



Knowledge of Food Safety and Handling Practices among Food Handlers in University Communities

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ABSTRACT

Food safety involves practices that prevent food contamination and disease, a critical issue highlighted in the 2030 Agenda for Sustainable Development Goals. Foodborne illnesses significantly impact public health, with inadequate knowledge and handling practices among food handlers contributing to outbreaks. This study aimed to assess food safety knowledge and the handling practices of food handlers in three university communities in Iringa Municipality, Tanzania. The study involved a cross-sectional descriptive design conducted in June and July 2024, utilizing convenience sampling to survey 56 participants. Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26, which computed the frequencies, percentages, and descriptive statistics of variables. The study revealed that 85.7% scored adequately in knowledge, with an average score of 73.1%, yet only 21.4% demonstrated adequate food handling practices, with practice scores averaging 47.8%. Furthermore, 98.2% of food handlers recognized symptoms of foodborne illnesses, and knowledge gaps were evident, with only 16.1% knowing the proper thawing method and 26.8% understanding ideal refrigeration temperatures. Observationally, 85.7% practiced handwashing before work, but only 7.1% wore gloves while handling ready-to-eat foods. The study reveals a significant gap between food handlers' knowledge of food safety and their actual handling practices. Effective food safety education and continuous training are critical for improving handling practices and reducing foodborne illness risks.

Keywords: Knowledge, Handling Practices, Food Safety, Food Handlers, University Communities

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INTRODUCTION

Food safety refers to the procedures used in handling, preparing, and storing food to prevent contamination and foodborne diseases (Ashkanani et al., 2021). It is one of the key areas of the 2030 Agenda for Sustainable Development Goals (SDG) and a public health concern worldwide due to the increased morbidity and mortality risk associated with the outbreak of foodborne diseases (Azanaw et al., 2021; Masiku et al., 2024).

Foodborne illnesses have a significant effect on global public health, causing widespread concern among consumers, producers, and policymakers alike. In many regions of the

developing world, the understanding of foodborne infections and their prevention remains limited (**Bulto et al., 2022; Habiballah et al., 2017**). Illnesses resulting from consuming contaminated food and beverages remain a major cause of health issues in various countries and can have severe consequences under certain conditions (**Bulto et al., 2022**). Food safety is now recognized as one of the top 10 global health threats as of 2019. Foodborne disease outbreaks pose significant challenges to public health, leading to an estimated 76 million illnesses, 325,000 hospitalizations, and around 5,000 deaths each year (**Odipe et al., 2019**).

Foodborne disease outbreaks in food preparation and service facilities are attributed to cooking and storing food at incorrect temperatures and cross-contamination of food due to unsanitary handling practices (**Bender et al., 2022**). Inadequate personal hygiene practices and sourcing food from unreliable suppliers have been identified as contributing factors to outbreaks of foodborne illnesses in food preparation and service settings (**Azanaw et al., 2021**). Food handlers can transmit the virus through actions such as coughing, speaking, breathing, sneezing, or singing. These activities can create infectious aerosols that spread the virus into the air around them (**Brizek et al., 2021**).

Food handlers lacking adequate food safety knowledge in food preparation and service facilities like restaurants can significantly endanger food safety (**Nyalo, 2020**). To ensure that food is safe by the time it reaches customers, it is essential for all food handlers to possess adequate knowledge and skills in food safety and hygiene during the preparation process (**Dewi et al., 2021; Limon, 2021**). Food handlers must maintain high levels of food hygiene and sanitation to avoid microbial contamination of food (**Maragoni-Santos et al., 2022**).

Outbreaks of foodborne illnesses can result in significant health issues and fatalities among the population, ultimately leading to higher hospitalization expenses for public health agencies (**Abdelwahed et al., 2022**). When a foodborne disease outbreak occurs, the government incurs expenses by paying health institutions to address the problem (**Chenarides et al., 2021; Teffo & Tabit, 2020**). Inadequate food handling procedures have been linked to low levels of food safety knowledge among food handlers (**Buheji, 2020**). According to the European Food Safety Authority, food services in food premises accounted for roughly 48.7% of foodborne illnesses in 2019 (**Buheji, 2020**). Disease Control and Prevention (CDC) estimates that there are around 48 million cases of foodborne illness yearly, resulting in the loss of 33 million healthy life years (**Abdelwahed et al., 2022**).

Food handlers play a significant role in food contamination (**Sharma et al., 2021**). In Tanzania, monthly reports have highlighted cases of food-related illnesses in key urban regions, particularly focusing on diarrhea and cholera. These cases have been linked to hygiene issues and unsanitary conditions associated with food vending practices (**URT, 2017**). The criticism has focused on the practices of street vendors regarding how they prepare, serve, and store food (**Juma et al., 2018**). This study aimed to assess the knowledge and food handling practices related to food safety among food handlers in three university communities in Iringa, Tanzania. By identifying gaps in knowledge and practices, the research sought to inform educational interventions to improve food safety standards in these environments.

MATERIALS AND METHODS

Study area

The study took place in three university communities in the Iringa municipal council of Tanzania, including Ruaha Catholic University (RUCU), Mkwawa University College of Education (MUCE), and the University of Iringa (UoI). These higher education institutions serve around 16,520 students in need of food services from both on-campus facilities and off-campus food handlers in the surrounding areas. Iringa municipal council is the region's administrative capital, characterized by its urban nature. According to the 2022 census, the municipality has a population of 202,490 residents. Geographically, it is bordered by the Iringa Rural and Kilolo district councils, located between latitudes 7.7° to 7.875° south of the Equator and longitudes 35.620° to 35.765° east of the Greenwich Meridian (Mbunda et al., 2023; Ntungwa et al., 2024).

Study design and population

A cross-sectional descriptive study was conducted from June to July 2024 to assess the knowledge and observed handling practices related to food safety. This study examined food handlers responsible for providing food services both on-campus and in the surrounding areas of the university communities.

Sample size and sampling procedures

In light of the limited population of food handlers across the three university campuses, a convenience sampling method was employed to identify and recruit participants. This approach facilitated the selection of 56 readily available individuals who met the necessary criteria for inclusion in the study. By utilizing convenience sampling, the research effectively maximized the participation rate while acknowledging the limitations inherent to this method.

Data collection

The study utilized structured questionnaires and observations to systematically collect data regarding participants' comprehension of food safety principles. The questionnaires featured 20 multiple-choice questions with three options each, where respondents were required to select the most appropriate answer for knowledge assessment. In addition to the questionnaire data, 12 food handling practices were evaluated through direct observation, allowing for a comprehensive assessment of actual behaviors by indicating "YES" if performed and "NO" if not performed. This multifaceted approach aimed to identify knowledge and practice gaps, ultimately contributing to enhanced food safety education and interventions within the community.

Data analysis

Data analysis was conducted using version 26 of the Statistical Package for Social Sciences (SPSS). This analysis examined frequencies and percentages, as well as descriptive statistics related to the knowledge and observed practices of food handlers assessed in the study.

Definitions and scoring

Participants who scored 60% or higher on the food safety knowledge questionnaire were considered to have adequate knowledge, indicating a good understanding of the subject. Those who scored below 60% were classified as having inadequate knowledge, revealing their understanding gaps. Food handlers were considered to demonstrate adequate practices when they exhibited safe and appropriate food handling behaviors in 60% or more of the observed practices. Conversely, they exhibited inadequate practices when such observed behaviors received a score of less than 60%.

Ethical considerations

Ruaha Catholic University (RUCU) has granted ethical approval for this research, referenced as RU/RPC/RP/2024/11. Permission to conduct research within the premises of the three universities was authorized by the offices of the deputy vice-chancellors for academics. Additionally, the director of the Iringa Municipal Council approved the collection of data in the off-campus surrounding areas. Informed consent was obtained from all participants involved in the study. All data collected were managed with the utmost regard for confidentiality, ensuring that no personal information was disclosed.

RESULTS AND DISCUSSION

RESULTS

Demographic characteristics of food handlers

Concerning demographic characteristics of food handlers (N = 56) across various categories, age distribution indicates that the majority, 24 (42.9%), were aged 18-25 years, followed by 16 (28.6%) of food handlers aged 26-35 years. Regarding gender, there is a predominant female presence: 38 (67.9%) compared to males 18 (32.1%). Concerning education, most food handlers, 18 (32.1%), had college or university education, followed by secondary education, 17 (30.4%).

Work experience varies, with 23 (41.1%) having 1-3 years of experience and 14 (25%) having less than a year. A high training rate in food hygiene is observed, with 43 (76.8%) of respondents having received training. Employment status primarily consists of full-time positions: 47 (83.9%). Finally, 46 (82.1%) food handlers work in off-campus cafeterias, while 30 (53.6%) work for more than 10 hours per day, as shown in **Table 1**.

Table 1: Demographic characteristics of food handlers (N = 56)

Demographic characteristics	Frequency (n)	Percent (%)
Age		
18-25 years	24	42.9
26-35 years	16	28.6
36-45 years	10	17.9
46-55 years	6	10.7
Gender		
Male	18	32.1
Female	38	67.9
Education level		
No formal education	4	7.1
Primary education	14	25
Secondary education	17	30.4
Vocational training	3	5.4
College or university	18	32.1
Work experience		
Less than 1 year	14	25

1-3 years	23	41.1
4-6 years	6	10.7
7-10 years	8	14.3
More than 10 years	5	8.9
Training in food hygiene		
Yes	43	76.8
No	13	23.2
Employment status		
Full-time	47	83.9
Part-time	9	16.1
Cafeteria location		
On-campus cafeteria	10	17.9
Off-campus cafeteria	46	82.1
Working hours per day		
Less than 8	4	7.1
8-10	22	39.3
More than 10	30	53.6

Distribution of knowledge among food handlers

Table 2 highlights the distribution of knowledge among food handlers concerning food safety practices. Among the questions with the highest correct responses, the question concerning common symptoms associated with foodborne illness received an impressive 55 (98.2%) correct answers, indicating that almost all respondents knew the signs of foodborne illnesses. Additionally, 54 (96.4%) respondents correctly identified the main reason for checking the expiration dates on food products. Similarly, 51 (91.1%) food handlers knew the best way to dry hands after washing them.

Conversely, there are notable gaps in knowledge among food handlers regarding certain critical aspects of food safety. Only 9 (16.1%) respondents correctly answered the proper way to thaw frozen food. Additionally, 15(26.8%) responded correctly concerning the ideal temperature for storing perishable foods in a refrigerator. Lastly, 24 (42.9%) food handlers correctly recognized the maximum time perishable food should be left at room temperature.

Table 2: Distribution of knowledge among food handlers

Knowledge questions	Knowledge responses	
	Correct n (%)	Incorrect n (%)
What is the main reason for washing hands before handling food?	48 (85.7)	8 (14.3)
What is the ideal temperature for storing perishable foods in a refrigerator?	15 (26.8)	41 (73.2)
What is cross-contamination?	42 (75.0)	14 (25.0)
Which practices help prevent foodborne illnesses?	46 (82.1)	10 (17.9)
Which symptom is commonly associated with foodborne illness?	55 (98.2)	1 (1.8)
What is the proper way to thaw frozen food?	9 (16.1)	47 (83.9)
Why is it important to keep raw meat separate from other foods?	49 (87.5)	7 (12.5)
What is the most effective way to kill bacteria in food?	44 (78.6)	12 (21.4)

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What is the maximum time perishable food should be left out at room temperature?	24 (42.9)	32 (57.1)
Why should you avoid using the same cutting board for raw meat and vegetables?	49 (87.5)	7 (12.5)
How can you ensure that leftovers are safe to eat?	39 (69.6)	17 (30.4)
Which practice is not recommended for maintaining kitchen hygiene?	43 (76.8)	13 (23.2)
What is the danger of not cooking food to its recommended temperature?	41 (73.2)	15 (26.8)
What is the most common cause of foodborne illnesses?	39 (69.6)	17 (30.4)
How can you tell if food has gone bad?	49 (87.5)	7 (12.5)
Why is it important to wear gloves when handling ready-to-eat food?	40 (71.4)	16 (28.6)
How often should food handlers wash their hands?	49 (87.5)	7 (12.5)
What is the best way to dry hands after washing them?	51 (91.1)	5 (8.9)
What should be done with food that has been left out overnight?	32 (57.1)	24 (42.9)
Why is it important to check the expiration dates on food products?	54 (96.4)	2 (3.6)

Observed practices among food handlers

Among the observed practices, the three highest scores reveal a positive trend in food hygiene practices. The highest compliance was seen in handwashing before starting work, with 48 (85.7%) food handlers adhering to this essential practice. Additionally, 40 (71.4%) food handlers were recognized for their overall cleanliness. Lastly, 37 (66.1%) food handlers maintained clean and hygienic fingernails, crucial for preventing contamination during food handling.

Conversely, the three lowest scores indicate critical areas needing improvement. Only 4 (7.1%) food handlers were observed wearing gloves while handling ready-to-eat food, showing a concerning disregard for cross-contamination prevention. Similarly, 10 (17.9%) food handlers had access to handwashing facilities equipped with soap and paper towels, which impedes their ability to maintain proper hygiene. Furthermore, the practice of washing hands after handling money or touching the face had a low compliance rate of 11 (19.6%) food handlers, signifying a potential risk to food safety, as described in **Table 3**.

Table 3: Observed food handling practices among food handlers

Observed practices	Practice responses	
	Yes n (%)	No n (%)
Washing hands before starting work	48 (85.7)	8 (14.3)
Washing hands after handling raw food	30 (53.6)	26 (46.4)
Washing hands after handling money or touching their face	11 (19.6)	45 (80.4)
Handwashing facilities equipped with soap and paper towels	10 (17.9)	46 (82.1)
Wearing clean and appropriate protective clothing	33 (58.9)	23 (41.1)
Wearing gloves when handling ready-to-eat food	4 (7.1)	52 (92.9)
Wearing hairnets or other hair coverings	26 (46.4)	30 (53.6)
Removing jewelry and accessories before food handling	16 (28.6)	40 (71.4)
Overall cleanliness of food handler satisfactory	40 (71.4)	16 (28.6)
Using designated utensils or tools for handling food	29 (51.8)	27 (48.2)
Maintaining clean and hygienic fingernails	37 (66.1)	19 (33.9)
Proper procedures for cleaning and sanitizing surfaces and equipment	37 (66.1)	19 (33.9)

Knowledge and practice levels among food handlers

The **Figure** presents the knowledge and practice levels among food handlers. It indicates that a significant majority, 85.7%, possess adequate knowledge regarding food safety, while only 14.3% display inadequate knowledge. However, when it comes to actual practices, only 21.4% of food handlers demonstrate adequate practice levels, while the majority, 78.6%, demonstrated inadequate practices, suggesting a substantial gap between knowledge and food handling practices.

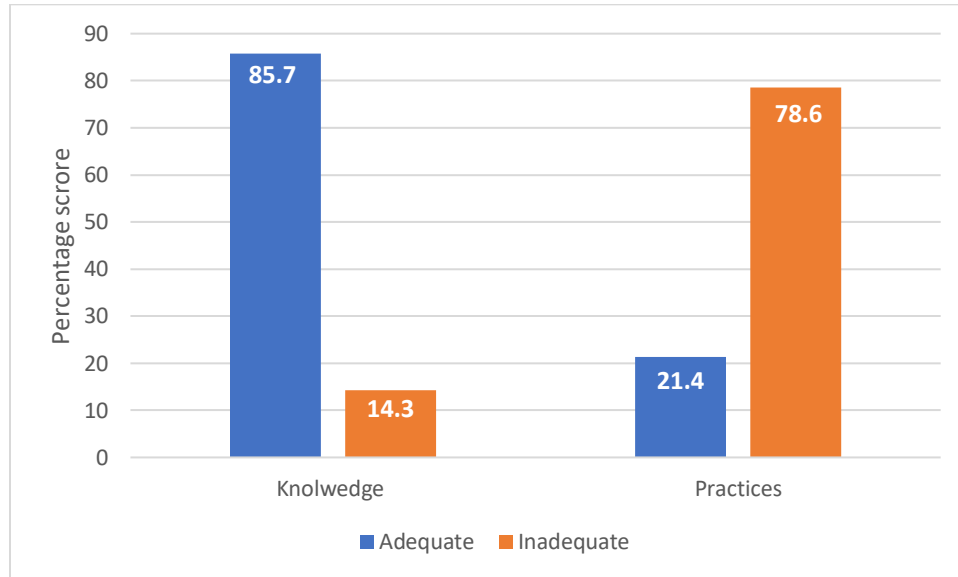


Figure: Knowledge and practice levels among food handlers

Descriptive Statistics of knowledge and practices

Table 4 provides a comprehensive overview of the descriptive statistics pertaining to knowledge and practice scores obtained from a sample of 56 participants. The knowledge score exhibited a minimum value of 40 and a maximum value of 90, resulting in an average (mean) score of 73.1%. The standard deviation for the knowledge scores was 12.2, which indicates an adequate level of knowledge among participants, accompanied by some degree of variability in the scores.

Regarding the practice scores, they ranged from a minimum of 8.3 to a maximum of 83.3, with an average (mean) score of 47.8%, indicating inadequate practice. The standard deviation of 17.2 further illustrates the variability in practice scores among participants, indicating that the scores are distributed over a wider range.

Table 4: Descriptive statistics of knowledge and practices in percentage scores

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Knowledge score	56	40	90	73.1	12.2
Practice score	56	8.3	83.3	47.8	17.2

DISCUSSION

The average knowledge score among food handlers was 73.1%, indicating an adequate understanding, while the average practice score was 47.8%, highlighting inadequate practice. Additionally, 85.7% of all food handlers demonstrated adequate knowledge, whereas only 21.4% exhibited adequate practices. These results are consistent with another Tanzanian study which revealed that while food handlers had a reasonable understanding of food safety, their actual practices were suboptimal, indicating a significant gap between knowledge and practice (**Magambo et al., 2023**).

Furthermore, the study conducted by **Ma'mun et al., 2019** found that while food handlers in a public university in Bangladesh had a good level of knowledge regarding personal hygiene, their actual hygiene practices were significantly lower, particularly among those with less education and younger age groups. This aligns with the findings of **Yildirim et al., 2020** who revealed that food handlers reported inadequate food safety practices despite their good knowledge.

Contrastingly, **Bulto et al.** reported a more favorable scenario in Addis Ababa, Ethiopia where food handlers in a student cafeteria demonstrated adequate practices and knowledge, with 70.6% achieving satisfactory scores in food safety practices and 57.94% in knowledge scores (**Bulto et al., 2022**). The results align with a separate study carried out in Debre Markos, Northwest Ethiopia, which found that 34.1% of food handlers demonstrated a strong understanding of food safety, while 72% practiced good food hygiene and safety measures in food establishments (**Alemayehu et al., 2021**).

In a similar study carried out in the Sohag Governorate of Egypt, it was found that 56.3% of food handlers demonstrated good food safety practices, and 39.2% exhibited a solid understanding of food safety principles (**Hamed et al., 2020**). Further supporting the notion of a knowledge-practice gap, **Hardiah et al.** indicated that there was no significant correlation between knowledge and hygiene behavior among food handlers, suggesting that high knowledge levels do not necessarily translate into improved practices (**Hardiah et al., 2020**).

This recent study indicated a notable high level of awareness among food handlers in some assessed aspects, with 98.2% recognizing common symptoms associated with foodborne illnesses, which aligns with findings from **Rodrigues et al.** among food handlers in Brazil (**Rodrigues et al., 2023**). In contrast, some studies reveal a concerning gap in knowledge, **Lee et al.** found that food handlers demonstrated poor knowledge of foodborne pathogens, with only 19.6% understanding the risks associated with improper food handling (**Lee et al., 2017**).

Moreover, in this study, 96.4% of respondents recognized the importance of checking expiration dates, aligning with **Tuncer and Akoğlu's** findings that proper food handling practices, including checking expiration dates, are crucial for preventing foodborne illnesses (**Tuncer & Akoğlu, 2020**). The study found that 91.1% of food handlers are aware of proper hand drying methods, supporting **Chen et al.** on the importance of hand hygiene to prevent foodborne outbreaks (**Chen et al., 2016**). However, **Sharma et al. (2021)** reported that many food handlers still practice inadequate hand hygiene, highlighting the need for ongoing training and reinforcement of best practices.

Low compliance rates among food handlers regarding critical hygiene practices reveal areas for improvement in food safety. Notably, only 7.1% wore gloves while handling ready-to-eat food, a key measure to prevent cross-contamination. This aligns with **Oliveira et al.**

highlighting inadequate glove-wearing practices and the need for improved adherence to hygiene protocols (**Oliveira et al., 2021**). In contrast, a study by Malavi et al. found that food safety training significantly improved glove-wearing practices among handlers, suggesting that educational interventions can enhance compliance (**Malavi et al., 2021**).

Similarly, the availability of handwashing facilities is critical for maintaining hygiene. This study reported that 17.9% of food handlers have access to handwashing facilities equipped with soap and paper towels, which is alarmingly low. This aligns with findings from Endalew et al. who noted that limited access to handwashing facilities was a significant barrier to proper hygiene practices in sub-Saharan Africa (**Endalew et al., 2022**). Conversely, Mwishingo's study demonstrated that the introduction of a structured Water, Sanitation, and Hygiene (WASH) program significantly increased handwashing behavior, indicating that improved infrastructure can lead to better hygiene practices (**Mwishingo, 2024**).

Furthermore, the low compliance rate of 19.6% for washing hands after handling money or touching the face is concerning. This finding is echoed in the research by Yenealem et al. which highlighted that many food handlers fail to wash their hands at critical times, including after handling money (**Yenealem et al., 2020**). Additionally, a study by Amegah et al. found that food handlers who received food safety training reported significantly better hand hygiene practices, suggesting that education can effectively improve compliance (**Amegah et al., 2020**).

CONCLUSION

The study highlights a significant disparity between knowledge and actual practices among food handlers. While the majority (85.7%) demonstrate adequate knowledge regarding food safety, this understanding does not translate into corresponding behaviors, as only 21.4% exhibit adequate food safety practices. The high awareness of common foodborne illness symptoms suggests that food handlers are informed about basic food safety concepts; however, critical gaps in knowledge regarding specific safe handling practices, such as thawing methods and storage temperatures, indicate a need for targeted educational interventions.

Moreover, the observed practices reveal essential areas that require improvement, particularly in adherence to protocols aimed at preventing cross-contamination, such as wearing gloves when handling ready-to-eat foods. The study underscores the necessity for ongoing training and reinforcement of food safety practices among food handlers to bridge the gap between knowledge and practice, ultimately enhancing food safety standards and reducing the risk of foodborne illnesses. Implementing regular workshops and practical demonstrations could effectively bolster safe handling practices and ensure that knowledge is not only acquired but actively applied in food handling environments.

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