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FOOD SAFETY KNOWLEDGE, ATTITUDES, AND PRACTICES OF FOOD HANDLERS AT SENIOR HIGH SCHOOLS IN THE TAMALE METROPOLIS.

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BY

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DECLARATION

Student's Declaration

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this University or elsewhere.

Mariama Bukari ....

(Student) **Signature** **Date**

Supervisor's declaration

I hereby declare that the preparation and presentation of the thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast (UCC)

Prof. (Mrs.) Sarah Darkwa …...…….…… …..…….

(Supervisor) **Signature** **Date**

ABSTRACT

Food safety is critical in institutions that serve large numbers of people on a daily basis. The purpose of the study was to examine the knowledge, attitudes, and practices of food handlers regarding food safety procedures in Senior High Schools in the Tamale Metropolis. Additionally, the study evaluated the relationship among food safety knowledge, attitudes and practices of food handlers. A cross-sectional survey design was employed and a questionnaire and observation checklist were used to gather data from 131 respondents in the schools. The study tested four hypotheses and used a one-sample t-test and Pearson Moment correlation to determine the statistical significance and relationships among the variables. Findings revealed a statistically significant difference in knowledge levels among food handlers at ($P \leq 0.05$), with 92.4% demonstrating high knowledge and 7.6% exhibiting low knowledge. There was also a statistically significant difference in attitudes towards food safety, with most food handlers displaying a positive attitude. Furthermore, food safety practices of the respondents significantly differed, with 77.1% demonstrating good practices and 22.9% exhibiting poor practices. Finally, the study established strong positive correlations among the knowledge, attitudes, and practices of food handlers. The study also found that a significant number of food handlers in the schools lacked formal education or certification in food safety training, which may explain the differences in food safety knowledge, attitudes, and practices among the respondents. Policymakers should therefore implement mandatory food safety training and certification for all school food handlers.

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DEDICATION

I dedicate this work to my beloved family.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

Background to the Study

A healthy food is essential for every living organism, especially humans, and it comes from safe food or ensuring appropriate food safety measures such as its production, preparation, and consumption, which are all important for the sustenance of life (Daniyan & Nwokwu, 2011 as cited in Appietu & Amuquandoh, 2020). "The current diets are resulting in premature mortality and susceptibility to both chronic and infectious diseases, and to ensure a healthy future for both people and planet, the growing population must be fed in a manner that is healthy, equitable, and sustainable" (UN/DESA, 2021). The concept of food safety is therefore relevant, as it helps protect consumers from the risk of foodborne diseases. "The wide attention given to food safety is also due to the upward trends in foodborne illness incidence rates over the past years, both locally and internationally" (Abdul-Mutalib et al., 2015). According to global estimates, "consumption of contaminated food causes 600 million people to fall sick, 549 million to get diarrhoea, and 420,000 die annually" (World Health Organization, 2015). Scallan et al. (2011), for example, state that "about 9.4 million episodes of foodborne illness in the United States were caused by 31 major pathogens, which led to 55961 hospitalizations and 1351 deaths". Similarly, "foodborne illnesses are common in Ghana, with 420,000 cases reported per year and an annual death rate of 65,000, costing US$69 million to the Ghanaian economy" (Mahami & Odonkor, 2012). The aforementioned

information indicates that foodborne infections are common, persistent, and associated with a high rate of morbidity and deaths.

According to Singh et al. (2011), "food is considered safe when it is free from chemical, biological, or physical hazards that may result in illnesses or even death for consumers". They further state that contamination of food in any food production chain can occur at any stage of the process before reaching the end consumer. Thus, it is important to prevent food contamination in the production process, especially when food is produced in large quantities or for mass consumption. Adhering to recommended food safety practices is crucial for ensuring that food remains free from contamination. According to Scallan et al. (2011), food safety refers to "conditions and measures that are necessary along the food production chain to ensure that it is safe, sound, and fit for human consumption". Also, Klimpel et al. (2019) state that, "food safety issues have been a worldwide problem as a large population of people are affected by foodborne and health-related complications". Food contamination offers risks to the whole public, particularly to vulnerable populations including newborns and young children, the elderly, and people with immunodeficiency disorders (Singh et al., 2011). This highlights the importance of food safety. Globally, investigations of food contamination reveal that normal food safety precautions are not followed satisfactorily during food processing (Tomohide, 2010, as cited in Appietu, 2018). It has also been reported that "more than 250 different illnesses are caused by eating food contaminated with potential pathogens such as bacteria, viruses, parasites, and toxins" (WHO, 2014). Baluka Miller, & Kaneene (2015),

reemphasize that "appropriate food safety practices in food service establishments play a role in preventing the occurrence of incidences of food-borne diseases". Improper food handling and inadequate hygiene practices can lead to pathogens contaminating food. This can result in their proliferation, potentially causing illness or even death, especially in individuals with weakened immune systems (Mellou et al., 2013). Making sure that food is safe is crucial both at home and in large-scale food service facilities where food is prepared and served. Research by Afolaranmi et al. (2015) found that many food handlers in a variety of food service environments lack basic food safety knowledge and skills, such as controlling temperature, maintaining personal hygiene, and preventing cross-contamination. Inadequate knowledge and improper food handling practices among handlers, combined with a lack of awareness about their potential risks associated with foods could explain the health and safety concerns posed by food handlers. While many instances of "foodborne illness have been linked to factors like improper cooking, temperature abuse, the use of contaminated raw ingredients, and cross-contamination between raw and cooked foods, food contact surfaces have also emerged as a significant risk factor" (Boro et al., 2015; Nhlapo et al., 2014). "Cross-contamination is often associated with contamination of dishes or surfaces with washing water, contaminated cloths and sponges, or contaminated items placed in contact with them" (Rossi et al., 2013). WHO (2015) states that "foodborne illness results from consuming food contaminated with microorganisms or their toxins, as well as from cross-contamination caused by enterotoxigenic staphylococci due to poor handling practices or from

infectious food handlers". The importance of addressing food safety issues related to foodborne diseases stems from both the direct health and economic burdens they impose, as well as their indirect impact on development and productivity. Schools have been recognized as establishments with high food safety risks (Da-Cunha, Stedefeldt, & De Rosso, 2012). Schoolchildren are mostly at risk of foodborne diseases in their early years, as their immune systems might either be underdeveloped or compromised due to other health conditions (Scallan et al., 2011). Additionally, Mellou et al. (2013) argued that even a few enteric pathogens, typically harmless to most healthy individuals, can lead to illness and possibly fatal outcomes in children, particularly those with weakened immune systems.

School feeding programmes are increasingly being adopted by many countries as a policy intervention aimed at solving hunger, improving nutrition, and addressing the long-term educational needs of pupils. However, the World Food Programme (2013) contends that 'implementation of school feeding policy demands significant institutional capacity for effective management, and governments frequently underestimate the resources required to run a successful and efficient school feeding programme'. As a result, governments frequently face difficulties in ensuring food safety within these programmes (Abushelaibi et al., 2016).

Preventing food contamination in schools is therefore crucial. WHO (2014) highlighted that training food handlers in food safety practices is essential for safeguarding public health. It emphasizes that enhancing food handlers'

knowledge and practices through education and training is necessary to prevent and control food contamination. Similarly, Lazarevic et al. (2013) argue that "training food handlers in food safety and hygiene is vital, as it plays a significant role in reducing food poisoning by ensuring the production and distribution of safe food". This suggests that proper training can enhance awareness of food safety principles, thereby helping to maintain food safety.

Despite the presence of standards, regulations, training, and regulatory bodies, incidents of food-borne illnesses are still being recorded in countries worldwide, both in developed and developing countries. According to Moyce and Schenker (2018), an individual's behavioural intention, influenced by their perception of behavioural control, is the most significant predictor of their actions in a given situation. This implies that people are more likely to engage in certain behaviours if they are motivated by anticipated benefits. Consequently, each observable behaviour can be attributed to a specific controlling factor, as well as its origin and underlying cause. Therefore, according to Akabanda, Hlortsi, & Owusu-Kwarteng (2017), it is crucial for individuals handling food to develop accurate understandings of food hygiene practices to minimise the chances of food-related infections. Consequently, individuals are less likely to engage in actions that they perceive as unachievable; instead, their perception of carrying out a task may be affected by factors such as limited resources, time limitations, or conflicting professional obligations. In an effort to understand the factors influencing food handlers' adherence to food safety protocols in food facilities, Krishnamurthy et al. (2020) conducted observations and interviews. The study

revealed that employees displayed varying rates of non-compliance with food safety standards, mostly in areas such as personal hygiene, cleaning, and sanitization procedures. It was observed that while employees made efforts to maintain good hand hygiene, they did not fully meet the criteria outlined in the 2005 food code. The employees expressed their commitment to following recommended practices in order to prevent bacterial growth, minimize cross-contamination, safeguard consumers, and meet legal, regulatory, and procedural obligations.

Furthermore, their participation in adhering to food safety practices was influenced by various factors such as receiving information and instructions, positive reinforcement, cultivating strong work habits, fostering a workplace culture, and ensuring customer satisfaction (Krishnamurthy et al., 2020). Krishnamurthy et al. (2020 also identified six key barriers that impede the effective implementation of food safety practices. These barriers include forgetfulness, demanding work schedules, lack of or insufficient information, perceived drawbacks of complying with safe food practices, limited resources, and the existing workplace culture. Therefore, it is crucial for managers to continuously promote and prioritize safe food handling procedures, address these barriers, utilize the identified motivators, and create an environment where food safety is a top priority.

Additionally, a research team from Kansas, Missouri, and Iowa in the United States found that “inadequate training on food safety guidelines and practices was a major obstacle to achieving compliance with food safety

regulations". This finding emerged from their investigation into interventions aimed at improving restaurant employees' adherence to food safety protocols (Taylor, Klaiber. & Kuchler, 2016). Similarly, an examination of food handlers' views on handwashing practices in restaurants revealed several barriers, including a lack of supplies and sinks, insufficient accountability, heavy workloads and stress, the type of facility, time constraints, and inadequate training in food handling and safety (Ababio & Lovatt, 2015).

In light of limited resources, a shortfall in awareness, and ineffective enforcement of regulations by the government, Handford, Elliott, and Campbell (2015) discovered that 60% of food handlers in Ghana did not possess certificates for medical examinations. Similarly, in discussing the challenges encountered in implementing food safety protocols, Manning (2018) corroborated Handford, Elliott, and Campbell's (2015) findings by identifying factors such as inadequate equipment and resource allocation, inadequate management of legal compliance, and insufficient education and training in food safety as obstacles to effective food safety procedures. Consequently, these aforementioned factors hinder the capacity of food handlers to follow correct food safety protocols.

Statement of the Problem

The World Food Programme (WFP) has revealed that "school feeding policies, implemented in both developed and developing countries, have been effective in increasing and maintaining school enrollment rates and addressing malnutrition among low-income families". The adoption of school feeding programme as a strategy to tackle hunger, improve nutrition, and meet the

extended educational needs of schoolchildren is becoming more common globally (WFP, 2013). Ensuring food safety during the transportation, storage, preparation, and serving of food is essential for the success of these programmes. The WFP notes that "while school feeding programmes require significant institutional capacity to operate effectively, they are often initiated without adequate resources for daily management" (WFP, 2013). In a school setting where thousands of students receive meals daily, a foodborne illness outbreak could lead to widespread illness or even fatalities, with serious legal and financial repercussions (WFP, 2013). Food contamination in schools can result in severe health issues, high medical costs, and the transmission of infections among students and staff, disrupting the learning environment (Scharff, 2012). "Many foodborne disease outbreaks are caused by cross-contamination during food preparation in food service facilities" (Smigic et al., 2016), which is a common issue in schools (Sanlier & Konaklioglu, 2012). In school settings, pupils with vulnerable immune systems are particularly at risk of foodborne illnesses due to their less developed immune defenses (Burke, Young, & Papadopoulos, 2016). Therefore, it is crucial for food handlers in schools to have strong knowledge, positive attitudes, and effective food safety practices to prevent contamination. According to the FDA (2013), schools account for a significant proportion of food establishments linked to "77% of all traceable foodborne diseases in Ghana". Despite numerous media reports on foodborne illness outbreaks in schools, there is often more emphasis on issues within the commercial food sector, particularly street foods and vendors (Ababio & Lovatt, 2015).

Recently, some schools in the northern regions of Ghana have also had students' embarking on violent protests over being fed poor quality food, expired food products, and water problems, among others (GNA, 2022). In 2012, over 20 students from Tamale Girls International School were hospitalized due to consuming contaminated food and water (Zaa-Multimedia, 2012). Similarly, on February 20, 2022, “students at Savelugu Senior High School protested against the administration, alleging they were being served expired milk and tinned fish”(Myjoyonline, 2022). These incidents highlight concerns about the food handlers' knowledge, attitudes, and practices regarding food safety in secondary schools. These incidents highlight concerns about the food handlers' knowledge, attitudes, and practices regarding food safety in secondary schools. Appietu (2018) recommends that “training for food handlers in Senior High Schools (SHS) in Ghana be prioritized to enhance food safety practices”. Additionally, more rigorous supervision of food preparation processes by relevant authorities and school management is needed to prevent future outbreaks of foodborne illnesses.

For the purpose of implementing the above recommendations, it is imperative to regularly carry out research on food safety issues in educational institutions where students are being fed, and it is even more necessary when events of students rioting as a result of being fed poor-quality food and expired food products are being reported. Although there are various studies conducted in some parts of Ghana on food handlers’ knowledge, attitudes, and food safety practices in SHS, such as Kunadu et al. (2016), Akabanda, Hlortsi, & Owusu-Kwarteng (2017), and Madilo, Letsyo, & Klutse (2022), no study of such kind has

been done in recent times in the Northern region of the country. To fill this research gap existing in the northern setting, this study therefore sought to assess food handlers' knowledge, attitudes, and practices of food safety in SHS in the Tamale metropolis. In addition, the recent reports (GNA, 2022) on food safety issues in some schools in the Northern region also point to the need to examine the food handlers' knowledge, attitudes, and practices in the region. Finally, based on the fact that thousands of students are fed meals prepared by these food handlers in SHS, special attention must be given to the knowledge, attitudes, and food handling practices of these food handlers through regular research.

Purpose of the Study

The purpose of the study was to examine the level of knowledge, attitudes, and practices of food safety procedures among food handlers in the senior high schools in Tamale Metropolis.

Objectives

This study sought to:

1. assess food handlers' knowledge in food safety.
2. identify food handlers' attitudes towards food safety.
3. examine food safety practices of the food handlers.
4. evaluate the relationship between food safety knowledge, attitudes and practices of food handlers.

Hypotheses

H_o1: Food handlers do not have significantly high knowledge of food safety

H_o2: Food handlers do not have a significantly positive attitude toward food safety.

H_o3: Food handlers do not exhibit significantly high levels of food safety practices

H_o4: There is no significant correlation between knowledge, attitudes, and practices of food handlers.

Significance of the Study

The findings hopefully will be valuable to policymakers, stakeholders, and researchers in the following ways: First, the findings gathered from the study will serve as a basis to sensitize food handlers and managers in schools towards specific food safety needs. This will facilitate the implementation of corrective and preventive measures to enhance safe food handling practices in schools. This study will also help institutional heads and hospitality educators understand the possible current state of food safety in their institutions to guide training and development programmes designed for food handlers. Furthermore, policymakers will gain a more profound understanding of the current obstacles affecting the implementation of food safety principles in schools. The findings of this study can assist Food Safety Regulatory Authorities in developing or altering policies to facilitate safe food supply in schools. Finally, the findings will also serve as the basis for further research on food safety in schools.

Limitations of the Study

While this study has contributed valuable insights into the food safety knowledge, attitudes, and practices of food handlers in Senior High Schools

within the Tamale Metropolis, it is important to acknowledge several limitations that may have influenced the findings and interpretations.

Firstly, the study relied heavily on self-reported data collected through questionnaires. This method is inherently subject to social desirability bias, where respondents may overstate their level of knowledge, attitudes, or good practices in order to present themselves in a more favorable light. Such bias could result in discrepancies between what was reported and the actual behaviors of the food handlers.

Secondly, the scope of the study was limited to public Senior High Schools in the Tamale Metropolis. As a result, the findings may not be fully generalizable to private schools or to other regions of Ghana, particularly areas with different socio-cultural contexts, institutional arrangements, or levels of resource availability. This geographical and institutional limitation may affect the broader applicability of the study's recommendations.

Additionally, the cross-sectional nature of the research design limits the ability to establish causality among the variables studied. Although the study revealed significant relationships between knowledge, attitudes, and practices, it cannot conclusively determine whether one variable causes change in another. Longitudinal studies would be more appropriate for examining such causal links over time.

The study also employed an observation checklist to validate some of the self-reported data. However, the presence of the observer may have influenced the behavior of food handlers, leading them to temporarily alter their practices during

the assessment period. This phenomenon, commonly referred to as the Hawthorne effect, may have introduced artificial improvements in observed food safety practices that do not reflect everyday routines.

Furthermore, the study excluded certain categories of food handlers, specifically national service personnel and student interns who assist in food preparation under the supervision of staff. Their exclusion may have resulted in the omission of important insights into the broader food handling environment within the schools, especially given that these individuals may be responsible for carrying out many day-to-day food-related tasks.

Another limitation lies in the limited exploration of training variables. While the study identified a lack of formal education or certification among some food handlers, it did not delve deeper into the quality, frequency, or duration of training programs previously attended. Understanding these training dimensions would have provided a more nuanced view of the knowledge and practice gaps identified.

Finally, language and literacy challenges may have posed a barrier for some respondents when completing the questionnaire. In cases where food handlers had limited literacy skills or difficulty understanding certain terms, their responses may not have accurately reflected their true knowledge or attitudes.

Despite these limitations, the study provides a useful foundation for understanding food safety behavior among institutional food handlers and highlights areas where policy intervention and further research are needed.

Delimitation of the Study

This study aimed to provide a comprehensive overview of the food safety knowledge, attitudes, and practices among food handlers in senior high schools within the Tamale Metropolis. The study concentrated on food handlers in all the public SHS schools. However, national service personnel and students on internship as food handlers were excluded because they work under the supervision of staff food handlers in the schools.

Organization of the Study

The study was structured into five chapters. The first chapter introduces the study, outlining the background, problem statement, objectives, hypotheses, significance, and delimitation of the study. The second chapter reviews relevant literature, covering conceptual, theoretical, and empirical perspectives on food safety knowledge, attitudes, and practices among food handlers. The third chapter details the research methodology, including the research design, population, sampling techniques, and procedures for data collection and analysis. The fourth chapter presents and discusses the research findings. Chapter Five concludes the study by summarizing the results, drawing conclusions, and offering recommendations.

CHAPTER TWO

LITERATURE REVIEW

Overview

This chapter reviewed literature on various aspects of food safety, including the concept of food safety, regulations and guidelines governing food safety, issues of food contamination and foodborne illnesses in Ghana, the existing food safety systems in the country, as well as the laws and standards pertaining to food safety. It also looks at what food handlers know about food safety, their attitude towards food safety, and what they do to make sure food is safe. It finally looks at theoretical issues and models that support the study

Definition of Key Concepts

Food Safety: Food safety is described as the scientific discipline and practical measures aimed at ensuring that food is safe for consumption by preventing, reducing, or eliminating risks, hazards, or contaminants that may cause harm to human health. It involves the handling, preparation, storage, and distribution of food in a way that lessens the likelihood of foodborne illnesses and other adverse health effects (Manning, 2018).

Food Handling: Food handling involves individuals who directly handle, prepare, or serve food in various food service establishments or food-related industries. Food handlers can be found in restaurants, cafeterias, catering companies, food processing facilities, food retail stores, and other similar settings. On the other hand, a food handler is someone who works in the food business and comes into close contact with food or things like silverware and plates that are

expected to come into contact with food. A person who works with food may perform activities including cutting, cooking, chilling, packaging, transporting, serving food, or cleaning the workspace and equipment (Faour-Klingbeil, Kuri,& Todd 2015).

Hazard Analysis and Critical Control Points (HACCP): HACCP, according to Al-Busaidi and Jukes (2017), is an orderly style used to find, assess, and control hazards at unalike phases of food manufacturing and processing. It includes detecting critical control points (CCPs) where hazards can be stopped, excluded, or brought to acceptable altitudes.

Good Manufacturing Practices (GMPs): GMPs can be seen as a set of guidelines as well as practices which ensure that production, handling, and storage of food are carried out in a hygienic and safe manner. GMPs cover areas such as personnel hygiene, sanitation, facility design, equipment maintenance, and pest control (Seidu, 2020).

Foodborne illness: foodborne illnesses are illnesses caused by consuming contaminated food. Understanding the causes, symptoms, and prevention of foodborne illnesses is essential for food safety. Common causes include bacteria (such as Salmonella and E. coli), viruses, parasites, and toxins produced by microorganisms (Rahman et al., 2012).

Cross-Contamination: Cross-contamination happens when injurious microorganisms or contaminants are moved from one food item to another, usually with direct contact or via unclean surfaces, utensils, or hands. Proper

handling practices, including separate storage of raw and cooked foods and proper cleaning and sanitization, are necessary to prevent cross-contamination.

Food Safety Culture: The culture of food safety refers to the shared values, beliefs, and behaviours related to food safety within an organization or community (Moyce & Schenker, 2018). It emphasizes the importance of promoting a positive food safety culture where all stakeholders are committed to upholding high standards of food safety and taking responsibility for safe food handling practices.

Requirements of Food Safety

Food safety is paramount to the prevention of foodborne illnesses and the protection of public health. Ensuring the safety of the food supply chain is imperative to protect public health and well-being. The requirements of food safety encompass a comprehensive set of measures and regulations aimed at minimizing the risk of foodborne illnesses and ensuring the quality of food products consumed by the public (Barnes et al., 2022). Adherence to stringent food safety standards is essential at every stage of food production. This session explores the fundamental aspects of food safety requirements, emphasizing the significance of regulatory compliance, hygiene practices, and quality control measures in maintaining food safety standards and safeguarding consumer health.

Personal Hygiene Practices

One fundamental principle for food handlers is maintaining proper personal hygiene practices. National and international regulations stipulate requirements such as regular handwashing, wearing appropriate protective

clothing, covering wounds or cuts, and avoiding behaviours that may contaminate food. These practices are crucial in preventing cross-contamination and reducing the risk of transmitting pathogens to consumers (Amegah et al., 2020).

Food Storage, Handling, and Temperature Control

Food handlers must adhere to regulations governing the storage, handling, and temperature control of food products. This includes proper storage of perishable items, preventing the growth of harmful bacteria through appropriate temperature control, and avoiding cross-contamination between raw and cooked foods. Compliance with these regulations ensures that food is safe for consumption (Amegah et al., 2020).

Cleaning and Sanitization

Food handlers must follow rigorous cleaning and sanitization procedures to maintain hygienic conditions. Regulations outline the use of appropriate cleaning agents, methods for sanitizing food contact surfaces, and the frequency of cleaning practices. Compliance with these regulations ensures the removal of dirt, debris, and harmful microorganisms, reducing the risk of contamination and improving food safety (Liguori et al., 2022).

Global Food Safety Regulations and Guidelines

Food safety is a global concern, and the establishment of comprehensive regulations and guidelines is vital to safeguarding public health and ensuring the quality of food products worldwide. International organizations such as the Food and Agriculture Organization (FAO) and the World Health Organization (WHO), along with various international standards like ISO 22000 and the Hazard

Analysis and Critical Control Point System (HACCP), play a central role in harmonizing food safety practices across borders. WHO plays a central role in providing leadership on global health matters, including food safety. It assists member states in developing and implementing food safety regulations, conducts risk assessments, and offers scientific advice (WHO, 2020).

Several international food safety standards and guidelines have been developed and adopted worldwide. These include: ISO 22000: Food Safety Management Systems: This international standard outlines the requirements for a food safety management system, ensuring that food products are safe for consumption and meet quality standards. Similarly, Hazard Analysis and Critical Control Points (HACCP) HACCP is an internationally recognized system that focuses on identifying and controlling food safety hazards (WHO, 2020; ISO, 2018). Considering food safety capacity building, many international organizations, including WHO, FAO, and the World Trade Organization (WTO), actively support capacity-building initiatives to assist countries in establishing effective food safety systems and regulations.

According to Moreb, Priyadarshini, Jaiswal, and Jaiswal (2017), many empirical reviews highlight the significance of food safety regulations and guidelines in preventing foodborne illnesses and protecting consumer health. Globally, food safety guidelines provide detailed recommendations for implementing Good Manufacturing Practices (GMP), which include appropriate facility design, equipment maintenance, sanitation, personnel hygiene, and training programs. These guidelines stress the importance of process control,

cross-contamination prevention, traceability, and allergen management to minimize hazards and maintain the integrity of food products throughout the production process.

The guidelines aim at promoting the implementation of Good Agricultural Practices (GAP) to certify the safety of food produced at the farm level (Oliveira, 2016). These practices encompass various aspects, including the use of quality seeds, safe irrigation water, proper pest control, responsible use of fertilizers and pesticides, and good hygiene practices during cultivation and harvesting. GAP guidelines provide recommendations on soil management, water quality, waste management, and worker hygiene to minimize potential sources of contamination and reduce risks associated with agricultural production.

Moreover, the guidelines stress the importance of applying HACCP principles and establishing Food Safety Management Systems (FSMS) to guarantee the safety of food products. HACCP is a systematic approach to identifying, assessing, and controlling potential risks to food safety. It guides you through the process of implementing HACCP, detailing things like hazard analysis, determining critical control points, setting critical limits, monitoring protocols, and remedial actions (Al-Busaidi et al., 2017). By implementing HACCP and FSMS, organizations can systematically address hazards, prevent foodborne illnesses, and demonstrate their commitment to food safety.

The food safety guidelines emphasize on the importance of risk assessment and management in ensuring food safety. Risk assessment involves the scientific evaluation of hazards, their likelihood of occurrence, and the cruelty

of potential health effects (Omari, Frempong, & Arthur 2018). This process helps identify potential hazards, set appropriate safety standards, and prioritize resources for control measures. Risk management entails implementing measures to minimize or eliminate identified risks, such as setting maximum residue limits for pesticides or establishing microbiological criteria for food products. By adopting a risk-based approach, these guidelines ensure that resources are focused on addressing the most significant food safety risks (Motarjemi et al., 2023). The goal of enforcing and updating food safety legislation and standards is to reduce risks at each phase of the food production. Salmonella, Campylobacter, and E. coli are just a few examples of the microbial infections that can cause illness, but there are also chemical pollutants, allergies, and physical dangers to consider (Faour-Klingbeil, Kuri, & Todd, 2015). Food safety regulations aim to lessen the potential sources of contamination throughout the food supply chain. They set standards for good agricultural practices, proper handling and processing methods, and hygienic transportation and storage conditions (Nguyen et al., 2022). These regulations help prevent the introduction of pathogens and other contaminants into the food system, reducing the likelihood of foodborne illnesses.

The compliance with food safety regulations and guidelines is associated with improved compliance among food establishments. Empirical studies have shown that establishments that prioritize food safety and adhere to regulations have lower rates of foodborne illnesses (Almeria & Dubey 2021). Strict enforcement of regulations through inspections, audits, and penalties encourages food handlers to implement preventive measures and maintain high standards of

food safety. The prevention of foodborne illnesses through the implementation of food safety regulations has a direct positive bearing on public health. It reduces the incidence of foodborne diseases, hospitalizations, and associated medical costs (Faour-Klingbeil, Kuri, & Todd, 2015).

In summary, food safety regulations and guidelines aim to protect consumers from potential hazards and risks associated with contaminated or unsafe food. These regulations establish standards for various aspects of food handling, including personal hygiene, facility sanitation, temperature control, and proper labeling. Compliance with these regulations ensures that food handlers adopt practices that minimise the transmission of pathogens and reduce the likelihood of foodborne illnesses. Global Harmonization of Standards: International food safety regulations and guidelines play a vital role in promoting harmonization and consistency in food safety standards across countries and regions.

Food Safety Standards and Regulations in Ghana

The Food and Drugs Authority (FDA) is Ghana's primary regulatory body responsible for ensuring food safety, among other duties. It oversees the enforcement of food safety standards and regulations in the country. The FDA has developed and adopted a range of guidelines and regulations to govern various aspects of food safety. Some key regulations and guidelines include: The Food and Drugs Authority Act (Act 820, 2012): This Act establishes the FDA and empowers it to “regulate and control the manufacture, distribution, sale, and use of food, drugs, cosmetics, and medical devices” in Ghana. The Public Health Act,

2012 (Act 851), also addresses various aspects of public health, including food safety. It grants authorities the power to regulate and inspect food businesses, ensuring compliance with safety and hygiene requirements.

The study conducted by Ababio and Lovatt (2015) provides a comprehensive review of food safety and food hygiene studies conducted in Ghana. Given the critical importance of ensuring food safety in safeguarding public health and promoting economic development, this review offers valuable insights into the state of food safety research and practices in Ghana. The review encompasses a wide range of topics related to food safety and food hygiene, including microbial contamination, foodborne illnesses, hygiene practices, regulatory frameworks, and challenges faced in ensuring food safety in Ghana. The authors aim to identify key areas of concern, gaps in knowledge, and opportunities for future research and intervention.

Ababio and Lovatt (2015) highlight studies documenting the presence of pathogenic microorganisms such as Salmonella, Escherichia coli, and Staphylococcus aureus in various food items sold in Ghanaian markets. These findings underscore the potential risk of foodborne illnesses and the need for robust food safety measures to mitigate microbial contamination.

The review also examines studies investigating hygiene practices among food handlers and consumers in Ghana. Poor hygiene practices, inadequate sanitation facilities, and a lack of awareness about food safety principles emerge as significant concerns. Ababio and Lovatt (2015) discuss research findings indicating suboptimal handwashing practices, improper food handling techniques,

and cross-contamination risks in food establishments across Ghana. Addressing these hygiene-related challenges is essential to preventing foodborne diseases and promoting public health.

Another crucial aspect covered in the review is the regulatory framework governing food safety in Ghana. Ababio and Lovatt (2015) analyze existing literature to assess the effectiveness of regulatory agencies such as the Food and Drug Administration (FDA) in enforcing food safety standards and regulations. Despite regulatory efforts, challenges such as limited resources, inadequate infrastructure, and gaps in enforcement persist. The review highlights the need for enhanced regulatory capacity and stakeholder collaboration to address these challenges effectively.

Motarjemi and Warren (2023) critically examined the implementation of HACCP as a key food safety management strategy, discussing barriers to its adoption in different settings. While HACCP is a scientifically validated approach to preventing foodborne illnesses, its practical application in developing countries remains inconsistent due to a lack of technical knowledge and financial support. The study found that many small- and medium-sized food businesses struggle with maintaining HACCP documentation, conducting hazard analyses, and verifying critical control points. In Ghana, the Food and Drugs Authority (FDA) has made attempts to integrate HACCP principles into food safety regulations; however, challenges such as low awareness among food handlers, high costs of implementation, and weak enforcement mechanisms have limited its success. This underscores the need for capacity-building initiatives, financial incentives, and

policy interventions to enhance compliance with HACCP in the Ghanaian food industry.

Incidence of food borne illness and outbreaks in Ghana

Foodborne illnesses are a significant public health concern in Ghana, as in many other countries. While specific incidence rates of foodborne illnesses have occurred in many parts of the world and left a mark on the health of populations, in Ghana, it is known that such illnesses are a common occurrence and can have serious health implications for the population (Rahman et al., 2012). The lack of comprehensive surveillance systems and underreporting of cases contribute to the challenge of obtaining precise data on the incidence of foodborne illnesses in the country. However, it is important to note that various pathogens and factors contribute to foodborne illnesses in Ghana. Poor sanitation, inadequate food handling practices, contaminated water sources, and insufficient refrigeration and storage facilities are among the factors that can contribute to the occurrence and transmission of foodborne pathogens.

In 2011, Ghana experienced a *Salmonella* outbreak that affected individuals who had consumed contaminated food. The specific food source implicated in the outbreak was not disclosed in the available reports. *Salmonella* is commonly associated with undercooked or raw poultry, eggs, and other contaminated food products (Rosfiani et al., 2022). The most commonly reported pathogens associated with foodborne illnesses in Ghana include *Salmonella, Campylobacter, Escherichia coli (E. coli*), and *Vibrio cholerae*. These pathogens can contaminate food at various stages of production, processing, and preparation,

leading to outbreaks and sporadic cases of foodborne illnesses (Colatruglio & Slater, 2014).

Also in 2015, a food poisoning outbreak occurred in the Greater Accra Region of Ghana, which was linked to the consumption of Koko (a popular local porridge) and Koose (a deep-fried bean cake) (Yeleliere, Cobbina, & Abubakari, 2017). The outbreak was attributed to the presence of aflatoxins, which are toxic substances produced by certain moulds that can contaminate crops (Yeleliere, Cobbina, & Abubakari, 2017). Aflatoxins can have harmful effects on human health, including liver damage and an increased risk of liver cancer (Purwanto, Budi Santoso, Asbari, & Harapan, 2020). The contamination of Koko and Koose with aflatoxins resulted in several individuals falling ill, and there were reported cases of deaths (Yeleliere, Cobbina, & Abubakari, 2017).

The outbreaks resulted in numerous hospitalizations, highlighting the potential consequences of foodborne illnesses and raising concerns about food safety practices in the country. The impact of food contamination extends to the tourism and hospitality sectors in Ghana. Visitors may be hesitant to try local food experiences or dine at establishments perceived to have food safety risks, leading to decreased patronage of restaurants, hotels, and other hospitality establishments (Manning, 2018). This can negatively affect the tourism industry, which relies on showcasing Ghana's cultural heritage and diverse cuisine to attract tourists. In 2008, the Food and Drugs Authority (FDA) of Ghana conducted an investigation that revealed the presence of a harmful industrial dye called Sudan IV in some palm oil products sold in the market. Sudan IV is a carcinogenic substance that

poses serious health risks when present in food products. Upon discovery of the contaminated palm oil, immediate measures were taken to ban its further distribution and sale, ensuring the protection of consumers' health (Yeleliere, Cobbina, & Abubakari, 2017).

Knowledge of Food Handlers on Food Safety

According to Needham (1956), as cited by Akabanda, Hlortsi, & Owusu-Kwarteng (2017), knowledge serves as the foundation for practice, while practice represents the fulfilment of knowledge. Since knowledge is linked to existing behaviours, it significantly impacts people's willingness to change them when they recognize that their behaviours are harmful (Moreb et al., 2017). Food handlers with a thorough understanding of safe food handling procedures can potentially reduce instances of food poisoning (Moreb et al., 2017). This implies that food handlers should be knowledgeable and skilled in food safety procedures and understand the role food plays in the spread of food-borne illnesses (Cooper et al., 2019). As Akabanda, Hlortsi, & Owusu-Kwarteng (2017) noted, "knowledge may be acquired through formal or informal learning procedures, individual experiences, perceptions, and reasoning."

Several studies have been conducted in various countries to evaluate food handlers' knowledge of food safety in specific areas, such as handwashing, temperature regulation, prevention of cross-contamination, food storage, and certain elements of food microbiology. The general level of knowledge among food handlers regarding food safety measures was found to be high (Siau et al., 2015). For instance, Moreb, Priyadarshini, and Jaiswal (2017) conducted a study

to evaluate food safety knowledge among food handlers in the Republic of Ireland. Their research focused on assessing the understanding of food safety principles and practices among food handlers in various food establishments across the country. Through surveys and interviews, the study explored awareness of food safety regulations, personal hygiene, proper food storage, and temperature control. The findings revealed significant knowledge gaps among food handlers, despite existing food safety regulations and guidelines. While some participants demonstrated a strong understanding of food safety principles, others showed deficiencies, particularly in proper food handling and hygiene practices. The study highlights the need for ongoing training and education to address these knowledge gaps and ensure compliance with food safety standards. By improving food handlers' knowledge and practices, stakeholders can reduce the risk of foodborne illnesses and foster a culture of food safety within the food service industry.

Similarly, Gong et al. (2016) conducted a survey to assess food safety knowledge and handling practices among households in Mainland China. The study aimed to evaluate the understanding of food safety principles among those responsible for food preparation and handling at home. Through interviews and questionnaires, the researchers examined various aspects of food safety, including proper food storage, handling of raw and cooked items, hygiene practices, and awareness of foodborne illnesses. The results revealed varying levels of knowledge among household food handlers. While some participants demonstrated a solid grasp of food safety principles and adhered to proper handling practices, others showed gaps in knowledge and engaged in risky

behaviours that could compromise food safety. Key concerns included inadequate handwashing, improper storage of perishable foods, and a lack of awareness about cross-contamination risks. The study highlights the need for education and awareness programs to enhance food safety knowledge and practices among households in Mainland China.

Priyadarshini, Alqurashi, and Jaiswal (2019) examined food safety knowledge and practices among foodservice staff in Al Madinah hospitals, Saudi Arabia, highlighting key relationships between education, training, and compliance with food safety standards. The study found that 92.6% of respondents demonstrated safe food handling practices, particularly in hand hygiene and cross-contamination prevention. However, gaps in food storage knowledge were evident, with less than 50% of respondents correctly identifying proper food storage temperatures. This discrepancy suggests that while basic food safety training is effective, targeted education on specific areas such as food storage and pathogen control is needed. A key strength of the study is its quantitative approach, using validated questionnaires and statistical analyses (Spearman's rho, linear regression) to establish causal relationships between knowledge and practices. The study revealed that higher education and prior food safety training significantly predicted better compliance, reinforcing the importance of structured training programs. However, a limitation is its reliance on self-reported data, which may introduce social desirability bias, as respondents could overstate adherence to safety protocols. The findings underscore the need for periodic refresher training and more practical, hands-on food safety

interventions. Future research should explore how environmental and organizational factors influence long-term adherence to food safety practices in hospital settings.

Gruenfeldova, Domijan, and Walsh (2019) also conducted research on food safety knowledge, practices, and training of food handlers in Ireland. The study aimed to assess how well food handlers understand food safety principles and the extent to which they follow recommended practices in food preparation and handling. Through surveys and interviews, the researchers explored various aspects of food safety, including hygiene practices, temperature control, the prevention of cross-contamination, and awareness of foodborne illnesses. The study provided important insights into the level of food safety knowledge among food handlers in Ireland. While many participants showed a satisfactory understanding of food safety principles, there were notable concerns regarding adherence to recommended practices. Specifically, some food handlers exhibited gaps in knowledge related to temperature control, proper handwashing techniques, and cross-contamination prevention.

In a different context, Alemayehu et al. (2021) conducted a cross-sectional study in Debre Markos Town, Northwest Ethiopia, to evaluate the knowledge and handling practices of food handlers in local food establishments. The study aimed to identify the factors influencing food safety knowledge and practices among these individuals. Through structured interviews and observations, the researchers examined various aspects of food safety, such as knowledge levels, hygiene practices, temperature control, and cross-contamination prevention. The findings

provided significant insights into the food safety knowledge and practices of food handlers in Debre Markos Town. While many participants showed a basic understanding of food safety principles, there were significant gaps in knowledge related to proper food handling techniques and hygiene practices. The study also identified several factors affecting food safety knowledge and practices, including educational background, training experience, and access to information resources. The research emphasized the need for targeted interventions to enhance food safety knowledge and practices among food handlers in Debre Markos Town. Furthermore, the study emphasized the importance of collaboration between food establishments, regulatory authorities, and public health agencies to strengthen food safety measures and protect consumer health.

Nguyen and Li (2022) conducted a systematic review of food safety management system (FSMS) implementation in global supply chains, analyzing managerial requirements, measurement tools, and critical success factors. The study's strength lies in its broad scope, covering 81 peer-reviewed studies from 2005 to 2020 and using biological mapping analysis (VOS viewer) to visualize research trends. The findings emphasize that mandatory and voluntary regulations play a central role in FSMS compliance, but there remains a lack of standardized measurement tools to assess its effectiveness. A notable contribution of the study is its identification of internal and external factors influencing FSMS adoption, including regulatory frameworks, firm size, technological advancements, and risk-based approaches. However, the study highlights significant research gaps, particularly in measuring FSMS effectiveness and the role of emerging

technologies (e.g., blockchain, IoT) in compliance monitoring. While the systematic approach provides a comprehensive overview, the reliance on secondary data limits its applicability, as it does not include primary empirical validation. Practically, the research serves as a valuable reference for food industry stakeholders but would benefit from a more in-depth analysis of region-specific regulatory challenges. Future studies should explore real-world implementation challenges and develop standardized FSMS assessment frameworks to bridge the gap between policy and practice.

Akonor and Akonor (2013) conducted a study to assess the food safety knowledge of domestic food handlers in Accra. The research aimed to evaluate the level of understanding among individuals responsible for food preparation and handling in household environments. Using surveys and interviews, the study explored various aspects of food safety knowledge, including hygiene practices, temperature control, cross-contamination prevention, and storage methods. The findings offered valuable insights into the food safety awareness of domestic food handlers in Accra. While some participants exhibited a basic understanding of food safety principles, the study revealed significant gaps in knowledge, particularly concerning proper food handling techniques and hygiene practices. Additionally, the research identified misconceptions and myths related to food safety among domestic food handlers, emphasizing the need for targeted education and awareness programs. The study highlighted the importance of enhancing food safety knowledge among domestic food handlers in Accra to reduce the risk of foodborne illnesses and promote public health. To address these

knowledge gaps, the researchers recommend strategies such as educational campaigns, training workshops, and the dissemination of information materials can help promote adherence to recommended food safety practices in household settings. Furthermore, the study emphasized the role of regulatory authorities and public health agencies in providing guidance and support to domestic food handlers to enhance food safety standards.

Addo-Tham et al. (2020) conducted a cross-sectional study on food safety knowledge and handling practices among street food vendors in Ghana, highlighting critical gaps in training, regulatory enforcement, and hygiene practices. The study found that 98.8% of vendors had good knowledge of food safety, yet many engaged in unsafe handling practices, such as using bare hands to serve food (43.5%) and handling money and food simultaneously (73.2%). These findings align with global studies that emphasize a disconnect between food safety knowledge and actual compliance (Priyadarshini, Alqurashi, and Jaiswal, 2019). A major strength of the study is its mixed-methods approach, combining structured questionnaires and observational checklists, which enhances the accuracy of self-reported knowledge and actual behavior. However, the study is limited by recall bias, as vendors may have exaggerated their compliance with safety practices. Additionally, the study's focus on one municipality (Ejisu-Juaben) limits its generalizability to other parts of Ghana. Despite these limitations, the research provides valuable policy recommendations, such as mandatory training programs and stricter enforcement mechanisms. Future studies should adopt longitudinal designs to assess sustained improvements in food safety

practices post-training and investigate how socio-economic factors influence compliance among food vendors.

Madilo, Letsyo, & Klutse (2022) conducted a cross-sectional study on food safety knowledge and practices among food handlers in tertiary and second-cycle institutions in Ghana. The study revealed that while food handlers demonstrated basic awareness of food safety principles, their practical application remained inadequate, particularly in areas like temperature control and hygiene protocols. This aligns with global findings indicating that food safety knowledge does not always translate into compliance, emphasizing the need for targeted training programs (Nguyen & Li, 2022). A major strength of the study is its large sample size (N = 608), which enhances its generalizability to institutional caterers in Ghana. However, its reliance on self-reported data raises concerns about social desirability bias, as participants may overstate compliance with food safety practices. A combination of observational assessments and microbiological testing could provide a more accurate evaluation of food safety adherence. Despite identifying a positive correlation between food safety knowledge and practices, the study highlights gaps in enforcement and regulatory oversight, particularly in monitoring institutional food handlers. Addressing these gaps requires mandatory certification, periodic inspections, and behavioral reinforcement strategies to ensure sustained food safety compliance. Future studies should explore the effectiveness of intervention programs in improving long-term adherence to food safety standards.

In another study, Meleko et al. (2015) conducted an evaluation of the sanitary conditions in catering establishments and assessed the food safety knowledge and practices of food handlers at the Addis Ababa University Students' Cafeteria. The study aimed to determine the hygiene standards upheld by these catering establishments and the extent to which food handlers understood and adhered to food safety protocols. By combining observational assessments with surveys, the research examined various aspects of food safety, including the cleanliness of food preparation areas, the personal hygiene practices of food handlers, temperature control measures, and cross-contamination prevention methods. The study also assessed the knowledge levels of food handlers regarding food safety principles and their application in daily practices. The findings revealed insights into both the sanitary conditions of the catering facilities and the food safety knowledge and practices of the handlers. While the research identified areas that needed improvement in hygiene practices and facility cleanliness, it also revealed deference in food safety knowledge among the food handlers. Some participants showed a lack of awareness concerning proper food handling techniques and hygiene standards, underscoring the need for targeted training and educational initiatives.

Several survey-based studies have used comparative analyses to delve deeper into variations in food handlers' knowledge levels across different demographic groups or types of food establishments. For instance, Chan et al. (2022) carried out a comparative analysis to examine food safety knowledge among food handlers in Malaysian schools. They found notable differences in

knowledge levels based on factors such as education level, years of experience, and cultural background. Similarly, Gomes-Neves et al. (2011) explored variations in food hygiene knowledge among food handlers in school canteens in Porto, Portugal. Their comparative analysis revealed disparities in knowledge levels influenced by socio-demographic factors. Such comparative analyses provide valuable insights into the multifaceted nature of food handlers' knowledge and the underlying factors contributing to knowledge disparities. Education level, for example, emerged as an important determinant of the level of knowledge in food safety procedures, with higher-educated food handlers exhibiting greater awareness of food safety principles.

Attitude of Food Handlers Towards Food Safety

The safety of food is a paramount concern in the food industry, with the responsibility of ensuring safe and hygienic food practices resting largely on the shoulders of those who handle food. The attitudes of these individuals towards food safety play a pivotal role in shaping their behaviours and ultimately determining the safety of the food they handle. Positive attitudes among those who work with food have been demonstrated repeatedly in research to be highly connected with improved adherence to food safety regulations and practices (Ali & Angelene, 2018). The behaviors of food handlers are influenced by their attitudes toward food safety. Positive attitudes, such as a sense of responsibility and commitment to customer safety, foster adherence to food safety guidelines (Bou-Mitri et a., 2018). Conversely, negative attitudes, such as complacency or lack of concern, can lead to lapses in food safety practices. It is crucial to

investigate food handlers' attitudes toward food safety in order to implement effective measures that will prevent foodborne illnesses. Also, understanding the factors that shape attitudes is important for promoting positive behaviour change. Several factors contribute to the development of attitudes among food handlers, including the following:

1. Personal Values and Beliefs: Food handlers' personal values and beliefs regarding food safety play a significant role in shaping their attitudes. People who place a high value on health and safety tend to have more favorable attitudes toward food safety practices (Ncube, Kanda, & Chijokwe, 2020). Conversely, those who hold misconceptions or underestimate the risks associated with foodborne illnesses may exhibit negative attitudes.

2. Organizational Culture: The culture within food establishments, including the attitudes and practices promoted by management and supervisors, can influence the attitudes of food handlers (Addo-Tham et al., 2020). A supportive and positive food safety culture that values and prioritizes safety creates an environment conducive to positive attitudes and behaviours among food handlers.

3. Peer Influence: Peers and coworkers in the workplace can impact food handlers' attitudes and behaviors (Tuglo et al., 2021). Positive role models who demonstrate a strong commitment to food safety can inspire and motivate others to adopt similar attitudes and practices.

4. Training and Education: The quality and effectiveness of training programmes can impact the attitudes of food handlers. Engaging and interactive training sessions that emphasize the importance of food safety and provide

practical guidance on implementing proper practices contribute to positive attitudes (Zanin et al., 2017).

5. Regulatory Requirements: The existence of food safety regulations and enforcement mechanisms can influence the attitudes of food handlers. Clear guidelines and the expectation of compliance create a sense of responsibility and accountability, fostering positive attitudes towards food safety practices (Seidu, 2020).

Promoting positive behaviour change among food handlers requires addressing the factors that influence attitudes: 1. Education and Awareness Programs: Thorough educational campaigns that emphasize the significance of food safety and the potential risks of non-compliance can foster positive attitudes and behaviors. These programmes should emphasize the shared responsibility of food handlers in protecting public health and provide practical strategies for implementing safe actices. (Nyamari, 2013)

Leadership and Management Support: Effective leadership and management support are vital for creating a positive food safety culture (Leso et al., 2018). Managers should model best practices, emphasize the significance of food safety, and offer resources and training to foster positive attitudes and behaviors among food handlers. Continuous Training and Reinforcement: Ongoing training programmes that reinforce food safety knowledge and provide updates on emerging issues and best practices can contribute to positive attitudes (Asmawi et al., 2018). Regular reminders and refresher courses help maintain awareness and sustain positive behaviour change.

Recognition and Incentives: Acknowledging and rewarding food handlers who demonstrate exemplary food safety practices can reinforce positive attitudes and behaviours (Amegah et al., 2020). Incentive programmes, such as performance-based bonuses or public recognition, can influence food handlers to practice high standards of food safety. Understanding these factors helps shape the attitudes of food handlers, and implementing targeted interventions can lead to positive behaviour change among food handlers. By fostering a culture of responsibility, providing adequate training and resources, and addressing misconceptions and barriers, will improve food handlers' attitudes towards food safety.

Food Safety Practices of Food Handlers

Practice, according to Akabanda, Hlortsi, & Owusu-Kwarteng (2017), involves the application of skills, techniques, methodologies, or Standard Operating Procedures (SOPs). To evaluate food handlers' procedures for handling food, researchers used self-reported questionnaires and observation methods. In a related study, Tuglo et al. (2021) assessed the frequency of safe and unsafe food handling practices among employees at food service facilities across nine Foodborne Active Surveillance Network (Food Net) sites. This research focused on self-reported data regarding four key food handling practices: hand washing, wearing gloves while handling cooked foods, checking the temperature of cooked foods, and working while ill. The results revealed that 40% of employees handling cooked food wore gloves and changed them an average of 15.6 times during an 8-hour shift. Comparatively, 71% of those handling both cooked and

raw foods indicate that they always wash their hands, and 67% reported changing gloves to prevent food contamination. Additionally, approximately 47% of participants used thermometers to monitor food temperatures, whereas 5% stated they never worked while feeling unwell. Significant variations in food handling procedures were associated with factors such as age, restaurant type, and job responsibilities.

Similarly, Akabanda, Hlortsi, & Owusu-Kwarteng (2017) conducted a study in Ghana using self-administered questionnaires to evaluate the food handlers' overall hygiene practices and training levels in 35 food outlets. Data collected from 50 randomly selected food handlers revealed that most adhered to satisfactory food safety practices. The participants indicated that they washed their hands after using the restroom or before starting each shift. Additionally, 82% consistently wore and frequently changed protective clothing, including gloves, and 92% did not experience coughing or diarrhea while working.

Food Safety Knowledge Versus Practices

Traditionally, it has been considered that knowledge instantly translates into behaviour, which then transforms into practice (Asmawi et al., 2018; Zanin et al., 2017). Nevertheless, a number of studies found that even though food handlers received the correct answers to questions relating to food safety, they frequently failed to put their knowledge into action (Bou-Mitri et al., 2018; Ncube et al., 2020). A study by Samapundo, Thanh, and Xhaferi (2016) investigated the sanitary conditions of food service establishments and the food safety knowledge and practices of food handlers in Ethiopia and found that "most food handlers had

a high level of knowledge regarding food hygiene". In spite of this, they showed insufficient knowledge in practice by handling raw food products without first washing their hands (75 percent of the time), wearing hand jewellery, and using their hands to touch regions of their bodies while preparing and serving meals (53 percent of the time), as a result, the knowledge scores of the food handlers were notably higher compared to their practice scores.

According to Akabanda, Hlortsi, & Owusu-Kwarteng (2017), research carried out in Ghana has shed light on the knowledge and behaviour gaps that exist among food companies, food handlers, and consumers. The research titled "Knowledge and Practices of Food Safety among Street Food Vendors in Ejisu-Juaben, Ghana" by Addo-Tham et al. (2020) investigated the aforementioned topic. According to the findings of the research, there were significant gaps between the vendors' theoretical understanding and their practical use of food safety procedures. It emphasized the significance of training and education programmes that are specifically designed to meet the individual requirements of street food sellers to improve the food safety practices of the vendors.

Tuglo et al. (2021) also examined the correlation between knowledge and practices of street food handlers in the North Dayi District of Ghana. It was discovered that food safety management practice and understanding of double-hand washing procedures were substantially correlated. They found, for example, that the practice of temperature control was strongly linked to food handlers' knowledge of food contamination methods and their awareness of sources of food contamination. The knowledge of food safety among those who handle food is

influenced by various factors. While most food handlers may possess some knowledge of food safety, their skill in maintaining proper food safety practices can be impeded by challenges such as limited access to clean water, inadequate storage facilities, and insufficient awareness of specific foodborne hazards (Almeria & Dubey, 2021). These issues create a disconnect between knowledge and the actual application of food safety practices.

Similarly, in Ghana food handlers have been found to have significant gaps in their knowledge and proper food safety practices. Research indicates that factors such as a lack of training, limited resources, and high staff turnover contribute to inconsistent implementation of food safety measures among these workers (Goh & Chua 2016). Food businesses in Ghana, including restaurants and food processing facilities, face challenges in maintaining consistent food safety practices. Limited resources, inadequate infrastructure, and insufficient implementation of food safety regulations have been identified as barriers to ensuring compliance and maintaining high standards of food safety (Omari et al., 2018).

Beyens, Failler, and Asiedu (2018) state that effective food safety management practices, including personal hygiene, preventing cross-contamination, purchasing, and storage, are closely linked to an understanding of the stages in food handling that are most likely to cause contamination. As a result, maintaining proper personal cleanliness and controlling temperature are strongly correlated with an understanding of the elements that contribute to food-borne diseases. According to Moreb et al. (2017), knowledge had a favourable

impact on the behaviours of food handlers. Their research revealed that food handlers exhibited high level of knowledge, a positive attitude, and effective practices concerning hygiene, cross-contamination, and food storage.

Four different kinds of links between knowledge, attitude, and behaviour or practice were discovered by Schwartz (1975), as mentioned by Zanin and Cunha(2017). It was discovered that knowledge may, in some cases, directly impact attitude but not behaviour, while in other cases, knowledge and attitude might both directly and simultaneously influence one another. Knowledge has both explicit and implicit effects on behavior. In the third connection, attitude acts as a mediating variable between knowledge and behavior, indicating that knowledge and attitude each independently impact behavior or practice. This effect can be linked to the training food handlers receive, which enhances their understanding of food safety principles potentially leading to improved food safety procedures. As Craddock and Maring (2020) noted, food handlers' training significantly boosts food safety knowledge and hygiene awareness, thereby promoting better food safety practices. However, staff attitudes can sometimes hinder improvements in these practices.

According to the World Health Organization (2020), training is crucial for providing food handlers with the essential knowledge and practices needed to enhance food safety. It also pointed out that training programs incorporating theories of behavior change deemed effective at improving both knowledge and practice. Training has been shown to increase productivity, boost job comfort, and improve both professional and food safety knowledge (Samapundo, Thanh, &

Xhaferi, 2016). Consequently, Lagerkvist et al. (2018) suggest that training plays a significant role in reducing the incidence of foodborne infections.

Relationship Between Knowledge, Attitude and Practice of Food Handlers on Food Safety

The relationship between knowledge, attitudes, and practices regarding food safety procedures among food handlers has been extensively examined in several studies in diverse locations and contexts. For example, Soares et al. (2012) conducted a study in Camaçari, Brazil, focusing on food handlers in schools. This study sought to evaluate the knowledge food handlers have about food safety principles and examine their attitudes towards food safety practices and their actual food handling and hygiene practices. The research revealed that food handlers with greater knowledge of food safety principles are likely to exhibit more positive attitudes toward food safety practices. Moreover, those with positive attitudes were more likely to adhere to recommended food handling and hygiene standards. These findings indicate a notable correlation between food handlers' knowledge, attitudes, and practices in the school setting.

In northern Malaysia, Abd Lataf Dora-Liyana et al. (2018) conducted research examining the association between knowledge, attitudes, and practices related to food safety and hygiene among food handlers at boarding schools. The findings of the study revealed that food handlers with higher levels of food safety and hygiene knowledge tended to exhibit more positive attitudes towards food safety practices. Additionally, those with positive attitudes were more likely to demonstrate better adherence to recommended food handling practices and

hygiene standards. This study therefore established a significant correlation between the food handlers' knowledge, attitudes, and practices in this educational setting. Moreover, the findings underscore the need for regular monitoring and reinforcement of food safety practices to ensure sustained compliance among food handlers.

Asmawi et al. (2018) investigated the associations between knowledge, attitudes, and practices regarding food safety among food handlers working in food courts. The researchers aimed to provide a comprehensive understanding of how knowledge, attitudes, and practices regarding food safety are interrelated within this group. The study's findings reveal several important insights: Firstly, the study emphasizes that knowledge plays a crucial role in shaping attitudes and practices of food handlers concerning food safety. This indicates that knowledge forms the basis for developing attitudes. Furthermore, the study highlights that attitudes significantly affect food handlers' practices. Food handlers who had a positive attitude towards food safety were more inclined to consistently adhere to recommended food handling practices. This emphasizes the role of attitudes as key motivators for behavior. However, the study also identifies gaps between knowledge, attitudes, and actual practices. Despite possessing sufficient knowledge and maintaining positive attitudes toward food safety, some food handlers still showed deficiencies in their food handling practices. This discrepancy suggests that additional factors, such as workplace culture, organizational support, and individual habits, may influence the translation of knowledge and attitudes into action.

Similarly, Siau et al. (2015) conducted a study that sheds light on the association between knowledge, attitudes, and practices concerning food safety among food handlers in food courts in Putrajaya. The study reveals that knowledge significantly influences food handlers' attitudes toward food safety. Individuals with greater knowledge of food safety principles are more likely to have positive attitudes towards adopting safety measures. Furthermore, the study emphasizes that having positive attitudes is essential for implementing effective food safety practices. Food handlers who hold favorable attitudes are more inclined to consistently adhere to recommended food handling procedures This underscores the motivational role of attitudes, which act as catalysts for adopting and maintaining safe food handling practices. However, the study also highlights variations between the knowledge, attitudes, and actual practices of food handlers in food the courts. Despite the participants possessing adequate knowledge and positive attitudes towards food safety, some food handlers exhibited lapses in their actual food handling practices. This discrepancy indicates that factors beyond individual knowledge and attitudes may influence the translation of knowledge and attitudes into action.

Zanin et al. (2017) carried out an integrative review to examine the association between food handlers' knowledge, attitudes, and practices related to food safety. Their study synthesized existing research to offer a thorough understanding of this relationship and to pinpoint key factors influencing food safety practices. The review underscores the importance of knowledge as a crucial determinant of food safety practices. It shows that food handlers who thoroughly

understand food safety principles are more inclined to adhere to recommended practices, emphasizing the vital role of knowledge in influencing behaviors and fostering a culture of food safety in food service environments. Furthermore, the review points out the significant impact of attitudes on food handlers' willingness to engage in safe food handling practices. Positive attitudes towards food safety act as motivational drivers, encouraging adherence to established protocols. On the other hand, negative attitudes or misconceptions about food safety can obstruct the adoption of safe practices. The review also identifies various factors that mediate the relationship between food handlers' knowledge, attitudes, and practices in food safety, including organizational support, the effectiveness of training, cultural norms, and individual beliefs.

Also, da Vitória et al. (2021) conducted a cross-sectional study to explore the association between knowledge, attitudes, and practices related to food safety among food handlers in schools in Espírito Santo, Brazil. Their research highlighted the interaction between these elements, demonstrating that food handlers who possess more knowledge about food safety tend to exhibit more favorable attitudes toward safety practices. Furthermore, those with positive attitudes were more likely to follow recommended food handling procedures. This indicates a direct correlation between food handlers' knowledge, attitudes, and practices in school environments. The research underscores the importance of both knowledge and attitudes in influencing food handlers' practices related to food safety. It emphasizes that possessing adequate knowledge alone may not suffice; favorable attitudes towards food safety are also essential drivers of safe

food handling practices. Therefore, interventions aimed at improving food safety practices among food handlers should not only focus on enhancing their knowledge but also on cultivating positive attitudes towards food safety.

Theoretical Review

Various theories and models have been used to explain human behaviors and enhance our understanding of these actions (Deutsch, Coleman, & Marcus, 2011). This study, therefore, leverages the following prominent theories to offer valuable insights into the variables of the study.

Theory of Reasoned Action (TRA)

Fishbein (1967) put out this idea in an effort to comprehend the connection between attitude and behavior. As seen in Figure 3, Boyd & Wandersman (1991) and Tuglo et al. (2021) described TRA as an essential series of connected ideas and presumptions created by social psychologists to comprehend and predict human behavior. The theory, according to Bamberg, Ajzen, & Schmidt (2003), is predicated on the idea that because humans are rational, they act in a way that makes sense given the knowledge that is available to them and the consequences of their actions. This implies that people consider the consequences of their choices before making a decision about whether or not to act in a certain way. In other words, while deciding whether to follow or not follow food safety laws and regulations, food handlers must take into account the repercussions or implications of their behaviour with regard to food safety procedures.

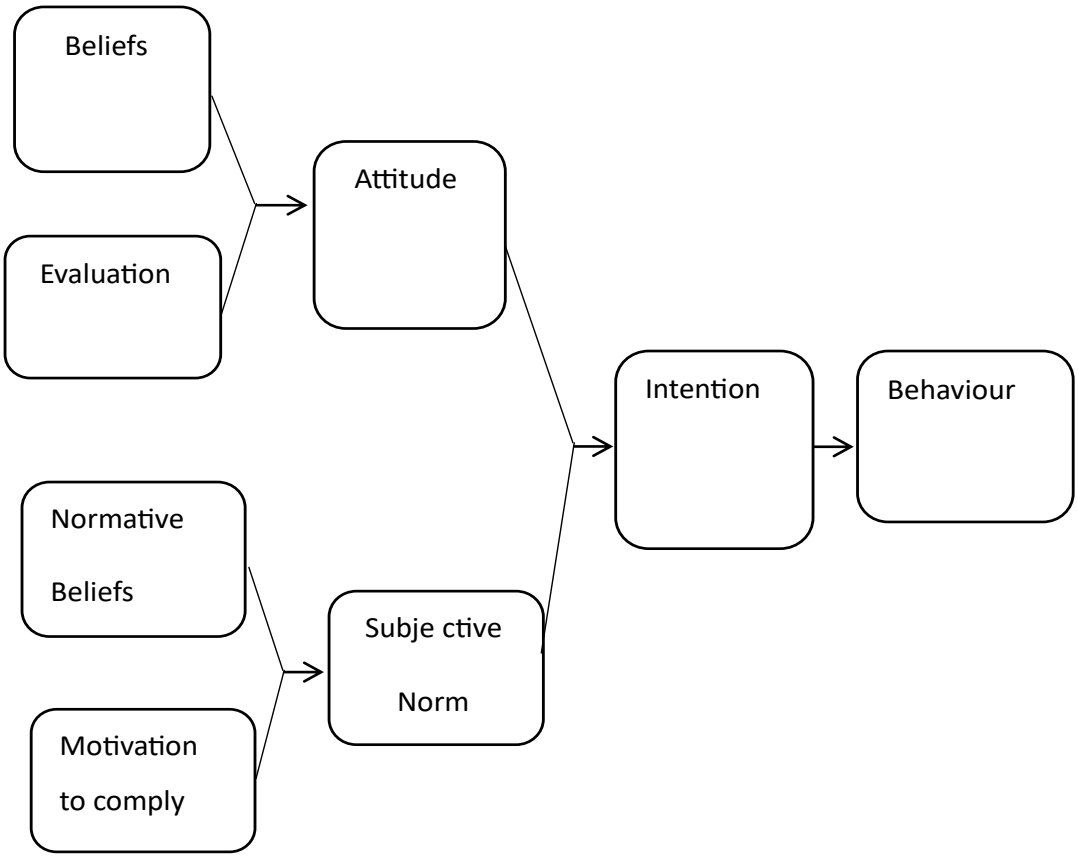

Figure 2.1: Theory of reasoned action (Fishbein, Middlestadt, and Hitchcock, 1994)

As indicated by Boyd & Wandersman (1991), once appropriate assessments of behaviour have been obtained, the factor that is most likely to forecast behaviour will be presented. According to the Theory of Reasoned Action (TRA), a person's actions are mainly influenced by their intention to behave in a certain way. The theory seeks to clarify the relationships between beliefs, attitudes, intentions, and behavior, as illustrated in figure 2.1. Nevertheless, the strength of a person's intention may not always accurately predict their actual behavior. The link between intention and behaviour is significant in the prediction of outcomes, according to Young et al. (2018), considering that the inclination towards a specific result will influence an

individual's decision to participate in a specific behaviour. Hence, concerning food safety, the knowledge or objectives that the food handler possesses, as well as the facility's desired outcomes, serve as motivating factors for the staff to perform as expected. Waddell et al. (2018) state that a person's attitudes towards a specific behavior and the perceived social pressures related to that behavior are the direct factors influencing their behavioral intentions. In other words, the way food handlers perceive food safety procedures depends on both the anticipated outcomes and the attitudes of those who hold influence, such as managers and facility owners. For example, if a food handler is keen on using gloves or food thermometers to check the temperatures of incoming food before storage, but the facility owner or manager does not acknowledge the importance of these items, the food handler's goal will not be achieved. Therefore, one's attitude is based on their perception of the effects or qualities of engaging in a particular behaviour, whereas their subjective norm is based on whether or not they are motivated to follow the advice of significant others (Milton, 2012). Essentially, the theory posits a link between behavioral and normative beliefs, behavioral intention, and actual behavior through attitudes and subjective norms. This means that when food handlers view food safety procedures favorably and believe that key figures (such as facility managers, chefs, and regulatory authorities) also endorse these practices, they are more likely to implement them effectively.

According to Milton (2012), the TRA is suitable for describing behaviour when there is strong influence over the person's ability to make their own judgements or select what to do. This suggests that both perceived and real

influences from internal and external factors can significantly hinder or support the implementation of intended actions in food safety knowledge and practices. For instance, barriers like insufficient resources, demanding work schedules, time limitations, and workplace culture can either facilitate or hinder planned activities, depending on how well they align with the expectations of the key individuals involved. This approach has the drawback of focusing exclusively on the strong cognitive orientation, which tends to ignore human nature, which also influences decision-making processes (Soon, Vanany, &Wahab, 2021). According to this view, only human intentions have an impact on behaviour. It overlooks the reality that previous behaviour may most accurately predict present behaviour since environmental cues may routinely cause a behavioural reaction (De Devitiis et al., 2021). Another limitation of the theory is its assumption that once an individual makes a decision to act, they will face no limitations in carrying out that action. However, in reality, people are frequently constrained from behaving or acting in certain ways due to factors such as limited capability, time limitations, environmental circumstances, organizational restrictions, and a lack of awareness.

The Health Belief Model (HBM)

In the 1950s, social psychologists in the United States, including Hochbaum, Rosenstock, and Kegels, developed the Health Belief Model (HBM) to understand and forecast health-related behaviours (De Devitiis et al., 2021). Originally created to address challenges with the free tuberculosis (TB) screening program in the U.S., the model has since been applied to investigate various health behaviors, including sexual risk behaviors and the transmission of

HIV/AIDS (Ababio and Lovatt, 2015), and the perspectives of older adults on implementing safe food-handling practices.

HBM emerged as a framework to guide researchers in understanding why individuals fail to adopt preventive measures for health promotion. It operates on the premise that health-related behaviors are more apt to occur when certain conditions are present: individuals perceive that not taking action will put them at risk of illness or disease, the consequences of inaction are perceived as severe, there are alleged paybacks to taking action, and the supposed importance overshadow the real costs. Additionally, there is an expectation that engaging in the behaviour will yield the desired outcome (Purwanto et al., 2020).

According to Davidson et al. (2018), the HBM looks at individuals' attitudes and views to elucidate and foresee their health behaviors. The model recognizes the influence of various factors, such as educational background, gender, age, race, and ethnicity, on a person's behaviour and attitudes, which, in turn, shape their perceptions and actions. External factors, like public education, exposure to images depicting the consequences of AIDS-related deaths, or participation in informal support groups, can also motivate individuals to reevaluate and potentially modify their sexual activities (Ali & Angelene, 2018).

According to Ababio and Lovatt (2015), the Health Belief Model (HBM) proposes that a person's engagement in a health-related behaviour is influenced by their opinion of susceptibility, severity, benefits, and barriers, which are considered perceived hazards and behavioural evaluation. This model encompasses factors that elucidate why some individuals adopt health-protective

behaviours while others do not. It is founded on the principle that individuals are more likely to adopt health behaviors when they believe that not taking action would make them susceptible to illness, that the disadvantages of inaction would be severe, and that the benefits of taking action are substantial. Additionally, when individuals perceive that the benefits outweigh the costs, they believe that engaging in the behaviour will lead to the expected outcomes (Ababio and Lovatt, 2015). Hence, within the HBM, human behaviour is considered to be influenced by two factors: the value individuals assign to a specific outcome and their assessment of the probability that a specific behavior will lead to that result. The Health Belief Model (HBM) has gained widespread acceptance due to its simplistic approach to health concepts, which facilitates easy implementation, application, and testing (Cooper et al., 2019). It has served as a valuable framework for studying various behaviours and has increased awareness among researchers and health professionals regarding the modifiable factors necessary for promoting health behaviour.

In the context of this study, the HBM is deemed suitable as it relates to the risks associated with unsafe food handling practices, addressing the perceived threats outlined in the model. These threats encompass risks to individuals, customers, and the food service establishment. Conversely, adhering to hygienic practices by food handlers can mitigate the occurrence of foodborne illnesses, safeguard the business against legal issues and food spoilage, and contribute to a positive reputation (Lu et al., 2021). However, factors such as insufficient

knowledge, time constraints, and limited resources can impede compliance with hygiene practices.

However, the Health Belief Model (HBM) does have its drawbacks. It lacks explicit indications of the links between variables as well as robust guidelines for both of the formulated variables (Handford et al., 2015). Moreover, its predictive power is limited, as the main variables (severity, vulnerability, benefits, and barriers) often demonstrate insignificant effects on health-related behaviour (Khayyam et al., 2021). This indicates that there are other significant variables that influence healthy behaviour that the model fails to consider, highlighting its incompleteness.

Conceptual Framework

The conceptual framework presented here depicts the study variables; knowledge, attitudes, and practices within the scope of food safety, including areas like personal hygiene, environmental hygiene, and food hygiene. It shows how these variables are interconnected and how they might impact the safety of food production. The framework explores how food handlers' knowledge of food safety across these domains correlates with their actual practices. It suggests that various sources of knowledge, including education, training, experiences, and subjective norms from the Theory of Planned Behavior, are expected to provide necessary information on food safety procedures. This knowledge is anticipated to drive food handlers to adopt proper practices, and consistent application is believed to reinforce their understanding through experience. Conversely, poor hygiene practices, inadequate storage conditions, and improper food handling can

result in food contamination and foodborne illness. In summary, the framework posits that knowledge gained from training and experience should directly influence practical actions, and, in turn, practice can shape food handlers' knowledge.

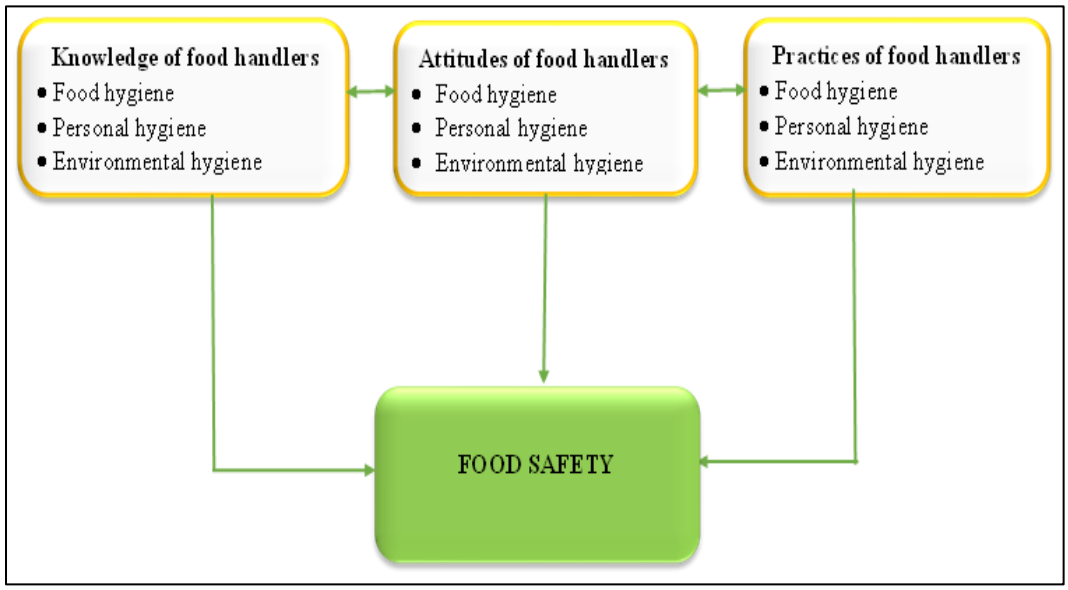

Figure 2.2 Conceptual Framework for the study (Bukari, 2024))

CHAPTER THREE

RESEARCH METHODS

Overview

This chapter describes the methodology used in the study, including the research design, target population, sampling methods, research instruments, data collection procedures, and data analysis.

Research Design

The research design is a crucial element in any study, as it defines the framework, strategy, and techniques that will be used to address research questions or test hypotheses. It acts as a roadmap for the entire research process, ensuring that the study is methodically structured and conducted with precision. Various types of research designs exist, each tailored to specific research goals and contexts (Creswell & Creswell, 2017). This study employed a cross-sectional survey. As noted by Cummings (2018), cross-sectional research enables the collection of data from a large sample at one specific point in time without manipulating any variables. The purpose of this study was to assess the food safety knowledge, attitudes, and practices of food handlers without impacting the variables, making the cross-sectional design appropriate. The researcher conducted an objective evaluation of participants' knowledge, attitudes, and practices regarding food safety

Study Area

Tamale serves as the capital city of the Northern Region in Ghana. As the third-most populous city in the country, Tamale is home to more than 400,000

individuals. Tamale is a multicultural city with a population made up of several different ethnic groups, including the Dagombas, Gonjas, Mamprusi, and others. Tamale is a significant economic hub in northern Ghana, with a thriving market system that meets the demands of both the urban population and the neighbouring rural areas. Shea butter, yam, maize, and millet are among the crops that are grown in the area and are important sources of revenue for the local farmers (GSS, 2021). Tamale also has universities and colleges, as well as a number of public and private senior high schools.

Population

Population refers the complete set of individuals or elements that possess at least one shared characteristic. It also denotes the broader group from which a sample is drawn (Saunders et al., 2019). The population for the study included all kitchen staff in the following public Senior High Schools (SHS) in Tamale.: Tamale SHS, Tamale Islamic SHS, Tamale Girls SHS, St. Charles SHS, Anbariya SHS, Kalpohin SHS, Business SHS, Northern School of Business, Vittin SHS, Ghana SHS, and Presbyterian SHS. All of these public senior high schools mentioned operate school feeding policies as part of their mandates. The total population of food handlers from all 11 schools in the Tamale metropolis was 237. However, the study excluded national service personnel and students on internships because they worked under the supervision of food handlers who were staff of the schools.

Sample and Sampling Procedure

In this study, the sample size was determined using Krejcie and Morgan's (1970) table. Having known the study population to be 237 food handlers in public senior high schools, a sample size of 148 respondents was deemed appropriate. Below is the breakdown of the study sample size in relation to each school involved in the study.

Table 3.1 List of Senior High Schools in Tamale with number of food handlers.

No.	Public Senior High Schools(SHS) in Tamale Metropolis	No. of Food Handlers	Sample size
1.	Tamale SHS	25	16
2.	Tamale Girls SHS	22	14
3.	St. Charles SHS	11	7
4.	Tamale Islamic SHS	26	16
5.	Kalpohin SHS	26	16
6.	Anbariya SHS	12	7
7.	Business SHS	29	18
8.	Vitting SHS	20	12
9.	Ghana SHS	22	14
10.	Northern School of Business	28	18
11.	Presbyterian SHS	16	10
	Total	**237**	**148**

The study used simple random sampling to select participants for inclusion. This technique was widely regarded for its ability to uphold the principles of fairness and impartiality, making sure that every individual in the population has the same chance of being selected for the sample (Babbie, 2016).

At its core, simple random sampling relies on the fundamental concept of randomness, a cornerstone in achieving an unbiased and truly representative subset that accurately reflects the diverse characteristics of the entire population. In practical terms, the implementation of simple random sampling involves several key steps. To ensure an unbiased selection of food handlers, a list of all eligible food handlers from each participating school was obtained, excluding student interns and temporary staff. Slips of paper were prepared; each labeled either "Yes" or "No." The number of "Yes" slips corresponded to the required number of participants per school, while the remaining slips were marked "No." All slips were folded, mixed thoroughly, and placed in a container. Each food handler was asked to randomly pick one slip. Those who picked a "Yes" slip were selected to participate, while those who picked a "No" slips were not included in the sample. The number of "Yes" slips per school was determined based on the proportion of food handlers in that school relative to the total sample size. This ensured fair representation across all participating schools. This method ensured that each food handler had an equal chance of selection, maintained randomness and minimized bias.

Data Collection Instruments

The study used questionnaire and observation checklist to collect data.

Questionnaire

In this study, the researcher employed a questionnaire as the primary tool for data collection. The questionnaire consisted of four sections. The first section (Section 1) collected data on the socio-demographic characteristics of the food

handlers. The second section (Section 2) evaluated the food handlers' knowledge of food safety, with response options of true, false, and don't know. The third section (Section 3) examined the food handlers' attitudes towards food safety, with response options of very important, somewhat important, and not important. The final section (Section 4) examined the practices of the food handlers, with response options of always, sometimes, and never.

To ensure the validity and reliability of the research instrument, a pilot test was conducted with 10 food handlers at Savelugu Senior High School. This pilot test helped refine the questionnaire by identifying ambiguous questions and ensuring that all items were clearly understood by participants. The study variables included food handlers' knowledge, attitudes, and practices. The reliability of the questionnaire was assessed using Cronbach's alpha coefficient (α), with an acceptable threshold of 0.7. The results showed high internal consistency across all scales: knowledge (α = 0.9), attitudes (α = 0.9), and practices (α = 0.9). This confirms that the instrument was highly reliable for measuring food safety knowledge, attitudes, and practices among food handlers.

Observation checklist

In addition to using a designed questionnaire, direct observations of food handlers' practices were conducted across the schools, covering areas such as food hygiene, personal hygiene, and environmental hygiene. This direct observation of food handlers' hygiene behaviour was used to confirm participants' responses to their hygiene practices. The researcher used a structured observation checklist, adapted from the Food and Drug Authority (FDA) food safety and

sanitation compliance checklist for the study . Food safety practices were evaluated under three main categories: 1. Personal hygiene (e.g., hand washing, wearing protective clothing), 2. Food hygiene (e.g., proper food storage, handling of raw and cooked food), and 3. Environmental hygiene (e.g., cleanliness of kitchen areas, waste management). The observations were recorded as "Yes" or "No" for compliance with each criterion. Additional remarks were noted for cases requiring clarification or further analysis. To maintain consistency two trained field assistants assisted with data collection. They received training on standardized observation techniques to minimize subjectivity and ensure reliability. The same checklist was used in all schools to ensure uniform evaluation criteria. The researcher cross-checked observation data against self-reported questionnaire responses to verify the accuracy of food handlers' reported practices. This structured approach ensured systematic, objective, and reliable observation of food safety practices in different school environments of the study.

Recruitment and Training of Field Assistants

In reference to the eleven (11) public senior high schools involved in the study, two (2) field assistants were recruited for the data collection. Persons with a minimum qualification of a diploma certificate, past experience in data collection, and fluency in Twi and Dagbani were recruited for the field work. They were trained in questionnaire administration techniques and in translating the questions into two local languages, Dagbani and Twi, to help food handlers who may not be fluent in English. The field assistants were also trained on ethical standards before being commissioned to collect data.

Data Collection Procedures

Prior to the data collection, the researcher obtained an introductory letter from the department and ethical clearance from the Institutional Review Board (IRB) of the University of Cape Coast. Once the necessary approvals were obtained from the school authorities, the consent of the food handlers were sought by administering the consent form to the participants from January 8th–12th, 2024. The importance of the study was explained to the food handlers, their involvement, the ethical principles guiding the entire study, and the need to fill out the consent form. Data collection was done in two forms through questionnaire and observation checklist between January 15th - 31st, 2024. The observation section was done by the researcher using a checklist, and the distribution of questionnaires to food handlers was done by two trained field assistants assigned for this task. Responding to the questionnaire took about 25 minutes; therefore, the food handlers were allowed to send the questionnaire home to fill out and return it the following day to prevent interruption of working periods for the participants. However, food handlers who could not read or write had the questionnaire translated into Dagbani or Twi by the field assistants at the convenience of the participants. Completed questionnaires were enveloped and sealed to ensure confidentiality.

Data Analysis

The data analysis was performed using version 20 of the Statistical Package for the Social Sciences (SPSS) software. The aim of quantitative data analysis is to transform raw numerical data into meaningful information through

logical and analytical methods. This research process focuses on identifying evidence to either support or refute the hypotheses that were developed, and as a result, a one-sample t-test was applied to hypothesis one H_o1: "Food handlers do not have significantly high knowledge of food safety". Hypothesis two H_o2: "Food handlers do not have a significantly positive attitude toward food safety", and hypothesis three H_o3: "Food handlers do not exhibit significantly high levels of food safety practices", The one-sample t-test was used to assess whether the mean scores of food handlers' knowledge, attitudes, and practices (KAP) differed significantly from a predefined reference value. The study adopted a significance level of 0.05 ($\alpha = 0.05$), which is the conventional threshold for hypothesis testing in social and health sciences. This threshold ensures that the probability of rejecting a true null hypothesis is minimized to 5%. This statistically grounded approach ensures scientific validity and practical relevance in evaluating food handlers' competencies. Finally, Pearson Moment correlation was applied to hypothesis four H_o4: "There is no significant correlation between knowledge, attitudes, and practices of food handlers." to identify the correlation among the food handlers' food safety knowledge, attitudes, and practices.

Data Management

The principal investigator, the field assistants, and the study supervisor had access to the field data. Upholding the utmost confidentiality and anonymity of the collected data was paramount. Therefore, a stringent protocol was implemented to safeguard the privacy of participants. Upon completion of the data collection, all questionnaires were assigned unique codes, dissociating them

from any identifying information about the participants. This measure ensured that individual identities remained undisclosed and protected throughout the study process.

Furthermore, to reinforce data security, both hard copies and soft copies of data will be stored in separate, secure places. Hard copies of the data were securely kept in a locked filing cabinet, accessible only to authorized personnel involved in the study. Similarly, the softcopy data was encrypted and stored on a dedicated pen drive device, safeguarding it from unauthorized access or tampering. These measures were planned to mitigate any potential risks associated with data breaches or unauthorized access. For the purposes of research integrity and accountability, all data will be retained securely for a period of five years after the completion of the study. This duration will allow for the preservation of evidence to substantiate the study methodology, results, and ethical conduct in the event of any challenges or inquiries pertaining to the research. However, upon the expiration of this five-year period, the hard copies will be shredded to render them irretrievable, while the softcopy data stored on the pen drive will be permanently cleared, leaving no trace of the confidential information it once contained. Adherence to these rigorous data management protocols will not only protect the rights and privacy of participants but also bolster the credibility and reliability of the research results.

Ethical Considerations

The ethical integrity of this study is paramount, and as such, the researcher sought for ethical clearance from the Institutional Review Board (IRB) of the

University of Cape Coast prior to commencing data collection. Additionally, formal permission was sought from the Tamale Metro Director of Education and the Headmasters and Headmistresses of the public senior high schools involved through an introductory letter from the Head of Department of Vocational and Technical Education, University of Cape Coast. The participants were informed on the study's purpose, the procedures to be followed, and any potential risks associated with their involvement. Ethical considerations such as informed consent, anonymity, and the right to withdraw from the study were thoroughly explained to all respondents. Consent was obtained through the administration of a consent form before the commencement of the main data collection phase. To protect the anonymity of participants and prevent the disclosure of individual identities, each respondent was assigned a unique code, dissociating them from any personally identifiable information, and only the researcher, field assistants, and study supervisors were granted access to the data, ensuring that participants' privacy rights were safeguarded throughout the study. Finally, referencing protocols was adhered to for all sources utilized in this study, including articles, journals, books, and other scholarly materials. This ensured academic integrity and recognition of the contributions of previous research in informing the current study's framework and findings.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This chapter presents the data collected, along with the analysis and discussion of the findings in relation to the objectives of the study.

Study participants

The total study population was 237 food handlers from eleven (11) government Senior High Schools in Tamale. A sample size of 148 participants was derived from Krejcie & Morgan's (1970) table and used for the study. Data was collected from nine (9) out of the eleven (11) Schools. The two schools that refused to join had a total of 27 food handlers and were therefore excluded. The final sample size was 131 participants. One hundred and thirty-one (131) questionnaires were distributed to the respondents at their schools' compound. All the questionnaires were completed fully and accurately, resulting in a 100% response rate. The diagram below shows participant inclusion and exclusion criteria.

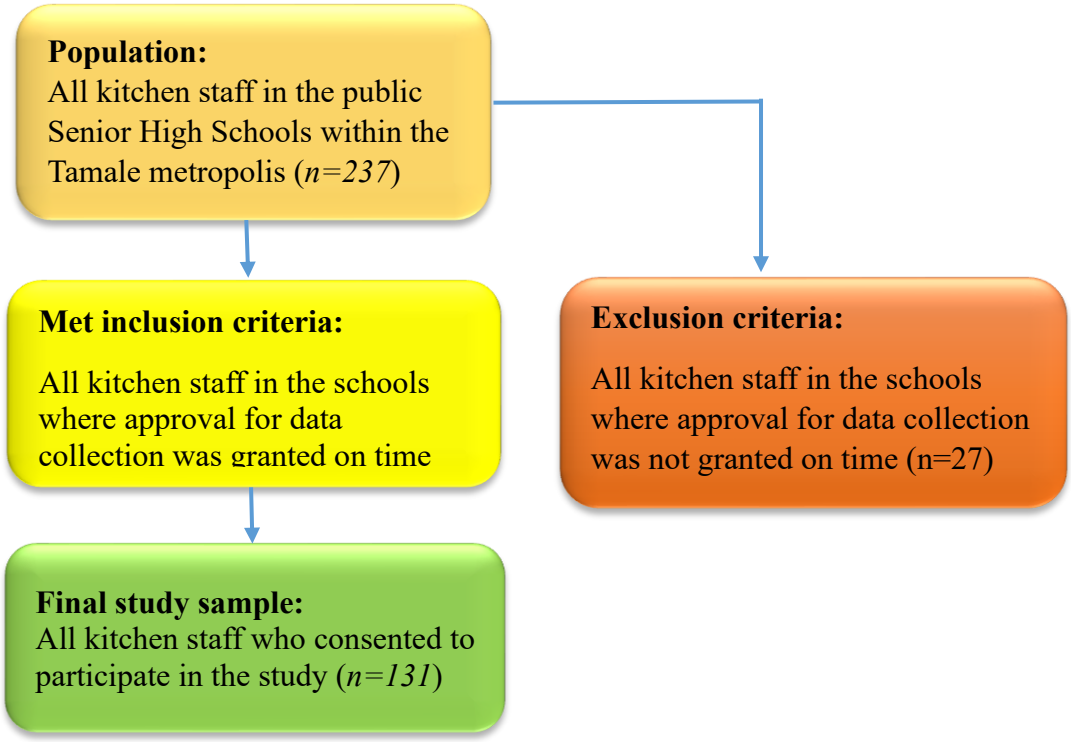

Figure 3: A Diagram showing Participants Inclusion and Exclusion

Presentation of Results

Socio-demographic and general characteristics of the respondents

Out of the 131 food handlers, females (77.9%) were slightly more than three times that of males (22.1%) as presented in Table 4.1. The ages of the respondents were ranged from 20 years to over 50 years and the result revealed that majority (32.8%) of the respondents were between 30 and 39 years of age; 29.8% were between 40 and 49 years old; 16% were between 20 and 29 years old; and 21.4% were between 50 and 59 years old. Regarding the educational status of respondents, 33.6% had attained polytechnic or university education, 26.0% had primary or secondary education, and 3.8% having other forms of education, while the remaining 36.6% of respondents had no formal education at all. About 67.9% of the participants were married, 10.7% were single, and 13.0% were widowed.

The majority (13.7%) of them were from Business Senior High School, while the least (6.1%) participants were from Anbariya Senior High School. About 34.4% of the participants worked in the school kitchen for at least 1–5 years at the time of the study, 29.8% of the participants had worked for 6–10 years, and 16.0% had worked for 16 years or more. With reference to the certificates that these food handlers possessed especially for a food safety training course, 9.2% reported having a vocational school certificate, 14.5%, a secondary school certificate, 20.6%, a polytechnic certificate, 7.6%, first degree, and 3.1%, a basic school certificate. Surprisingly, 45% of the food handlers reported not having any certification in food safety training.

Table 2 Socio-Demographic and general characteristics of the respondents

Variable	Frequency (n)	Percentage (%)
Place of Work		
Tamale SHS	16	12.2
Tamale Girls SHS	14	10.7
Islamic SHS	16	12.2
Kalpohin SHS	16	12.2
Anbariya SHS	8	6.1
Business SHS	18	13.7
Vitting SHS	12	9.2
GHANASCO	14	10.7
NOBISCO	17	13.0
Length of employment as a kitchen staff		
1-5yr	45	34.4
6-10yr	39	29.8
11-15yr	26	19.8
16yr & above	21	16.0

Certificates in food safety training course		
Basic certificate	4	3.1
Secondary school certificate	19	14.5
Vocational School certificate	12	9.2
Polytechnic certificates	27	20.6
First degree and above	10	7.6
None	59	45.0

Source: Bukari, 2024

Assessment of respondents' food safety knowledge

In assessing the knowledge level of the respondents on food safety procedures in this study, 18 multiple-choice questions were used, where one mark was awarded for each correct answer, and zero mark given for incorrect answers. The total score for food safety knowledge of the respondents was calculated by summing the marks for each item, and the mean ± standard deviation (SD) of the food safety knowledge score was computed. Table 4.1 illustrates the knowledge of the respondents in food safety procedures. Contaminated food always comes with some negative change in taste as correctly reported by majority (74.0%) of the food handlers, while 22.1% and 3.8% responded wrongly and also showed some level of ignorance respectively. A total of 89 respondents, representing 67.9%, knew that contaminated food always had some changes in colour. When asked, whether contact between cooked and raw foods could lead to food contamination, 90.1% of the respondents correctly responded. Majority of the respondents (95.4%) knew that separate surfaces should be used for cooked and raw food, while 1.5% did not know that. Again, regarding the fact that farm produce must be washed before cooking, almost all the respondents answered it correctly. Items

on hygiene such as keeping the hair uncovered during cooking could cause food contamination, majority (93.1%) of the food handlers responded correctly, while 6.1% and 0.8% responded wrongly and showed some level of ignorance and did not know.

To be able to exhaustively assess the knowledge on food safety of the respondents, the study further examined their knowledge on whether wearing jewelry, such as rings, during food handling could cause food contamination. A total of 120 respondents (91.6%), responded correctly. Also, food handlers when they get diarrhoea tend to pose a risk to food contamination; the majority (93.8%) of the food handlers responded correctly, while 3.1% and 3.1% responded wrongly and showed no knowledge of what happened last year. Proper washing of utensils is very important in ensuring food safety; almost all the respondents, 99.1%, responded correctly to that time. The mean ± SD food safety knowledge score was 16.1 ± 2.14, with a minimum score of 8 points and a maximum score of 18 points.

Table 3: Food safety knowledge of respondents

Variables	Responses n (%)		
	True	False	Do not know
Contaminated food always changes in taste.	97 (74.0)	29(22.1)	5(3.8)
Contaminated food always changes in smell.	85(64.9)	41(31.3)	5(3.8)
Contaminated food always changes in colour.	89(67.9)	40(30.5)	2(1.5)
Contact between cooked and raw foods can lead to contamination.	118(90.1)	12(9.2)	1(0.8)
Different surfaces should be used for cooked and raw food.	125(95.4)	4(3.1.)	2(1.5)
Farm produce must be washed before cooking.	124(94.7)	4(3.1)	3(2.3)
Cooked food should be served at a temperature of at least 60°C or higher to inhibit bacterial growth.	114(87.0)	8(6.1)	9(6.9)
Healthy individuals can transmit germs into food.	111(84.7)	18(13.7)	2(1.5)
Keeping the hair uncovered during cooking can cause food contamination.	122(93.1)	8(6.1)	1(0.8)
Wearing of jewelry such as rings while handling food can lead to contamination	120(91.6)	7(5.3)	4(3.1)
Food handlers wear protective clothing to prevent food contamination.	117(89.3)	11(8.4)	3(2.3)
Hand hygiene helps in prevention of food contamination.	126(96.2)	3(2.3)	2(1.5)

A food handler with a disease such as diarrhoea increases the risk of contaminating food.	123(93.9)	4(3.1)	4(3.1)
Proper washing of utensils is very important in ensuring food safety.	130(99.2)	1(0.8)	0(0.0)
Cooking utensils should be washed in soapy water.	128(97.7)	2(1.5)	1(0.8)
It is necessary to rinse utensils under running water or in warm water.	125(95.4)	3(2.3)	3(2.3)
Cooking should be done in a clean environment (inside and outside).	128(97.7)	0(0.0)	3(2.3)
Regular medical examinations are necessary in order to promote food safety.	127(96.9)	2(1.5)	2(1.5)

Source: Bukari, 2024

Overall knowledge level of the food handlers

The respondents' knowledge levels were categorized as low or high. Respondents whose knowledge level score was above 70% of the total score were grouped as having a high knowledge level, while those with a lower knowledge level score below 70% of the total score were categorized as having a low knowledge level. In all, majority of the respondents, 121 (92.4%), demonstrated high knowledge of food safety, whereas 10 (7.6%) demonstrated low knowledge (Figure 4.2).

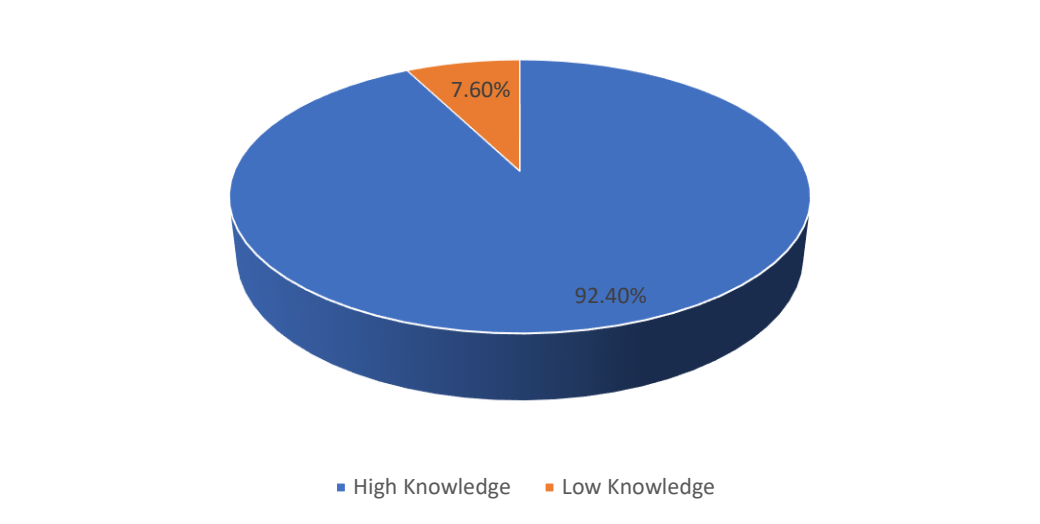

Figure 4: Overall knowledge on food safety
Source: Bukari, 2024

Descriptive Analysis and One Sample T-test Analysis of the overall knowledge of the food handlers

Table 4.3 demonstrates that all the variables of the knowledge assessment of the respondents were capable of influencing their knowledge. A one-sample t test was run on the overall knowledge score. There was a statistically significant difference in food handlers' knowledge of food safety since the p-value (0.0001) for a 95% confidence interval is less than the significance level (0.05).

Table 3: Descriptive Analysis and One Sample T-test Analysis of the overall knowledge of the food handlers

	Test Value = 0.05					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Knowledge Score	86.223	130	.000	16.09924	15.7298	16.4686

Source: Bukari, 2024

Food handlers' attitudes towards food safety measures

Attitudes towards food safety practices of the food handlers were evaluated using 14 items rated on a 3-point Likert scale (1 = not important, 2 = slightly important, and 3 = very important). The mean ± SD score for attitudes towards these practices was then calculated. In Table 4.4, majority (95.4%) of the respondents perceived that food safety for human health was very important, while 2.3% thought it was not important. Similarly, 95.4% of the respondents perceived that training for food handlers is very important, while 2.3% thought it was not important. Furthermore, 94.7% indicated that hand washing is a very important food safety practice. In addition, 93.1% noted that washing farm produce before cooking was very important, while 6.1% thought otherwise. Similarly, 95.4% of the respondents agreed that keeping hair covered during food preparation was very important. Furthermore, 91.6% of the respondents affirmed that the removal of jewelry before food preparation is very important, while 2.3% thought otherwise. Again, 90.8% of the respondents indicated that the food temperature guidelines are very important in minimizing the risk of foodborne illnesses, while 3.1% think otherwise. In addition, 88.5% of the respondents affirmed that the sensory expectation of food in determining fitness to eat is very important, while 0.8% thought otherwise. Similarly, 98.5% of the respondents perceived that keeping the cooking environment clean was very important, while 0.8% thought otherwise. The mean ± SD attitude score of food handlers towards food safety and hygienic practice was 40.94 ± 2.58, with a minimum score of 27 points and a maximum score of 42 points. The overall attitude of the food

handlers was perceived to be significantly positive based on their attitude mean score.

Table 4: Respondents' Attitudes towards food safety measures

Variable	Response n (%)		
	Not Important	Slightly Important	Very Important
How important is food safety to human health?	3(2.3)	3(2.3)	125(95.4)
How important is food safety training for food handlers?	2(1.5)	3(2.3)	125(95.4)
How important is hand washing to food safety practices?	0(0.0)	7(5.3)	124(94.7)
How important is the washing of farm produce before cooking?	1(0.8)	8(6.1)	122(93.1)
How important is keeping your nails neatly trimmed?	2(1.5)	7(5.3)	112(93.1)
How important is it to keep your hair covered during food preparation?	2(1.5)	4(3.1)	125(95.4)
How important is the removal of jewellery before food preparation?	3(2.3)	8(6.1)	120(91.6)
How important is the use of separate surfaces for raw and cooked food?	1(0.8)	7(5.3)	123(93.9)
How important are food temperature guidelines in minimizing the risk of foodborne illnesses?	4(3.1)	8(6.1)	119(90.8)
How important is sensory expectation of food in determining fitness to eat?	1(0.8)	13(9.9)	116(88.5)
How important is checking the expiration date of food products before usage?	1(0.8)	5(3.8)	125(95.4)
How important is the wearing of clean protective clothes during food preparation?	2(1.5)	6(4.6)	123(93.9)
How important is keeping the cooking environment clean as part of the food safety requirement?	1(0.8)	1(0.8)	129(98.5)
How important is regular medical examination of food handlers?	2(1.5)	5(3.8)	124(94.7)

Source: Bukari, 2024

Descriptive Analysis and One Sample T-test Analysis of the overall attitude of the food handlers

Table 4.5 illustrates that all the variables included to assess the food handler's attitude were capable of influencing their attitude towards food safety. A one-sample t-test was run on the overall attitude score. The result shows a statistically significant difference in food handlers' attitudes since the p-value (0.0001) for a 95% confidence interval was less than the significance level (0.05).

Table 5: Descriptive Analysis and One Sample T-test Analysis of the overall attitude of the food handlers

	Test Value = 0.05					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Attitude Score	180.318	130	.000	40.89615	40.4474	41.3449

Source: Bukari, 2024

Food safety practices assessment

The food handlers' practices in food safety were assessed using an 18-item questionnaire, where responses were recorded as 'yes', 'no', or 'never'. Each correct response was awarded one mark, and incorrect responses received zero marks. The mean ± SD score of the respondents' practices in these areas was computed based on their responses. The results are presented in Table 4.4 below. Almost all the participants (96.9%) indicated they always washed their hands before cooking. However, only 37.4% indicated they always wore gloves when handling food, while 34.4% sometimes used gloves, and 28.2% never used gloves when handling food. Also, almost all the participants (95.4%) indicated they

always washed their hands after using the washroom during cooking, while 4.6 indicated they sometimes did so after using the washroom. Furthermore, 69.5% indicated that they always wore protective clothing when cooking, while 25.2% sometimes wore protective clothing, and 5.3% never wore protective clothing when cooking. On how often they rinsed utensils under running or warm water, 78.6% indicated that they always did, 18.3% indicated that they sometimes did and 3.1% indicated that they did not rinse utensils under running or warm water. Also, on how often they used separate surfaces for raw and cooked food, 88.5% indicated they always did, 9.9% indicated that they sometimes did, and 1.5% indicated that they did not use different surfaces for handling raw and cooked food. Furthermore, on how often they go for medical check-ups, about half of the participants (50.4%) indicated that they always did, 42.0% indicated that they sometimes did, and 7.6% indicated that they did not go for medical check-ups. The mean ± SD food safety practice score was 9.84 ± 1.85, with a minimum score of 4 points and a maximum score of 12 points. The overall practice of the food handlers was considered to be good based on their mean score of food safety practices.

Table 6: Food safety practices assessment

Variables	Responses n (%)		
	Always	**Sometimes**	**Never**
How often do you wash your hands before cooking?	127(96.9)	4(3.1)	0(0.0)
How often do you wear gloves when handling food?	49(37.4)	45(34.4)	37(28.2)
How often do you wash your hands after using the washroom during cooking?	125(95.4)	6(4.6)	0(0.0)
How often do you remove your jewellery when cooking?	91(69.5)	33(25.2)	7(5.3)
How often do you wear protective clothing when cooking?	91(69.5)	30(22.9)	10(7.6)
How often do you keep the kitchen clean?	124(94.7)	6(4.6)	1(0.8)
How often do you keep dustbins covered?	97(74.0)	27(20.6)	7(5.3)
How often do you wash utensils in soapy water?	119(90.8)	11(8.4)	1(0.8)
How often do you rinse utensils under running or warm water?	103(78.6)	24(18.3)	4(3.1)
How often do you wash maize before soaking?	115(87.8)	9(6.9)	7(5.3)
How often do you wash maize after soaking?	123(93.9)	7(5.3)	1(0.8)
How often do you wash beans before cooking?	126(96.2)	5(3.8)	0(0.0)
How often do you use separate surfaces for raw and cooked food?	116(88.5)	13(9.9)	2(1.5)
How often do you separate raw food from cooked food?	120(91.6)	10(7.6)	1(0.8)
How often do you serve cooked food at a hot temperature (60°c or above)?	102(77.9)	27(20.6)	2(1.5)
How often do you maintain a standard temperature for food storage?	103(78.6)	20(15.3)	8(6.1)
How often do you participate in food safety workshops?	51(38.9)	48(36.6)	32(24.4)
How often do you go for medical check-ups?	66(50.4)	55(42.0)	10(7.6)

Source: Bukari, 2024

Overall practice level of the food handlers

The food safety practices of the respondents were categorized into poor and good practices. Respondents whose practice level score was above 70% of the total score were grouped as having a good practice level, while those with a practice level score below 70% of the total score were categorized as having poor practice. In all, majority of the respondents, 101 (77.1%), demonstrated good practice in food safety, whereas 30 (22.9%) demonstrated poor practice (Figure 4.3).

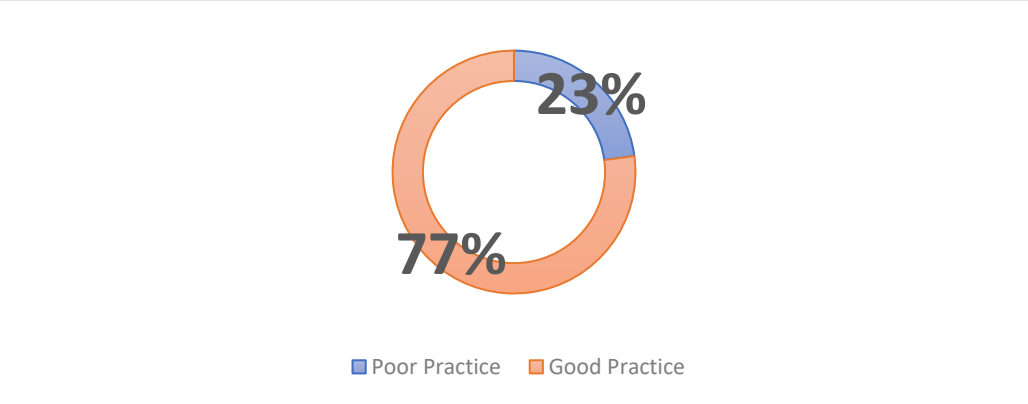

Figure 5: Overall practice level of the food handlers
Source: Bukari, 2024

Descriptive Analysis and One Sample T-test Analysis of the overall practice of the food handlers

Table 4.7 demonstrates that all the variables included in the assessment of the food handler's practice are capable of influencing their practice. A one-sample t test was run on the overall practice score. The result indicated a significant difference in food handlers' practices since the p-value (0.0001) for a 95% confidence interval is less than the significance level (0.05).

Table 7: Descriptive Analysis and One Sample T-test Analysis of the overall practice of the food handlers

	Test Value = 0.05					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Practice Score	60.342	130	.000	9.79733	9.4761	10.1185

Source: Bukari, 2024

Personal hygiene of food handlers (Checklist)

On observation of the personal hygiene practices of respondents in the various schools, the results of study revealed that all the respondents (100%) wore a cap or had their hair restrained during food preparation and service. On additional inspection of the personal hygiene of the food handlers, it was detected that more than half (66.7%) wore a clean apron or overcoat during food preparation and service, while 33.3% do not. Furthermore, all the food handlers wore gloves during the preparation and serving of the cooked food. Majority (77.80%) of the food handlers did not cut their finger nails neatly as expected. Also, more than half of the respondents did not wash their hands in between handling raw and cooked food. The results are shown in figure 4.4.

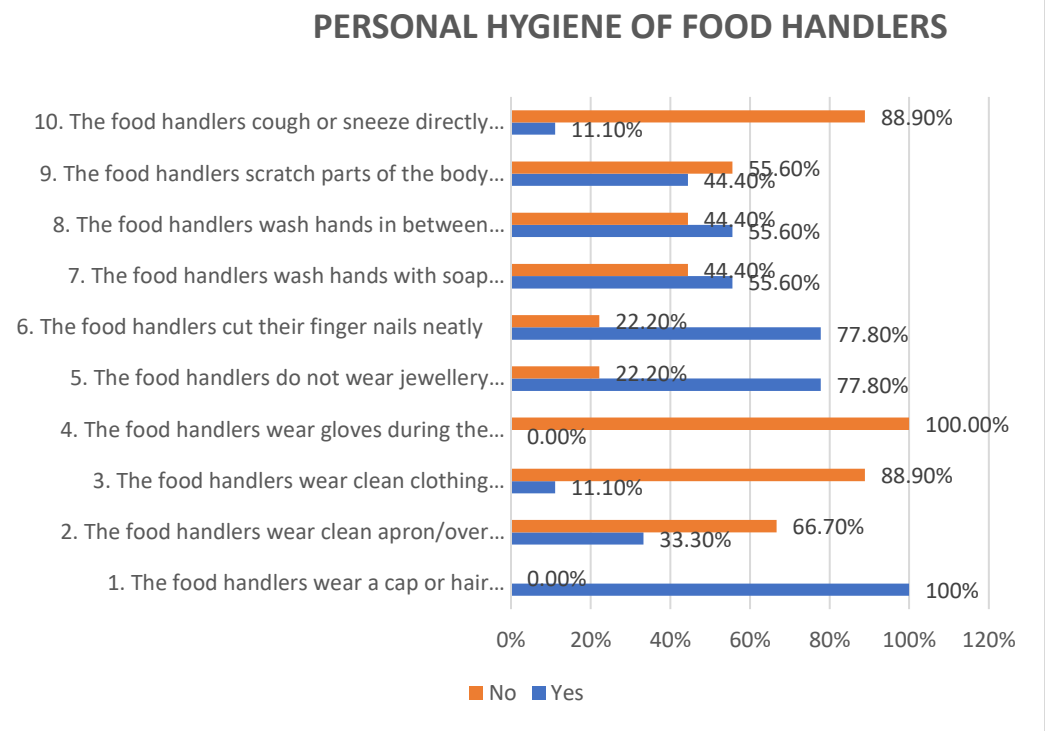

Figure 6: Personal hygiene of food handlers
Source: Bukari, 2024

Environmental hygiene and sanitation (Checklist)

On observation of the environmental hygiene and sanitation practices of food handlers in the schools. The results in Table 4.8. showed that all the food handlers (100%) operated in a clean environment (inside and outside), potable water was used for food preparation, and suitable containers for water storage were available. However, only 22.2% of the kitchen was provided with self-closing doors, windows, and other openings were protected to eliminate pests. Also, only 3 (33.3%) of the schools had waste bins with fitting lids available, and waste bins in the kitchen were emptied regularly.

Table 8: Environmental hygiene and sanitation

Environmental hygiene and sanitation	Responses n (%)	
	Yes	No
Food handlers operate in a clean environment.	9(100.0)	0(0.0)
An adequate and appropriate drainage system is provided	6(66.7)	3(33.3)
The kitchen is provided with self-closing doors	2(22.2)	7(77.8)
Doors, windows, and other openings are protected to eliminate pests	2(22.2)	7(77.8)
Adequate ventilation in the kitchen to remove heat and odour	7(77.8)	2(22.2)
Floors, Walls, and Ceilings kept clean; free from dirt, stains and cobwebs.	4(44.4)	5(55.6)
Waste bins with fitting lids are available.	3(33.3)	6(66.7)
Waste bins in the kitchen are emptied regularly.	3(33.3)	6(66.7)
The main waste bins outside are emptied daily.	4(44.4)	5(55.6)
Provision of adequate toilet facilities and accessories.	4(44.4)	5(55.6)
Toilet facilities are kept clean.	4(44.4)	5(55.6)
Provision of hand washing stations and equipped with sanitary towel for use by kitchen staff.	2(22.2)	7(77.8)
Potable water is used for food preparation.	9(100.0)	0(0.0)
Suitable means of water storage are available.	9(100.0)	0(0.0)

Source: Bukari, 2024

Food hygiene practices of food handlers (Checklist)

On observation of the food hygiene practices of the respondents in the various schools. From Figure 4.5, the results indicated that all cooked foods were served hot. However, none of the respondents used calibrated food thermometers for checking the appropriate temperatures of the food. About 77.8% of the food handlers separated raw foods such as meat, vegetables, and salads from cooked foods during storage, while 88.9% of the food handlers washed food items before use or storage. The results are shown in

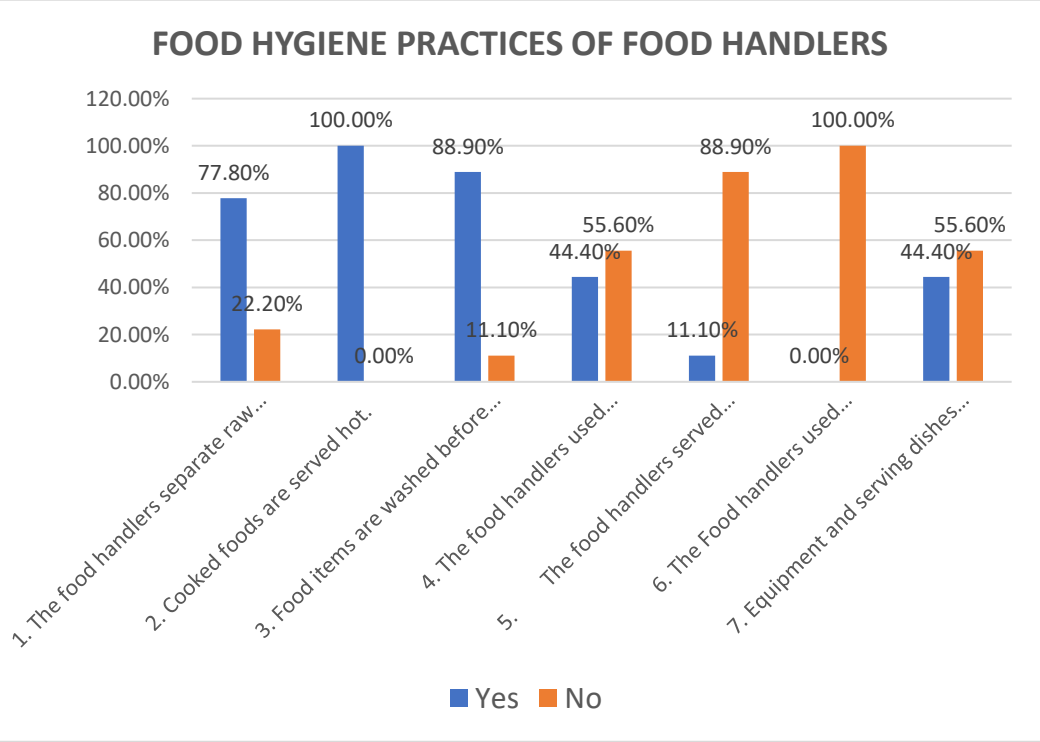

Figure 7: Food hygiene practice of food handlers
Source: Bukari, 2024.

Correlation analysis among continuous variables and food hygiene and safety practice scores

The correlation analysis was used to examine linear relationships among continuous variables (knowledge, attitude, and practice). Statistical significance was set at a p-value of less than 0.05 with a 95% confidence interval. A strong positive association (r = 0.6604) was discovered between participants' food safety knowledge, and attitude, and practice. Furthermore, a strong positive association (r = 0.4397) was found between participants' food safety knowledge and their practices. Also, a strong positive association (r = 0.4792) was discovered between participants' attitude level and their food safety and hygiene practices. The results are shown in Table 4.9 below.

Table 9: Correlation analysis among variables and food safety and hygienic practice score

Variables	Knowledge score	Attitude score	Practice score
Knowledge score	1.000		
Attitude score	0.6604*	1.000	
Practice score	0.4397*	0.4792*	1.000

*Correlation is significant at the 0.05 level (2-tailed).
Source: Bukari, 2024

Multiple linear regression analysis of factors associated with food safety and hygienic practice

A linear regression was conducted to assess the relationship between food safety and hygienic practice and the independent variables knowledge score and attitude score. To ensure the validity of the regression model, these assumptions were tested:

1. Normality of Residuals: A normal Q-Q plot was used to confirm that residuals followed a normal distribution.
2. Multicollinearity: Variance Inflation Factors (VIF) were calculated, and all values were below 10, indicating no serious multicollinearity among predictor variables.
3. Homoscedasticity: A residuals vs. fitted values plot was examined to confirm that variance remained constant across observations.
4. Linearity: Scatter plots were used to verify the linear relationship between independent variables (knowledge and attitude scores) and the dependent variable (food safety and hygienic practices).

These diagnostic tests confirmed that the assumptions of multiple linear regression were met, ensuring the robustness of the model. Descriptive statistics were used to identify the proportion of missing values within the dataset. Cases with minimal missing values (less than 5%) were addressed using mean imputation for continuous variables (e.g., knowledge, attitude, and practice scores) and mode imputation for categorical variables. This method preserves the overall distribution of the data while minimizing the impact of missing values on

the analysis. However, cases where a substantial portion of responses was missing (more than 20% of responses in a single variable), the affected records were excluded from analysis to prevent distortion of statistical results. A sensitivity analysis was conducted to compare results with and without imputed data, ensuring that the imputation process did not introduce bias.

Outliers were identified using box plots and standardized z-scores, with extreme values defined as those exceeding ±3 standard deviations from the mean. For continuous variables such as knowledge, attitude, and practice scores, outliers were further assessed using Cook's distance and Mahalanobis distance to determine their influence on regression estimates. Outliers that significantly affected the model were either adjusted to the nearest acceptable value within the normal range) or removed if they were deemed to be errors in data entry.

The model summary table assessed the overall regression model. In the first section, R indicates the correlation that exists between the independents. R-square (R2) is the proportion of variance in the dependent variable that can be predicted from the independent variables. The constant is the conditional mean when all predictors' variables are zero. The result as presented in Table 4.10 explained 25.6% of the variance ($R^2 = 0.256$) in food safety and hygienic practices, indicating that knowledge and attitude scores contribute moderately to variations in practice. The correlation coefficient ($R = 0.506$) suggests a moderate to strong association between the predictor variables (knowledge and attitude) and the outcome variable (food safety and hygienic practice). More specifically, the standardized regression coefficients (β) from Table 4.12 show that attitude scores

(β = 0.337, p = 0.001) have a stronger association with food safety and hygienic practices compared to knowledge scores (β = 0.216, p = 0.004). This indicates that a one-unit increase in attitude scores is associated with a 0.337 increase in practice scores, while a one-unit increase in knowledge scores is associated with a 0.216 increase in practice scores. Additionally, the 95% confidence intervals for knowledge scores (0.0123 to 0.364) and attitude scores (0.097 to 0.388) confirm the statistical significance of these relationships, as the intervals do not include zero. These findings suggest that improving attitudes toward food safety may have a stronger impact on enhancing hygienic practices than increasing knowledge alone.

Table 10: Summary Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.506[a]	0.256	0.244	1.6205

Predictors: (Constant), knowledge score, attitude score.
Source: Bukari, 2024

Table 11: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	114.708	2	57.35	21.84	.000[b]
	Residual	333.515	127	2.62		
	Total	448.223	129			

a. Predictors: (Constant), knowledge score, attitude score
Source: Bukari, 2024

b. dependent variable **(**food safety and hygienic practice)

Table 12: Coefficient

Model		Unstand-ardized Coefficients		Standa r-dized Coeffic -ients	T	Sig.	95% CI	
		B	Std. Error	Beta				
1	(Constant)	-3.12	2.331		-1.34	0.183	-7.728	1.494
	Know-edge Score	0.188	0.089	0.216	2.12	0.004	0.0123	0.364
	Attit-ude score	0.242	0.073	0.337	3.30	0.001	0.097	0.388

Dependent variable (food safe and hygienic practice)
Source: Bukari, 2024

Discussion of Findings

The findings of the study were discussed to present the facts as to whether the objectives of the study have been achieved. The findings were also compared with the results of past researches to see the level of agreement or disagreement between the researchers.

Knowledge of food handlers on food safety

This study assessed the knowledge of food handlers in food safety at the Senior High Schools in Tamale with a null hypothesis; H_o1: "Food handlers do not have significantly high knowledge of food safety". The result, however, showed a significant difference in their knowledge in food safety procedures. The knowledge level assessment of the respondents was categorized into low and high. Participants whose knowledge level score was above 70% of the total score were grouped as having a high knowledge level, while those with a lower knowledge level score below 70% of the total score were categorized as having a

low knowledge level. In all, majority of the respondents, 121 (92.4%), demonstrated high knowledge of food safety, whereas 10 (7.6%) demonstrated low knowledge of food safety (Figure 4.1). In reference to this finding, the null hypothesis of the study was rejected.

The difference in knowledge among the respondents could be attributed to the high percentage of food handlers who had no formal education or certification in food safety training (Table 4.1). This underscores the need for targeted educational programmes to ensure all food handlers are adequately trained in food safety principles. The finding aligns with various researches conducted globally, which have also identified gaps and variations in knowledge and practices among respondents. For instance, Siau (2015) found that food handlers generally had high knowledge in food safety procedures. While Siau reported high general knowledge, the current study's statistically significant difference in food handlers' food safety knowledge indicates that there are still critical areas with substantial knowledge gaps, emphasizing that a high general understanding does not necessarily translate to thorough knowledge across all areas. Findings by Moreb, Priyadarshini, and Jaiswal (2017) highlighted varying levels of understanding among food handlers, with some demonstrating good knowledge and others showing deficiencies, particularly in food handling techniques and hygiene standards. The significant difference found in the knowledge among food handlers in the current study supports the observation of varying levels of knowledge, indicating that while some food handlers may have a good grasp of food safety principles, significant gaps still exist that need to be addressed through continuous

training and education. Similarly, Gong et al. (2016) also reported mixed levels of knowledge among food handlers in Mainland China, with common issues in handwashing, food storage, and awareness of cross-contamination. In addition, Gruenfeldova, Domijan, and Walsh (2019) also found satisfactory knowledge levels among food handlers in Ireland but noted significant gaps in specific areas such as handwashing, and prevention of food contamination. This is in line with the current study's findings of a significant difference in food handlers' knowledge of food safety, emphasizing the need for training in these areas. The comparative analysis of food handlers' knowledge in Malaysian schools by Chan et al. (2022) revealed notable differences in the knowledge of food handlers based on their level of education, work experience, and cultural background. This difference in food handlers' knowledge aligns with the findings of the current study, indicating that demographic factors significantly influence the respondents' knowledge and the need for customized training interventions.

The findings of study on food handlers' knowledge of food safety can be better understood through the Theory of Reasoned Action (TRA) which posits that individuals' behaviors are driven by their intention, which is influenced by their knowledge and subjective norms (Fishbein, 1967). In the context of this study, the high level of food safety knowledge (92.4%) among respondents suggests that many food handlers hold favorable attitudes toward safe food handling practices. Their knowledge may shape positive behavioral intentions, leading to safer food handling. However, the significant variations in knowledge indicate that while some food handlers intend to practice food safety, gaps in

knowledge might hinder their ability to execute these practices effectively. Subjective norms such as workplace culture, peer influence, and supervisory expectations may play a role in reinforcing or undermining food safety knowledge. Food handlers work in an environment where hygiene standards are emphasized, their knowledge is more likely to translate into practice. Thus, to enhance food safety practices, knowledge alone is not enough; workplace norms and reinforcement through policies and peer influence must support behavior change. To improve food handlers' practical application of food safety knowledge, interventions should be designed based on this theoretical framework by strengthening subjective norms (TRA). Ghana Food and Drugs Authority (FDA) and the Ghana Education Service (GES) should collaborate to develop biannual training programmes to promote food safety in the senior high schools in Ghana.

In summary, the current study's finding is consistent with the broader body of research, indicating that while there is generally a high level of knowledge among the respondents, significant gaps persist in specific areas such as proper handwashing, cross-contamination prevention, and food hygiene practices. This consistency underscores the need for targeted interventions to address these gaps. Therefore, comprehensive training programmes, educational campaigns, and regular assessments are crucial in ensuring food handlers have the necessary knowledge to maintain high food safety standards. The variations in food safety knowledge based on demographic factors such as education level, years of experience, and cultural background highlight the need for tailored training programmes. These interventions should focus on addressing specific gaps

identified through regular assessments and should be designed to be accessible and relevant to diverse groups of food handlers.

Attitude of food handlers towards food safety

The study sought to examine the attitude of food handlers towards food safety in the Senior High Schools with a null hypothesis, H_o2: **"**Food handlers do not have a significantly positive attitude toward food safety". The findings of the study, however, revealed a statistically significant difference in food handlers' attitudes towards food safety at the Senior High Schools in Tamale metropolis (see Table). The mean ± SD of the attitude score of the respondents towards food safety and hygienic practice was 40.94 ± 2.58, with a minimum score of 27 points and a maximum score of 42 points. This suggests that most food handlers recognize the importance of maintaining positive attitudes towards food safety procedures. The overall attitude of the food handlers was perceived to be positive based on their attitude mean score. This indicates that while the average attitude was positive, there was variation among individual scores. Based on this finding, the null hypothesis of the study H_o2: "There is no statistically significant difference in food handlers' attitudes towards food safety" was therefore rejected.

The significant difference as found in food handlers' attitudes towards food safety could be as result of the high percentage of food handlers without formal education or certification in food safety training (Table 4.1). While the study found that most of the respondents recognized the importance of food safety and the need to maintain positive attitudes, the variation in individual attitudes suggests that there is room for improvement through trainings. The finding aligns

with that of Teffo and Tabit (2020) and Bou-Mitri et al. (2018), which also identified varying levels of attitudes among food handlers towards food safety. They observed significant differences in attitudes based on factors such as educational background, training, and years of experience. Food handlers with higher educational levels and formal training exhibited more positive attitudes towards food safety. The comparative analysis with Teffo and Tabit (2020) and Bou-Mitri et al. (2018) suggest continuous education and formal training are crucial in shaping positive attitudes towards food safety. Training programmes should be enhanced and made more accessible to food handlers to ensure consistent and up-to-date knowledge of food safety practices. (Zanin et al., 2017). According to Asmawi et al. (2018), training programmes that reinforce food safety knowledge and provide updates on emerging issues and best practices can contribute to positive attitudes among food handlers.

The findings of the study also aligned with Health Belief Model (HBM) which explains how individual perceptions influence attitudes and behaviors (Ababio & Lovatt, 2015). The results of the current study can be interpreted using the HBM construct that food handlers with higher food safety training are likely to perceive a higher risk of foodborne illness, leading to more positive attitudes towards hygiene practices. Those with less education or training may underestimate the risks, leading to lower motivation to maintain safe practices. Based on this theoretical insights, targeted interventions should include: making food safety training more accessible, particularly for food handlers with lower education levels, and implementing regular refresher courses to sustain positive

attitudes and prevent complacency. The regular reminders and refresher courses will help maintain awareness and sustain positive attitudinal change among food handlers. Therefore, Ghana Food and Drugs Authority (FDA) and the Ghana Education Service (GES) should collaborate to develop biannual training programmes for food handlers to promote food safety in the senior high schools in Ghana. The training programmes should be tailored to address specific gaps in knowledge and attitudes, especially for food handlers with less education and experience. This approach can help elevate the overall standards of food safety practices in various settings.

Food safety practices of food handlers

The study investigated "the food safety practices of food handlers in Senior High Schools in the Tamale metropolis", with the null hypothesis: "Ho3: Food handlers do not exhibit significantly high levels of food safety practices". However, the finding revealed a significant difference in the food handlers' practice in these schools (Table 4.7). Specifically, the results showed that the majority of the respondents, demonstrated good practices regarding food safety measures, while small proportion of the respondents demonstrated poor practices (Figure 4.2). Consequently, the null hypothesis of the study (Ho3: "There is no statistically significant difference in the Food handlers' practices of food safety measures" is rejected.

The significant difference as found in food handlers' practices could be ascribed to the high percentage of food handlers without formal education or certification in food safety training (Table 4.1). This highlights the need for in-

service training, monitoring, and reinforcement of good practice to reduce the risk of foodborne illnesses. In comparing the current study to Akabanda, Hlortsi, & Owusu-Kwarteng (2017) and Tuglo et al. (2021), which also investigated the practices of food handlers in different settings. Akabanda, Hlortsi, & Owusu-Kwarteng (2017) employed self-reported questionnaires and observational methods to evaluate food handling procedures, including personal and general hygiene habits among food handlers and reported high levels of satisfactory food handling practices among the respondents. For example, 100% of food handlers reported washing their hands after using the restroom, and 82% reported wearing and frequently changing protective clothing. The current study's finding of 77.1% of food handlers demonstrating good practices is slightly lower than the specific practices reported by Akabanda, Hlortsi, & Owusu-Kwarteng (2017). However, both studies showed a generally good food safety practices among the food handlers. Similarly, Tuglo et al. (2021) combined self-reported questionnaires and observational methods to provide a comprehensive view of food handlers' practices. The study revealed specific areas needing improvement, such as the consistent use of thermometers and adherence to not working while ill. Despite these gaps, the general food handlers' practices were satisfactory. While the current study showed a clear division between good and poor practices, Tuglo et al. (2021) provided a detailed analysis that identified specific areas for improvement. The combination of self-reported and observational methods in Tuglo et al. (2021) likely provided a comprehensive view of food safety practices, a strength that the current study also demonstrated. Both the current study and

those by Akabanda, Hlortsi, & Owusu-Kwarteng (2017), and Tuglo et al. (2021) highlight the high level of practices of food safety procedures but also underscore the need for continuous training and monitoring to address gaps and ensure comprehensive food safety practices. Training should be tailored to address specific gaps identified in the studies.

The finding of study on food safety practices among food handlers can be better understood through the Theory of Reasoned Action (TRA). The TRA posits that an individual's behavior is influenced by their intentions, which are shaped by their attitudes and subjective norms (Fishbein, 1967). In the context of this study the result showed that 77.1% of food handlers demonstrated good food safety practices, suggesting that many hold strong behavioral intentions to follow food safety guidelines. However, the presence of fewer food handlers with poor practices indicates that not all intentions translate into action. The TRA highlights the importance of social and workplace norms in shaping behavior. If supervisors, peers, and institutional policies emphasize food hygiene and safety, food handlers are more likely to adopt these behaviours. The significant difference in food safety practices found in the study could be due to variation in training and workplace expectations. Food handlers in environments where food safety is strictly monitored may feel greater pressure to comply, while those in less regulated settings may develop lax practices. The study revealed that lack of formal education and food safety certification was associated with poorer food safety practices. This aligns with TRA's argument that knowledge and beliefs shape intentions, meaning that without proper training and reinforcement, even

food handlers with a positive attitude toward food safety may fail to consistently apply good practices. Thus, food safety practices can be enhanced by reinforcing workplace norms, increasing training accessibility, and ensuring that food handlers receive continuous behavioral reinforcement. Therefore, Ghana Food and Drugs Authority (FDA) and the Ghana Education Service (GES) should collaborate to develop biannual training programmes for food handlers and also implement monitoring systems to promote food safety in the senior high schools

Relationship between food safety knowledge, attitudes, and practices of the food handlers

The study evaluated the relationship between food safety knowledge, attitudes, and practices of food handlers in the Senior High Schools at Tamale with a null hypothesis: "H_o4: There is no significant correlation between knowledge, attitudes, and practices of food handlers." The findings, however, revealed a strong positive association between food safety knowledge, attitudes, and practices among participants. Specifically, the study discovered a strong positive association between participants' knowledge and their attitudes towards food safety and hygienic practices, a strong positive correlation between participants' knowledge and their actual food safety and hygienic practices, and a strong positive association between participants' attitudes and their actual food safety and hygienic practices (Table 4.9). H_o4: "There is no statistically significant relationship between food safety knowledge, attitudes, and practices of food handlers" was therefore rejected. These findings were consistent with several past studies conducted across different settings and regions, such as Soares et al.

(2012), who conducted a study among food handlers in schools in Camaçari, Brazil, and found that higher levels of food safety knowledge were associated with more positive attitudes towards food safety practices, and positive attitudes were linked to better adherence to recommended food handling and hygiene practices. This study underscores a significant correlation between knowledge, attitudes, and practices (KAP), aligning with the current study's findings that knowledge influences attitudes, which in turn influence practices. Similar to the current study, Abd Lataf Dora-Liyana et al. (2018) also studied food handlers in boarding schools in Northern Malaysia and reported that respondents who had higher levels of knowledge exhibited more positive attitudes towards food safety practices. Those with positive attitudes were more likely to adhere to recommended food handling practices and hygiene standards. This confirms a substantial correlation between knowledge, attitudes, and practices, emphasizing the need for regular monitoring and reinforcement of food safety practices.

Asmawi et al. (2018) investigated food handlers in food courts and reported that knowledge shapes the attitudes and practices of food handlers. Also positive attitudes significantly influence food handlers' practices. Their findings however showed lapses in actual practices, indicating that factors such as workplace culture and organizational support might affect the implementation of knowledge and attitudes in practice. This study's findings also align with the current study, particularly regarding the influence of knowledge on attitudes and the importance of attitude in driving practice. Zanin et al. (2017) conducted an integrative review of existing literature on food safety Knowledge Attitudes, and

Practices (KAP) among food handlers and found a strong link between their knowledge and adherence to recommended practices, and positive attitudes towards food safety measures. The review supports the current study's findings by emphasizing the fundamental role of knowledge and attitude in shaping practice. Da-Vitória et al. (2021) studied food handlers in schools of Brazil, and reported a direct correlation between higher levels of food handlers' knowledge and positive attitudes in food safety practices, and positive attitudes were associated with better adherence to recommended food handling practices. This study, like the others, confirmed the positive correlations between knowledge, attitudes, and practices that were observed in the current study.

Overall, the current study's findings are consistent with past studies across different settings and regions, all of which highlight strong positive correlations between knowledge, attitudes, and practices of food handlers in food safety procedures. These correlations underscore the importance of knowledge and attitudes in influencing food safety practices and suggest that enhancing food safety education and fostering positive attitudes are crucial for improving food handling behaviours.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Overview

This section includes the summary, conclusion, and recommendations of the study.

Summary

The study's goal was to investigate the level of knowledge, attitudes, and practices of food safety procedures among food handlers in Tamale Metropolis senior high schools. The study specifically assessed the food handlers' knowledge of food safety procedures, identified their attitudes towards food safety procedures, and examined their food safety practices. Additionally, it evaluated the association between food handlers' knowledge, attitudes and practices of food safety procedures. The researcher conducted a cross-sectional survey using a questionnaire and observational methods to investigate food safety knowledge, attitudes, and practices among food handlers in public senior high schools in the Tamale. The study population included all kitchen staff in the schools. Out of a total study population of 237, the researcher selected a sample size of 148 based on Krejcie and Morgan's table (Krejcie & Morgan, 1970). Finding evidence to either support or reject hypotheses formulated for the study, a one-sample t-test was applied to hypothesis one: "H_o1: There is no statistically significant difference in food handlers' knowledge of food safety", Hypothesis two "H_o2: There is no statistically significant difference in food handlers' attitudes towards food safety" and hypothesis three "H_o3: There is no statistically significant

difference in the food handlers' practices of food safety measures", while Pearson Moment correlation was applied to hypothesis four "H_o4: There is no statistically significant relationship between food safety knowledge, attitudes, and practices of food handlers" to identify the correlation among the variables.

Key findings

The findings revealed a statistically significant difference in knowledge levels. The assessment categorized knowledge into low and high levels, with participants scoring above 70% classified as having high knowledge and those below 70% as having low knowledge. The results showed that the majority, 121 (92.4%), demonstrated high knowledge, while only 10 (7.6%) had low knowledge. The null hypothesis 1 was therefore rejected. The findings also identified a statistically significant difference in respondents' attitudes towards food safety, with most respondents having a positive attitude towards food safety measures, though individual scores varied. Consequently, the null hypothesis 2 was rejected.

In addition, the results showed a statistically significant difference in practices of the food handlers with 101 (77.1%) respondents demonstrating good practices and 30 (22.9%) demonstrating poor practices. Therefore, the null hypothesis 3 was rejected. Finally, the results also revealed a strong positive relationship among the variables: between knowledge and attitudes, knowledge and actual food safety practices, and between attitudes and actual food safety practices of the respondents. These correlations indicate that higher knowledge

level of respondents is associated with more positive attitudes and better practices, therefore the null hypothesis 4 of the study was rejected.

Conclusion

The study conducted a comprehensive assessment of food handlers' knowledge, attitudes, and practices regarding food safety in senior high schools within the Tamale Metropolis. The conclusions drawn from the findings reflect the extent to which each stated objective was achieved.

1. Assess food handlers' knowledge in food safety

The study findings revealed that most food handlers demonstrated a high level of food safety knowledge, with 92.4% scoring above 70% benchmark. This indicates that the objective was achieved, as it provided a clear assessment of food handlers' knowledge levels.

2. Identify food handlers' attitudes towards food safety

The study found significant difference in food handlers' attitudes toward food safety. Majority have a significantly positive attitude toward food safety though individual scores varied. This aligns with previous studies emphasizing the influence of attitudes on compliance with food safety measures. The objective of the study was therefore met.

3. Examine food safety practices of food handlers

The study assessed the practical application of food safety measures and found that the majority (77.1%) exhibit significantly high levels of food safety practices and a minority (22.9%) exhibiting poor practices. A significant gap was observed in food hygiene and safety practices of the food handlers. This provided

a comprehensive examination of food safety practices and thereby confirmed that the objective has been achieved.

4. Evaluate the correlation between food safety knowledge, attitudes, and practices of food handlers

The study found a strong positive correlation between knowledge, attitudes, and practices. Higher knowledge levels were associated with positive attitudes, which in turn influenced better food safety practices. This confirms that the study effectively evaluated the interrelationship among these variables.

Recommendations

With reference to the results of the study, the following recommendations were offered to enhance knowledge, attitudes, and practices of food handlers in food safety procedures at the Senior High Schools:

1. Ghana Food and Drugs Authority (FDA) and the Ghana Education Service (GES) should collaborate to develop mandatory, structured training programs tailored to address specific knowledge gaps. Training should be conducted at least twice a year and should cover personal hygiene, cross-contamination prevention, food storage practices, and temperature control. The training materials should be translated into local languages to accommodate food handlers with limited formal education.
2. The Management of the Schools should implement recognition and reward systems such as incentives or public acknowledgment for food handlers who consistently follow food safety procedures.

3. The FDA should launch quarterly awareness campaigns to emphasize the importance of food safety in preventing foodborne illnesses. These campaigns should include educational posters, radio announcements, and community engagement sessions.
4. School management should implement a structured feedback system where food handlers receive regular performance reviews based on hygiene audits. A quarterly feedback session should be held, allowing food handlers to discuss challenges and receive guidance on improving food safety practices.
5. The GES and FDA should ensure that all schools adopt and enforce standardized food safety protocols aligned with the Ghana Food Safety Policy. These protocols should be displayed in food preparation areas and enforced through regular inspections.
6. Experienced and certified food handlers should mentor and coach new or less experienced workers. A peer-learning system should be established, where one-on-one mentorship or group training sessions are held every three months.
7. The Ministry of Education should ensure that schools are adequately resourced with: Food thermometers, cleaning supplies, Protective gear and Proper food storage facilities.
8. The FDA and GES should implement compulsory food safety certification for all food handlers in Senior High Schools. Food handlers should be

required to undergo annual refresher courses to keep up with emerging food safety standards and best practices.

9. The FDA and Ghana Health Service (GHS) should increase the frequency of school inspections from once a year to at least twice annually. Inspections should be unannounced to ensure compliance. Schools that consistently fail to meet food safety standards should face sanctions, including mandatory retraining or suspension of food handling privileges.

Suggestions for Further Research

The following areas were identified for further research:

1. Future research should investigate the long-term influence of training programmes on the knowledge, attitudes, and practices of food handlers. This will help determine the effectiveness and sustainability of training interventions over time.
2. Explore the underlying factors contributing to variations in food safety attitudes and practices of food handlers. This can include psychological, cultural, and socio-economic factors that influence food safety behaviours.
3. Assess the effectiveness of continuous education and refresher courses in maintaining high knowledge and good practices of food handlers.
4. Comparative studies should be conducted on food safety knowledge, attitudes, and practices among food handlers in different regions or districts. This will highlight regional disparities and inform targeted interventions where needed.

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APPENDICES

APPENDIX 'A' : Questionnaire for Food Handlers

Dear Respondent,

My name is Mariama Bukari, a student of University of Cape Coast, Department of Home Economics. As part of the requirement for the award of MPhil in Home Economics, I am undertaking this research to examine **'Food Safety Knowledge, Attitudes, And Practices of Food Handlers at Senior High Schools in The Tamale Metropolis'**. The research result will only be used for academic purposes and treated with the utmost confidentiality. The findings from this study will also contribute to the development of policy guidelines, and implementation of targeted training programs for food handlers in schools

Your participation in this study is voluntary and you may withdraw at any point necessary. The attached questionnaire will take about twenty-five (25) minutes to complete.

You may contact me for any clarification on the questionnaire through this number: 0243730187

Your participation will be appreciated.

Thank you.

Please Kindly Read the Questions Carefully and Answer by Ticking (√) In The Appropriate Box or Filling in The Relevant Information Where Necessary.

SECTION 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENT
1. What is your age group? 20- 29yr[ ] 30-39yr[ ] 40-49yr[ ] 50-59yr[ ]
2. Sex? Male [ ] Female [ ]
3. What is your marital status? Married [ ] Single [ ] Separated [ ] Divorce [ ] Widowed [ ]
4. Level of Education None[ ] Primary/Secondary[ ] Polytechnique/University [ ] Others [ ], specify……..
5. Your place of work? [ ] Tamale SHS [ ] Tamale Girls SHS [ ] Islamic SHS [ ] Kalpohin SHS [ ] Anbariya SHS [ ] Business SHS [ ] Adventist SHS [ ] Vitting SHS [ ] GHANASCO [ ] NOBISCO [ ] St.Charles SHS [ ] Presby SHS
6. Length of employment as a kitchen staff? 1-5yr [ ] 6-10yr[ ] 11-15yr[ ] 16yr & above [ ]
7. Which one of the following certificates in food safety training course do you have? Basic certificate [ ] Secondary school certificate [ ] Vocational School certificate [ ] Polytechnic certificates[ ] First degree and above [ ] None [ ]

PLEASE SELECT (√) THE OPTION THAT BEST REPRESENTS YOUR OPINION.			
SECTION 2: FOOD SAFETY KNOWLEDGE ASSESSMENT	1=True 2=False 3=Do not know		
	1	2	3
8. Contaminated food always changes in taste.			
9. Contaminated food always changes in smell.			
10. Contaminated food always changes in colour.			
11. Contact between raw and cooked foods contributes to food contamination.			
12. Separate surfaces should be used for raw and cooked food.			
13. Farm produce must be washed before cooking.			
14. Cooked food should be served hot at a minimum temperature of 60°C or above to prevent the growth of bacteria.			
15. Healthy people can cause illness by carrying germs into food.			
16. Keeping the hair uncovered during cooking can cause food contamination.			
17. Wearing of jewellery such as rings, during food handling can cause food contamination.			

18. Food handlers wear protective clothing to prevent food contamination.			
19. Hand hygiene helps in prevention of food contamination.			
20. A food handler with a disease such as diarrhoea poses a risk of food contamination.			
21. Proper washing of utensils is very important in ensuring food safety.			
22. Cooking utensils should be washed in soapy water.			
23. It is necessary to rinse utensils under running water or in warm water.			
24. Cooking should be done in a clean environment (inside and outside).			
25. Regular medical examinations are necessary for food handlers in order to promote food safety.			
SECTION 3: ATTITUDES TOWARDS FOOD SAFETY ASSESSMENT	1=Very Important 2=Slightly important 3=Not important		
	1	2	3
26. How important is food safety to human health?			
27. How important is food safety training for food handlers?			

28. How important is hand washing to food safety practices?			
29. How important is the washing of farm produce before cooking?			
30. How important is keeping your nails neatly trimmed?			
31. How important is it to keep your hair covered during food preparation?			
32. How important is the removal of jewellery before food preparation?			
33. How important is the use of separate surfaces for raw and cooked food?			
34. How important are food temperature guidelines in minimizing the risk of foodborne illnesses?			
35. How important is sensory expectation of food in determining fitness to eat?			
36. How important is checking the expiration date of food products before usage?			
37. How important is the wearing of clean protective clothes during food preparation?			
38. How important is keeping the cooking environment clean as part of the food safety requirement?			

39. How important is regular medical examination of food handlers?			
SECTION 4: FOOD SAFETY PRACTICES ASSESSMENT	1=Always 2=sometimes 3=Never		
	1	2	3
40. How often do you wash your hands before cooking?			
41. How often do you wear gloves when handling food?			
42. How often do you wash your hands after using the washroom during cooking?			
43. How often do you remove your jewellery when cooking?			
44. How often do you wear protective clothing when cooking?			
45. How often do you keep the kitchen clean?			
46. How often do you keep dustbins covered?			
47. How often do you wash utensils in soapy water?			
48. How often do you rinse utensils under running or warm water?			
49. How often do you wash maize before soaking?			
50. How often do you wash maize after soaking?			

51. How often do you wash beans before cooking?			
52. How often do you use separate surfaces for raw and cooked food?			
53. How often do you separate raw food from cooked food?			
54. How often do you serve cooked food at a hot temperature (60°C or above)?			
55. How often do you maintain a standard temperature for food storage?			
56. How often do you participate in food safety workshops?			
57. How often do you go for medical check-ups?			

APPENDIX 'B': Observation Checklist For Food Handlers' Food Safety Practices

Name of School: ……...

Date: …….

PERSONAL HYGIENE OF FOOD HANDLERS	Yes	No	Further remarks
1. The food handlers wear a cap or hair restraint during food preparation and service			
2. The food handlers wear clean apron/over coat during food preparation and service			
3. The food handlers wear clean clothing (uniform/own outfit) during food preparation and service			
4. The food handlers wear gloves during the preparation and serving of ready to eat foods or foods eaten raw			
5. The food handlers do not wear jewellery during food preparation			
6. The food handlers cut their finger nails neatly			
7. The food handlers wash hands with soap			

and warm water before and during food preparation			
8. The food handlers wash hands in between handling raw and cooked food			
9. The food handlers scratch parts of the body (hair, skin, ears, eyes, nose) during food preparation			
10. The food handlers cough or sneeze directly into food during food preparation			
ENVIRONMENTAL HYGIENE AND SANITATION	**Yes**	**No**	**Further remarks**
11. Food handlers operate in a clean environment (inside and outside).			
12. An adequate and appropriate drainage system is provided			
13. The kitchen is provided with self-closing doors			
14. Doors, windows, and other openings are protected to eliminate pests			
15. Adequate ventilation in the kitchen to remove heat and odour			
16. Floors, Walls, and Ceilings kept clean; free from dirt, stains and cobwebs.			

17. Waste bins with fitting lids are available.			
18. Waste bins in the kitchen are emptied regularly.			
19. The main waste bins outside are emptied daily.			
20. Provision of adequate toilet facilities and accessories (for kitchen staff)			
21. Toilet facilities are kept clean.			
22. Provision of hand washing stations and equipped with sanitary towel for use by kitchen staff.			
23. Potable water is used for food preparation.			
24. Suitable means of water storage are available.			
FOOD HYGIENE PRACTICES OF FOOD HANDLERS	**Yes**	**No**	**Further remarks**
25. The food handlers separate raw foods such as meat, vegetables and salads from cooked foods during storage.			
26. Cooked foods are served hot.			
27. Food items are washed before use or storage.			

28. The food handlers used separate chopping boards for raw meat/ fish and ready to eat foods			
29. The food handlers served cooked food with covered hands or clean ladles.			
30. The Food handlers used calibrated food thermometers for checking appropriate temperatures of food			
31. Equipment and serving dishes are washed and rinsed under running			

APPENDIX 'C' : Ethical Clearance

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 0558093143 / 0508878309
E-MAIL: irb@ucc.edu.gh
OUR REF: IRB/C3/Vol.1/0544
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0011497

14TH DECEMBER, 2023

Ms Mariama Bukari
Department of Vocational and Technical Education
University of Cape Coast

Dear Ms Bukari

ETHICAL CLEARANCE – ID (UCCIRB/CES/2023/159)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research **Food Safety Knowledge, Attitudes, and Practices of Food Handlers at Senior High Schools in The Tamale Metropolis.** This approval is valid from **14th December 2023 to 13th December 2024.** You may apply for an extension of ethical approval if the study lasts for more than 12 months.

Please note that any modification to the project must first receive renewal clearance from the UCCIRB before its implementation. You are required to submit a periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us about this protocol.

Yours faithful

Koffi F. Amuquandoh
Ag. Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST

APPENDIX 'D' : Letter of Introduction from Department VOTEC, UCC

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION

TELEPHONE: 0312299210
E-MAIL: votec@ucc.edu.gh

Our Ref: VTE/IAP/V.4/43
Your Ref:

Department of Vocational and Technical Education
University Post Office
Cape Coast

12th January 2024

The Regional Director
Ghana Education Service
Tamale N/R

Dear Sir/Madam,

INTRODUCTORY LETTER – MARIAMA BUKARI

We have the pleasure of introducing to you **Mariama Bukari** who is an MPhil student of this Department with registeration number **ET/HET/22/0018**.

Currently, she is at the data collection stage of her research work and we would be most grateful if you could give her the necessary assistance from your outfit to enable her progress with the collection of data.

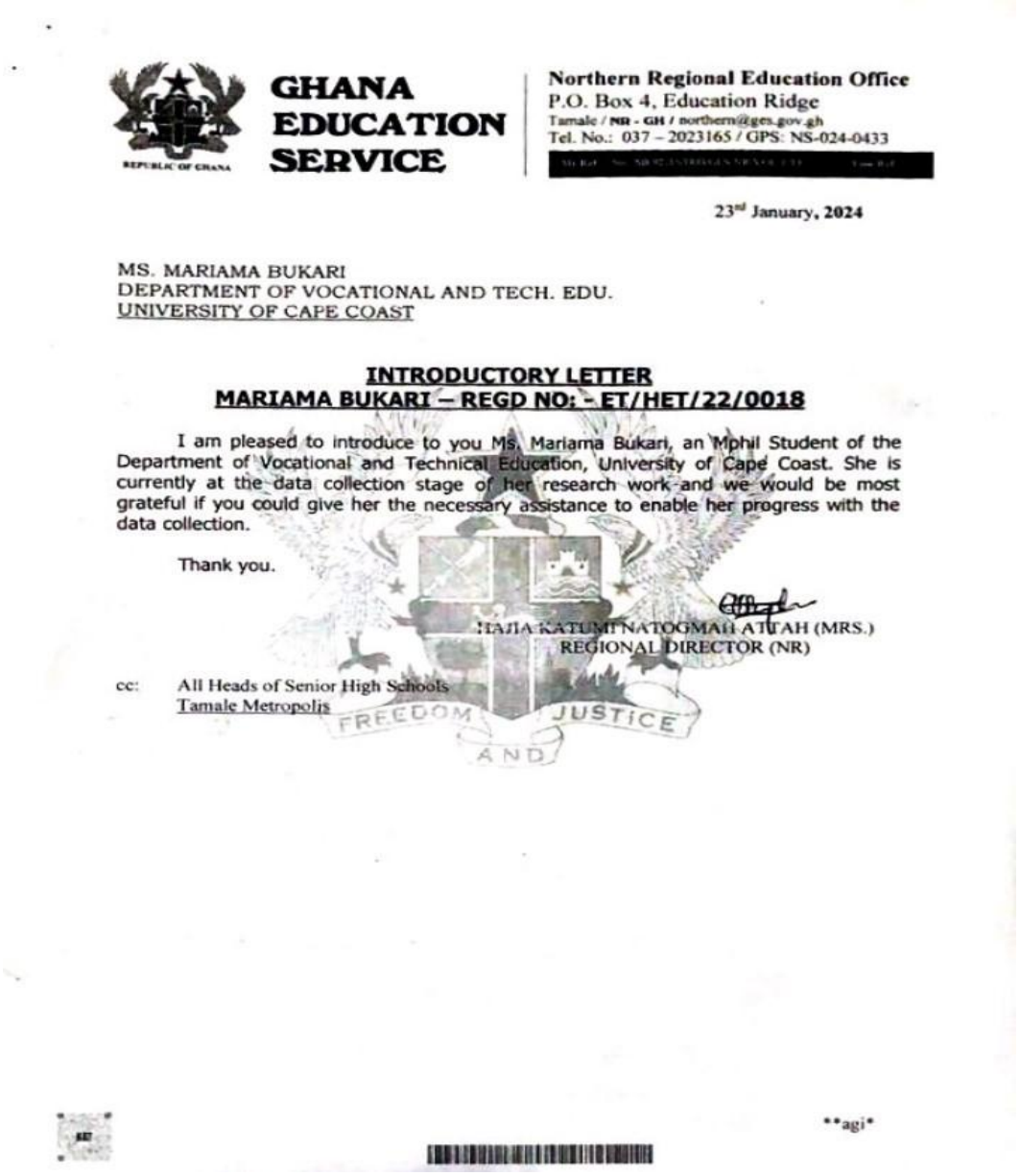
Thank you.

Yours faithfully,

Dr. (Mrs.) Patience Danquah Monnie

HEAD OF DEPARTMENT

APPENDIX 'E' : Letter of Introduction from Regional Director, GES, (NR)



GHANA EDUCATION SERVICE

Northern Regional Education Office
P.O. Box 4, Education Ridge
Tamale / NR - GH / northern@ges.gov.gh
Tel. No.: 037 – 2023165 / GPS: NS-024-0433

23rd January, 2024

MS. MARIAMA BUKARI
DEPARTMENT OF VOCATIONAL AND TECH. EDU.
UNIVERSITY OF CAPE COAST

INTRODUCTORY LETTER
MARIAMA BUKARI – REGD NO: - ET/HET/22/0018

I am pleased to introduce to you Ms. Mariama Bukari, an Mphil Student of the Department of Vocational and Technical Education, University of Cape Coast. She is currently at the data collection stage of her research work and we would be most grateful if you could give her the necessary assistance to enable her progress with the data collection.

Thank you.

HAJIA KATUMI NATOGMAH ATUAH (MRS.)
REGIONAL DIRECTOR (NR)

cc: All Heads of Senior High Schools
Tamale Metropolis

FREEDOM AND JUSTICE

**agi*