always wore gloves and washed their hands before preparing food [40], suggesting that wearing gloves and hand washing are common practices there.

Thermometers and other food temperature monitoring tools are required to determine whether food is in the danger zone [5]. The key purpose of cooking is to enhance the taste, eliminate germs, and increase the shelf life of foods [59]. Only 20% and 14.62% of participants consistently used thermometers to monitor refrigerated and cooked food, respectively (Table-4). Almost 50% of FBDs are linked to improper storage temperatures [59, 60], while 45% are linked to improper reheating temperatures. Consistent with a prior study [49], we noticed that some of our participants engaged in incorrect behavior when using the same dish towel to clean shells and hands. This lack of adherence to the instructions provided during the food safety training might be because the respondent just did not understand any of the information presented during food safety training.

Lack of hand sanitization might contaminate foods, endangering the customers. Consistent with studies in Iran [47] and Malaysia [49], most respondents in this study reported washing dishes used for preparing raw meat, poultry, and fresh foods before using them to prepare cooked food; using separate cooking bowls and chopping materials for preparing fresh and cooked meals; separating both uncooked and cooked meals before preserving them; and washing countertops with hot, soapy water after preparing food. This standard of personal cleanliness is required to prevent potentially fatal infectious diseases.

We found that 43.75% of respondents had good knowledge, 60% had a favorable attitude toward food safety, and 42.85% engaged in excellent practices (Figures-1–3). Research conducted in Mekelle City, Northern Ethiopia [52] showed that its inhabitants had above-average levels of food safety knowledge, attitude, and behaviors at 65%, 81.1%, and 58.9%, respectively. However, studies from Nigeria and Egypt indicated that 81% and 39.2% of respondents had excellent knowledge, 71% and 61% had favorable attitudes, and 37% and 56.3% had good behaviors, respectively [8].

Promoting appropriate food safety procedures requires raising awareness about food safety issues and encouraging a positive mindset. Therefore, increasing the training for food handlers is crucial to foster more optimistic perspectives on food safety.

## Conclusion

Our results showed that most respondents had poor knowledge of food hygiene and preservation. Contrastingly, most of them showed good knowledge of personal hygiene as 72.31% and 81.54% of them were somewhat familiar with proper hand sanitization procedures and the use of gloves. Most of the participants had a positive attitude toward food safety and about the prevention of contamination, in addition to the cross-contamination of food. Even though the participant's knowledge about food safety was good, their overall practices to prevent food safety indicate that

there is still a significant knowledge gap. However, regarding food handlers' practices, the results suggested that there might be an increased risk of foodborne infections due to inadequate to moderately adequate food safety measures among food handlers. Therefore, implementing education and training programs to improve the food handlers' attitudes, understanding, and behaviors is strongly recommended to improve food safety. Furthermore, orders should be established to allow continued monitoring.

## Authors' Contributions

MHGK, IDS, AMT, and SSA: Conceptualized and designed the study. MHGK: Drafted the manuscript. IDS and AMT: Data collection and statistical analysis. MHGK and SSA: Edited the manuscript. All authors have read, reviewed, and approved the final manuscript.

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## Competing Interests

The authors declare that they have no competing interests.

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