

UNIVERSITY OF GHANA
COLLEGE OF BASIC AND APPLIED SCIENCES

**ASSESSMENT OF MICROBIAL CONTENT OF STREET FOODS
AND HYGIENE PRACTICES OF FOOD VENDORS: A CASE
STUDY OF OPETEKWEI COMMUNITY, ABLEKUMAH WEST
MUNICIPALITY.**

BY

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MAY, 2025

DECLARATION

I, Lois Boatemaa Boateng, Affirm that this thesis represents the outcome of my independent research, with proper acknowledgement of all referenced sources.



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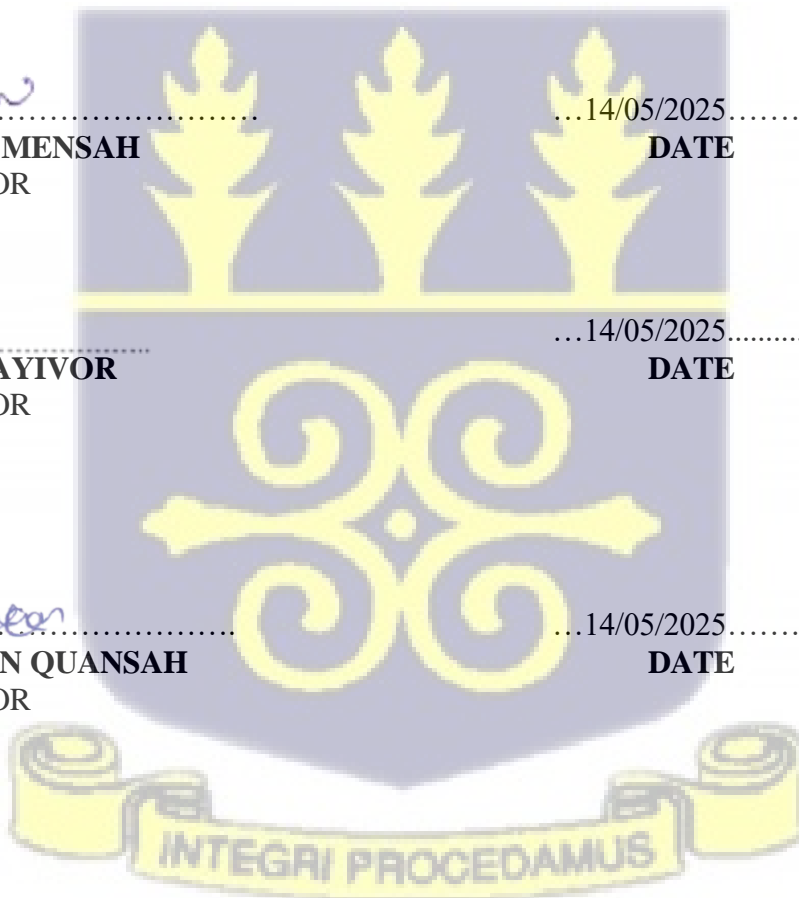
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DEDICATION

This study is dedicated to my mother, Mrs. Margaret Adu Boateng, my sister, Keziah Adu Twumwaa Boateng, and my fiancé, Mr. Bright Ofori, for their unwavering financial support and encouragement throughout this journey. I also express my heartfelt gratitude to the Almighty Jehovah God for His blessings, kindness, and compassion.



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ABSTRACT

Street food is a vital component of Ghana's urban food system, providing affordable meals and livelihoods, particularly in low-income areas. Despite its benefits, the safety of street food remains a significant public health concern. This study therefore investigated microbial contamination in selected street foods and assessed vendor hygiene practices in Opetekwei in the Ablekuma West Municipality in the city of Accra, with the view to making proposals for improving the urban food sector. Using a mixed-method approach, interviews were conducted with 31 street food vendors and 100 consumers, alongside discussions with regulatory officials. Laboratory analysis of 50 food samples tested for total aerobic bacteria, yeast and mold, total coliforms, and pathogens such as *Escherichia coli*, *Salmonella sp.*, *Shigella sp.*, and *Vibrio cholerae*. The study found most vendors were female (97%). While 99.5% had good food safety knowledge, their hygiene practices were poor. Notably, 77% of vending sites were near choked gutters and dusty roads, all lacked running water, and 87% of vendors handled money while serving. Poor hygiene was linked to education level ($p = 0.006$). Consumers were predominantly male (64%), with 63% buying street food daily despite 82% lacking confidence in vendors' hygiene. Popular meals included Koko (61%) for breakfast, stir-fried noodles (indomie) (80%) for dinner, and *waakye* (66%), *banku* (55%), and *kenkey* (55%) for lunch or dinner. Affordability (61%) and taste (66%) influenced street food purchases. Several food samples, including *macaroni* (M), salad (S), fish (F), *waakye* (W), *gari* (G), *indomie* (I), pepper sauce (P), and *kenkey* (K), exceeded microbial safety limits set by the Health Protection Agency (2009), Centre for Food Safety (2014), and ICMSF (2018). For

Total Aerobic Count, many samples were deemed "unsatisfactory" (>5 log CFU/g), with M3 having the highest count (9.24 log CFU/g). Kenkey (K8) (8.12 log CFU/g) had the highest yeast and mold count exceeding the limit of >3 log CFU/g. Total Coliform Count also surpassed the acceptable threshold (>4 log CFU/g) in samples like M2 (7.35 log CFU/g), S2 (5.99 log CFU/g), W4 (6.45 log CFU/g), P8 (5.81 log CFU/g), F3 (6.29 log CFU/g) and K8 (8.49 log CFU/g). Notably, *E. coli* was detected in 81.82% of *Macaroni*, 66.67% of Salad, 75% of Pepper sauce, 37.5% of *Indomie* samples. *Salmonella sp.* was present in 6.25% of Kenkey, 25% of Fish, and 6.25% of *Indomie* samples. The prevalence of *Shigella sp.* was detected in 18.18% of *Waakye*, 81.81% of *Macaroni*, 33.33% of *salad*, 43.75% of Fish, and 43.75% of *Indomie samples*. No pathogen was detected in *gari* samples. *Vibrio cholera* was present in 9.9% of *Waakye*, 36.36% of *macaroni*, 11.11% of *salad*, 6.25% of *kenkey* and *pepper sauce*, 37.5% of *fish*, and 12.5% of *Indomie*. The pathogens identified in the sampled foods reflect inadequate sanitary conditions at many vending sites, poor food hygiene practices, lack of personal hygiene among vendors, and ineffective temperature control of food. The study highlights the need for street food vendor and consumer training on hygiene, improved food vending infrastructure, regular inspections of the street food vendors by the Environmental health Unit, and frequent microbial testing to ensure food safety compliance.

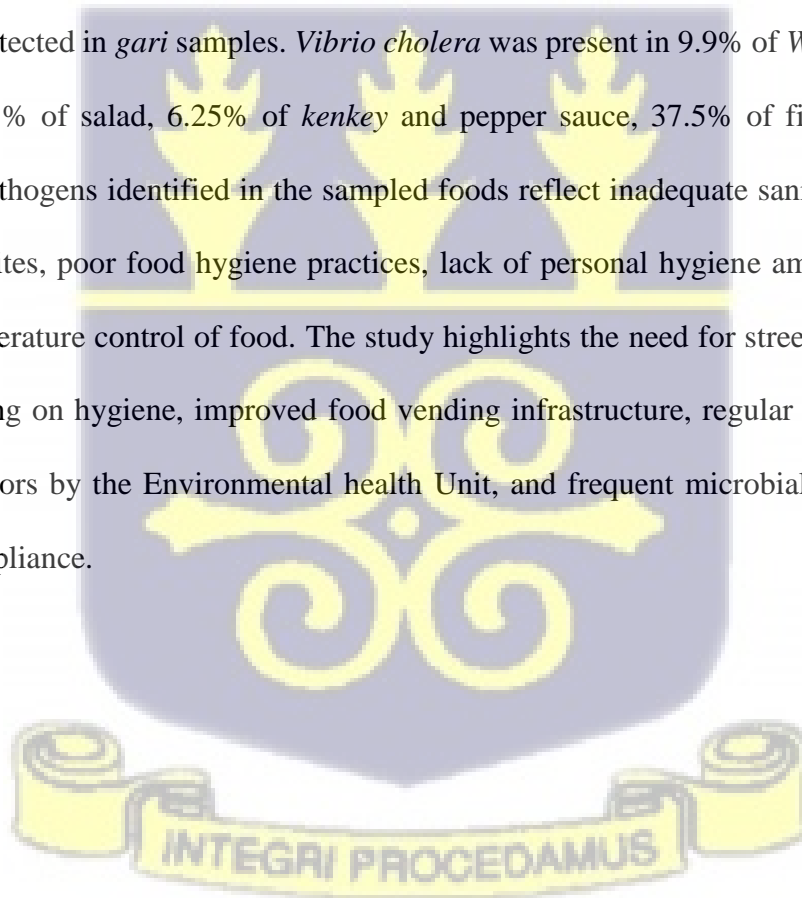
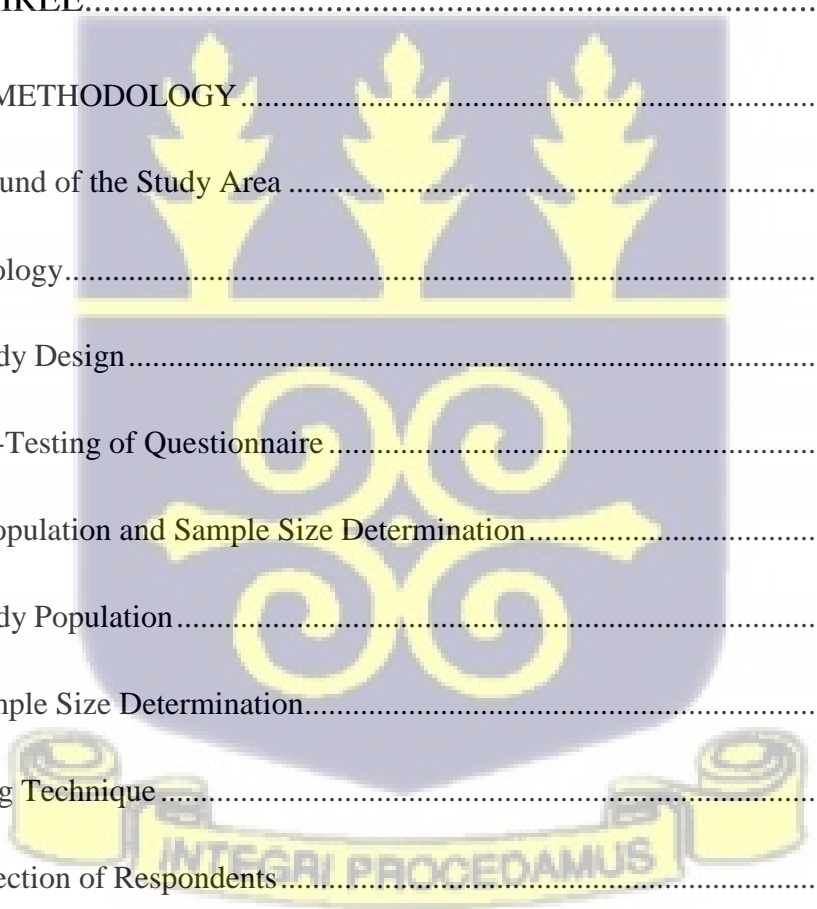


TABLE OF CONTENT

DEDICATION	2
ACKNOWLEDGEMENT	4
ABSTRACT	5
TABLE OF CONTENT	7
LIST OF FIGURES	14
LIST OF TABLES	15
LIST OF ABBREVIATIONS	17
CHAPTER ONE	18
INTRODUCTION	18
1.1 Background	18
1.2 Problem Statement	21
1.3 Aim and objectives	24
1.3.1 Aim	24
1.3.2 Specific objectives	24

1.4 Justification of the Study	24
1.5 Research Questions.....	25
1.6 Organization of Study.....	26
CHAPTER TWO	27
LITERATURE REVIEW	27
2.1 Introduction	27
2.2. Street Foods	27
2.2.1 Common street foods in Ghana.....	29
2.2.2 Street Food Vendors	31
2.2.3 Street Food Consumers	32
2.3 Food Contamination and Diseases	33
2.3.1 Microbial Contamination of Food	34
2.3.2 Bacterial Contamination and Foodborne Illnesses	35
2.3.2.1 <i>Salmonella species</i>	35
2.3.2.2 <i>Escherichia coli (E. coli)</i>	37
2.3.2.3 <i>Bacillus cereus</i>	37
2.3.2.4 <i>Staphylococcus aureus</i>	38
2.3.2.5 Yeast	38
2.3.2.6 Molds	39
2.3.2.7 <i>Shigella</i>	40

2.3.2.8 <i>Vibrio</i>	41
2.4 Health Risks Associated with Street Food Consumption.....	41
2.5 Knowledge on Food Safety and Food Borne Diseases.....	42
2.3.2 Hygienic practices during food handling.....	44
2.6 Legal Frameworks on Food Vending	47
2.6.1 Food Vending Regulatory and Institutional Framework in Ghana	48
2.8 Conceptual Framework.....	50
CHAPTER THREE.....	56
RESEARCH METHODOLOGY.....	56
3.0 Background of the Study Area	56
3.2 Methodology.....	60
3.2.1 Study Design.....	60
3.2.2 Pre-Testing of Questionnaire.....	60
3.3 Study Population and Sample Size Determination.....	60
3.3.1 Study Population.....	60
3.3.2 Sample Size Determination.....	61
3.4 Sampling Technique.....	61
3.4.1 Selection of Respondents.....	61
3.5 Data Collection	62
3.5.1 Food sampling.....	63



3.6 Microbial analysis.....	65
3.6.1 Media Preparation.....	65
3.6.2 Quality Assurance.....	65
3.6.3 Enumeration and Identification of Microorganisms.....	65
3.6.3.1 Biochemical test for <i>E. coli</i>	66
3.6.3.2 <i>Salmonella</i>	66
3.6.3.3 <i>Shigella</i>	66
3.6.3.4 <i>Vibrio cholerae</i>	67
3.7 Data Analysis.....	67
3.7.1 Qualitative Analysis.....	67
3.7.2 Quantitative Analysis.....	68
3.8 Ethical clearance.....	70
CHAPTER FOUR.....	71
RESULTS.....	71
4.1 Institutional and Regulatory Frameworks.....	71
4.2.1 Analysis of Qualitative Interview Data.....	71
4.2 Socio-demographic Characteristics of Street Food Vendors.....	73
4.2.1 Years of Experience in the Food Business among Street Food Vendors.....	74
4.2.2 Operating Hours of Street Food Vendors.....	75
4.2.3 Street Food Vendors Receiving Regular Health Checkups.....	76

4.2.4 Locations of Food Preparation.....	76
4.3 Level of Knowledge of Street Food Vendors on Foodborne Diseases.....	76
4.3.1 Knowledge of Foodborne Diseases	79
4.4 Hygienic Practices of Street Food Vendors.....	80
4.4.1 Determinants of Hygienic Practices of Street Food Vendors	84
4.5 Compliance Level of Street Food Vendors in Opetekwei.....	85
4.6 Socio-demographic Characteristics of the Street Food Consumers	88
4.7 Consumers' Perception on Safety of Food Provided by Street Food Vendors	91
4.7.1 Reasons for Buying Street Food	91
4.7.2 Awareness of Street Foods among Consumers.....	91
4.7.3 Frequency of Buying Street Foods	92
4.7.4 Time Street Foods Are Purchased.....	92
4.7.5 Types of Foods Bought as Breakfast.....	93
4.7.6 Types of Foods Bought as Lunch	93
4.7.7 Types of Foods Bought as Dinner	94
4.7.8 Concerns about Food Safety, Hygiene, and Cleanliness	94
4.7.9 Factors Influencing Purchasing Decisions.....	95
4.7.10 Affordability and Price Comparisons	95
4.7.11 Eating Habits and Preferences	96
4.7.12 Health Concerns.....	96

4.7.13 Influence of Vendors' Hygienic Practices.....	97
4.7.14 Awareness and Enforcement of Regulations	97
4.7.15 Consumers' Perceptions on Safety of Food Provided by Street Food Vendors	98
4.8 Disease Causing Microorganisms and their Levels in Food Sold by Vendors	99
CHAPTER FIVE.....	105
DISCUSSION	105
5.1 Demographic Characteristics of Street Food Vendors	105
5.2.1 Years of Experience in the Food Business among Street Food Vendors	106
5.2.2 Operating Hours of Street Food Vendors	107
5.2.3 Street Food Vendors Receiving Regular Health Checkups	107
5.2.4 Locations of Food Preparation.....	108
5.3 Institutional and Regulatory framework.....	108
5.4 Knowledge Levels of Street Food Vendors on Foodborne diseases.	112
5.5 Hygienic Practices Among Street Food Vendors.....	115
5.6 Compliance Level of Street Food Vendors in Opetekwei.....	116
5.7 Consumers' Perceptions on Safety of Food Provided by Street Food Vendors.....	118
5.8 Disease Causing Microorganisms and their Levels in Food Sold by Vendors	120
5.9 Integration of Theories.....	122
5.9.1. Health Belief Model (HBM).....	123
5.9.2. Theory of Planned Behavior (TPB).....	124

5.9.3. Social Cognitive Theory (SCT).....	124
CHAPTER SIX	126
CONCLUSION AND RECOMMENDATIONS	126
6.1 Conclusion.....	126
6.1.1 Institutional and Regulatory framework guiding food vending in Opetekwei.....	126
6.1.1.1 Compliance Level of Street Food Vendors in Opetekwei.....	126
6.1.2 Knowledge Level among Street Food Vendors on Food Borne Diseases	126
6.1.2.1 Hygiene Practices Among Street Food Vendors	127
6.1.3 Consumers’ Perceptions on Safety of Food Provided by Street Food Vendors	127
6.1.4 Disease Causing Microorganisms and their Levels in Food Sold by Vendors	128
6.2 Recommendations	129
6.2.1 Ablekuma West Municipal Assembly (AWMA).....	129
6.2.2 Environmental Health Unit – Ablekuma West Municipal Assembly	130
6.2.3 Street Food Vendors and Consumers	130
6.2.5 Government of Ghana	131
REFERENCES	132
APPENDIX	165



LIST OF FIGURES

Figure 2. 1: Conceptual Framework on Factors Associated with Microbial Contamination of Street Food.....	54
Figure 3. 1: Map of Opetekwei Community.....	58
Figure 3. 2: A Map Showing the Study Area.....	59
Figure 4. 1: Radar Diagram of Compliance Scores.....	86
Figure 4. 2: Heatmap of Correlations Between Demographics and Compliance Parameters	88



LIST OF TABLES

Table 3. 1: Types of foods and the time sold in the study area (Opetekwei).....	60
Table 3. 2: Food Items Sold by Vendors Categorized by Time of Day.....	63
Table 4. 1: Identified Themes	71
Table 4. 2: Distribution of Socio-demographic Characteristics of the Street Food Vendors.	74
Table 4. 3: Years of Experience in Food Business	75
Table 4. 4: Operating Hours of Street Food Vendors	75
Table 4. 6: Food Preparation Locations of Food Vendors.....	76
Table 4. 7: Food vendors' Knowledge Level on Foodborne Diseases (N = 31).	77
Table 4. 8: Association between Knowledge of Foodborne Diseases, Age, Educational Level, and Years in the Food Business.....	79
Table 4. 9: Environment and Location Hygiene of Food Vendors.....	80
Table 4. 10: Personal Hygiene of Food Vendors.....	81
Table 4. 11: Food Display and Serving Practices.....	82
Table 4. 12: Food Storage and Leftover Management	83
Table 4. 13: Garbage disposal practices	83
Table 4. 14: Cooked Food Storage and Serving Conditions.....	84
Table 4. 15: Chi-Square Analysis of the Association between Hygienic practices of Food Vendors, Age, Educational Level, and Years in the Food Business.....	84
Table 4. 16: Distribution of Socio-demographic Characteristics of the Street Food Consumers.	89
Table 4. 17: Reasons for Buying Street Food.....	91
Table 4. 18: Awareness of Street Foods Among Consumers	92
Table 4. 19: Frequency of Buying Street Foods	92
Table 4. 20: Time Street Foods Are Purchased	93
Table 4. 21: Types of Foods Bought as Breakfast.....	93
Table 4. 22: Types of Foods Bought as Lunch	94
Table 4. 23: Types of Foods Bought as Dinner	94
Table 4. 24: Concerns About Food Safety, Hygiene, and Cleanliness	95
Table 4. 25: Factors Influencing Purchasing Decisions.....	95
Table 4. 26: Affordability and Price Comparisons	95

Table 4. 27: Eating Habits and Preferences	96
Table 4. 28: Health Concerns.....	96
Table 4. 29: Influence of Vendors' Hygienic Practices	97
Table 4. 30: Awareness and Enforcement of Regulations.....	97
Table 4. 31: Chi-Square Analysis for the Association between Consumer Perceptions of street food safety and Demographics characteristics.	99
Table 4. 32: Microbial load and presence of pathogens in food samples from street food vendors in Opetekwei.	102
Table 4. 33: Prevalence of Selected Pathogens of Specific types of Street Foods sold in Opetekwei.....	104



LIST OF ABBREVIATIONS

AMA	-	Accra Metropolitan Assembly
CAC	-	Codex Alimentarius Commission
CDC	-	Centers for Disease Control and Prevention
CFU	-	Colony-Forming Unit
EHSU	-	Environmental Health and Sanitation Directorate
EPEC	-	Enteropathogenic Escherichia coli
ETEC	-	Enterotoxigenic Escherichia coli
FAO	-	Food and Agriculture Organization
FDA	-	Food and Drugs Authority
FSI	-	Food Safety Inspector
HBM	-	Health Belief Model
MLGRD	-	Ministry of Local Government and Rural Development
MMDAs	-	Municipal, Metropolitan, and District Assemblies
PoG	-	Parliament of Ghana
SCT	-	Social Cognitive Theory
SDG	-	Sustainable Development Goal
TPB	-	Theory of Planned Behavior
USD	-	United States Dollar
USEPA	-	United States Environmental Protection Agency
WHO	-	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

Food is vital for life and health, supplying essential nutrients that support energy, growth, and body functions (World Health Organization: WHO, 2019). Lack of adequate nutrition can lead to health problems such as malnutrition, a reduced immune system, and increased vulnerability to diseases (Morris & Mohiuddin, 2023). Street food is growing in popularity, particularly in urban areas, due to its accessibility, affordability, and wider range of available options. However, the increase in the patronize of street food is also driven by urbanization and lifestyle shifts that favor convenience over nutritional quality (Hiamey & Hiamey, 2018; Haleegoah et al., 2020; Casari et al., 2022). Poor food handling and preparation can cause foodborne diseases, often due to contamination by bacteria, viruses, or parasites during the preparation process (Adeosun et al., 2022).

Food safety encompasses the measures used to guarantee the safety of food for consumption, with the goal of preventing contamination and the occurrence of foodborne diseases (FDA, 2022; FSIS, 2024). The World Health Organization has established guidelines for the appropriate management, storage, preparation, and cooking of food to minimize the risks posed by pathogenic microorganisms, viruses, parasites, and chemicals. Prioritizing food safety is crucial for safeguarding public health, as contaminated food is a significant contributor to global illness, especially in areas with insufficient infrastructure and substandard hygiene standards (WHO, 2022). According to the World Health Organization (WHO) and the Food and Agriculture Organization (FAO), 1.6 million people globally suffer from food borne disease daily. This is due to consumption of food contaminated with bacteria, viruses, parasites or chemicals resulting in more than 200 diseases ranging from diarrhoea to cancers (United Nations, 2023). Insufficient

sanitation, poor storage infrastructure, ineffective regulatory frameworks, and low knowledge about proper food handling worsen food safety issues in Sub-Saharan Africa, including nations such as Ghana, Nigeria, and Kenya (Cudjoe et al., 2022).

Regions with limited access to proper water, sanitation, and hygiene infrastructure bear a significantly heavier burden of foodborne illness, as these conditions are crucial for preventing the spread of pathogens through contaminated food (World Health Organization: WHO, 2019). Food safety concerns in Sub-Saharan Africa are complex as a result of several factors, including the wide use of informal markets, insufficient refrigeration, poor regulatory supervision, and environmental limitations like climate change, which impact food production and storage (Ayanlade & Radeny, 2020).

Effective implementation of food safety interventions in order to reduce the burden of foodborne diseases in vulnerable populations requires collaboration among governments, international organizations, and local communities (Dodo, 2021). Lack of robust regulatory frameworks and insufficient enforcement of food safety standards intensify the exposure of individuals to contaminated and unwholesome foods into the market (Dodo, 2021). Informal food markets characterized by a considerable absence of regulatory supervision provide challenges in implementing food safety regulations (Dodo, 2021). The issues surrounding food safety in Sub-Saharan Africa are complex and include substandard hygiene and sanitation practices, including insufficient access to clean water and improper food handling, which facilitate the transmission of foodborne disease (Cudjoe et al., 2022).

The combination of poverty and food insecurity compels a significant number of people to settle for dangerous and contaminated food because of the limited availability of nourishing alternatives (Bjornlund et al., 2022). Contaminated food frequently leads to the occurrence of foodborne

diseases such as cholera, typhoid, and diarrhoea (Cudjoe et al., 2022). Children, especially those under five years old are at a heightened risk for foodborne diseases as their immune system are under development, making them less capable of fighting off infections (Mielech et al., 2021). The lack of adequate knowledge and instruction on proper food handling procedures among customers, farmers, and food handlers worsens these problems. Lack of comprehensive food safety education among customers, food handlers, and vendors frequently leads to substandard hygiene processes, including insufficient hand washing and hazardous food handling, which in turn contributes to the elevated occurrence of foodborne diseases (Kariuki et al., 2017). Thus, ensuring food safety requires a holistic approach that includes strengthening regulatory frameworks, improving infrastructure for food storage and transportation, and increasing awareness about proper food handling practices (Dodo, 2021).

Coastal areas are particularly vulnerable to rising sea levels, affecting around 10% of the global population living in low-lying regions (Amaratunga, 2022; Fleming et al., 2018). These changes lead to chronic flooding, disrupting daily life and contaminating water supplies with salt water and pollutants, overwhelming drainage systems, and leading to stagnant water that fosters unsanitary conditions (Fleming et al., 2018). Climate change and environmental variables, including severe weather conditions, also affect food production, storage, and transportation, thereby increasing the likelihood of food safety risks (Ayanlade & Radeny, 2020). For example, contamination of water sources caused by flooding in coastal regions might exacerbate the challenges faced in ensuring food safety (Cusick, 2022).

Street food constitutes an integral part of the informal sector in some developing nations. It offers easily available meals to people but frequently lacks proper control, thereby presenting a substantial health hazard of foodborne diseases (Rakha et al, 2022). Over 2.5 billion individuals

worldwide consume street food every day, emphasizing its crucial role in providing cost-effective nourishment, particularly in metropolitan regions where extended work hours and economic considerations drive increased demand (Jaffee et al., 2018). The uncontrolled nature of street food vending, considered as vending of food products from substandard sanitation and food safety regulatory measures, frequently results in contamination. Street foods across different regions frequently contain bacteria such as *Escherichia coli*, *Salmonella*, and *Staphylococcus aureus*, all of which have been associated with several foodborne diseases (Alimi, 2016; Mohammed et al., 2020; Salamandane et al., 2023; Labana et al., 2024). Promoting appropriate hygienic standards among food vendors, especially in informal markets, and implementing focused interventions can greatly reduce the likelihood of contamination and subsequently reduce food-borne diseases significantly. An investigation of the microbiological composition of street food and the hygienic methods used by food handlers is critical for identifying possible contamination origins and improving food safety protocols, thus safeguarding public health (Zanin et al., 2017).

This study therefore investigates the microbiological composition of specific street meals at vending sites in Opetekwei, a coastal community, and evaluates the sanitary conditions of food handling with the view to making recommendations for enhancing food safety operations and reducing foodborne illnesses.

1.2 Problem Statement

Street food is an important food option readily available at cheaper rates to consumers in urban centres in developing countries. In Ghana cost-effective and easily available dishes like *waakye* (a dish of cooked rice and beans colored with the stock of dry millet leaves), *kenkey* (a Ghanaian dish which is cooked by a mixture of fermented maize and hot water into a smooth, whitish consistent paste wrapped in maize husk), *jollof rice* (rice cooked in tomato sauce), *Hausa porridge* (a sweet,

soured smooth millet flour mixed with hot water and spiced with ginger and chili pepper), and *indomie* (stir-fried noodles with vegetables) (Oukhouya, 2022). Cost-effectiveness and convenience significantly influence the demand for these meals, particularly among the urban low- and middle-income population (Agyeman, 2020). However, the increasing prevalence of street food vending raises significant public health concerns due to poor hygiene practices and inadequate sanitation infrastructure (Nkosi & Tabit, 2021).

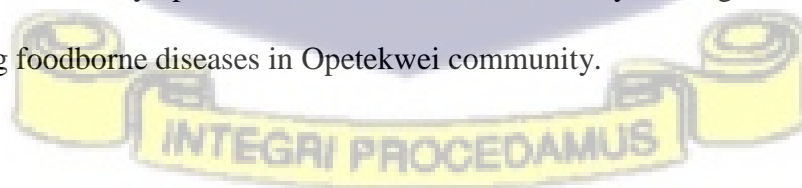
Vendors frequently work in unhygienic settings, such as areas adjacent to open gutters, traffic-prone roadways, and waste disposal sites, thereby increasing the likelihood of microbial contamination leading to unsafe food and negative consumer perceptions. (Rakha et al., 2022). The exponential growth of unregulated street food vendors contributes to the poor enforcement of food safety standards by regulatory bodies like the Environmental Protection Agency (EPA), Food and Drugs Authority (FDA), and the Ghana Standards Authority (GSA) (Bansah, 2018). Inadequate implementation of hygienic standards and the widespread presence of street food vendors lacking appropriate certification exacerbate the problem (Agyeman, 2020; Rakha et al., 2022). Between 2013 and 2021, for example, the Food and Drugs Authority documented 1,914 instances of food poisoning, with 60 food-borne diseases outbreaks resulting in 36 deaths in Ghana, underscoring the gravity of the problem (Apinga, 2022). Conditions such as economic difficulties, weak regulatory enforcement, low literacy levels and training, create a setting where street food vendors frequently operate without the required certifications (Werkneh et al., 2023; Dzodzegbe, 2024).

Along Ghana's coastline, low-lying settlements like Opetekwei in the Ablekuma West Municipality of the Greater Accra Region have serious challenges in ensuring food safety due to recurrent flooding, inadequate waste management, and inadequate water quality (Essuman, 2017).

Flooding may increase infection transmission, with associated increase in susceptibility to food and waterborne illnesses (CDC, 2022; Anthonj et al., 2019).

Opetekwei faces unique challenges in ensuring adequate sanitation and clean water supplies for food preparation, primarily due to its low-lying terrain and rapid municipal development (Ofori, 2021). In Opetekwei, waste dumping sites have been created at the banks of the lagoon and rubbish are indiscriminately dumped into gutters. Drainage systems are blocked resulting in flooding after rains (Zurek, 2022). The stalls, tables or vending containers of most of the food vendors in Opetekwei are situated on the choked gutters which might be partially covered or uncovered. The proximity of food vending stalls to uncovered choked gutters presents significant health hazards and food safety concerns due to the risk of contamination from microbial pollutants (Dzodzegbe, 2024). Evaluating the magnitude of these risks and identifying the specific types of contaminants that may impact food safety are essential for preventing food borne illness in the Opetekwei community.

The objective of this study is to analyze the microbiological composition of selected street foods at vending sites in Opetekwei, as well as to evaluate the sanitary procedures of food sellers in this coastal village. The study aims to uncover significant hygiene flaws and contamination sources in order to enhance food safety operations and interventions, thereby making a valuable contribution towards reducing foodborne diseases in Opetekwei community.



1.3 Aim and objectives

1.3.1 Aim

The overall aim of this research is to assess the microbial content of street foods and the hygienic practices of food vendors in Opetekwei, a coastal community in the Ablekumah West Municipality in the city of Accra.

1.3.2 Specific objectives

The specific objectives are to;

- Identify the institutional and regulatory frameworks that guide the sale of street food in Opetekwei Community and establish their level of compliance.
- Assess the level of knowledge of street food vendors on foodborne disease and hygienic practices.
- Assess consumers' perceptions on safety of food provided by vendors in Opetekwei Community.
- Identify the presence and determine levels of microbial pathogens in selected street-vended foods in the community.

1.4 Justification of the Study

Street food is a widespread and readily available source of meals in many urban areas, including the Greater Accra Region. Street food serves as a source of livelihood for individuals and contributes to the local economy. A large segment of the population, including vulnerable groups like children, pregnant women, and the elderly, consumes street foods. However, failure to follow appropriate food hygiene practices can lead to foodborne illnesses from street food. Given the high consumption rates, any contamination in street foods can have widespread health implications, especially in communities where sanitation facilities are limited. Similar to any other urban area,

food vendors in the Opetekwei community provide a variety of Ghanaian foods, including *rice and stew*, *waakye*, *Hausa porridge*, *kenkey*, and many others, for sale along streets, in schools, at lorry stations, and other public spaces. Opetekwei, located in Ablekumah West Municipality, provides an opportunity for a community-specific investigation. Unlike other parts of the region, there are no published studies that have assessed the microbial content of street-vended food in Opetekwei.

This research will offer valuable insights into food vendors' awareness of foodborne diseases, their hygienic practices, and the presence and concentrations of microbial pathogens in specific street foods in Opetekwei. This study aims to expand the current information base available to academics who are specifically interested in the fields of food hygiene and environmental health in Ghana and other regions. Such information will be beneficial to policymakers in decision making and programs, particularly concerning the street food vending sector. The study anticipates to significantly improve the culinary standards provided by street food vendors in Opetekwei, Ablekumah West Municipality.

1.5 Research Questions

The research was guided by following research questions.

- What are the institutional and regulatory frameworks that guide street food vendors in Opetekwei Community and to what extent do vendors comply with these regulations?
- What is the level of knowledge on hygienic practices and foodborne diseases of street food vendors?
- What are consumers' perceptions on the safety of food sold by vendors in Opetekwei?

- Which microbial pathogens are present and what are the levels of contamination in selected street-vended foods in the community?
- What recommendations can be made to enhance food safety operations and reduce foodborne illnesses in Opetekwei?

1.6 Organization of Study

Chapter one sets the stage for the study by introducing the research topic, outlining the background, and articulating the significance of the study. Chapter two reviews research on street foods, focusing on their public health risks, including vendor practices, consumer behavior, and microbial contamination. The review identifies research gaps and suggests improvements in regulation, education, and training. Chapter three outlines the mixed-method research design used in the study. It describes the target population, respondent selection methods, and steps taken to ensure the reliability of data collection instruments. Additionally, it addresses the study's limitations and the strategies employed to overcome them, ensuring the quality and credibility of the research. Chapter four provides a comprehensive analysis of the data and shows the primary outcomes derived from the study's objectives and research questions. Chapter five analyzes the study's findings, comparing them with existing research and highlighting key trends. Chapter six includes conclusions summarizing the study's key findings and their implications. It offers recommendations for enhancing public health, food safety and suggests areas for further research.



CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Street foods are of great significance in the culinary culture of numerous countries, as they provide a convenient and cost-effective means of nourishment for a wide array of consumers (Bouafou et al., 2021). Nevertheless, the pervasive popularity of street foods has elicited apprehensions regarding their safety and its ramifications for public health. The presence of microorganisms in street foods and the sanitary measures implemented by vendors during the process of preparation and handling have become significant determinants affecting the overall safety and quality of these food items (Verma et al, 2022).

This chapter examines the current issues related to microbial status of street foods and the hygiene practices implemented by street food handlers. The subsequent sections include studies that provide insights into the presence of microbial contamination in street foods, the determinants that influence vendor hygiene practices, the consequences of foodborne diseases, and the potential approaches for enhancing the overall safety of street foods.

2.2. Street Foods

Street foods are located along the streets or in any other public open area, where street food vendors prepare and/or sell diverse range of cooked foods and drinks to consumers (FAO, 2016). In contrast to formal food establishments like restaurants, vendors retail their food utilizing push carts, baskets, balancing poles, or movable booths (Kowalczyk & Kubal-Czerwińska, 2020). Within the formal sector food business, there exists the capability to produce processed meals for these vendors. Alternatively, the vendor or another small-scale processor may carry out the processing step independently. High-traffic public areas, including sidewalks, market back alleys, roadways,

school grounds, truck and railway terminals, seashores, parks, and other public spots, often serve as venues for their sales (FAO & WHO, 2019). To enhance efficiency and minimize delays, street food vendors strategically display their servings in leaves, basic white plastic rubbers, styrofoam plates, disposable plastic bowls, plates, cups, or cutlery, and then package them in polythene bags for customers to take away (Unnisa & Chowdary, 2019).

Urban areas of Ghana are characterized by the widespread presence of street food (Bormann et al., 2016; FAO, 2016). Similar to other countries, street food preparation in Ghana involves various arrangements, such as fully prepared meals at one place and then transported to busy areas like funerals; partially cooked foods at one site and finished at another for immediate or later consumption; cooked and sold foods at the same place; and home-prepared foods prepared and transported to a separate vending site (Bansah, 2018).

Haleegoah et al. (2020) investigated the problems and potential for improving street-vended local foods (SVLFs) in Ghana, specifically examining the major parties involved, such as food vendors, Environmental Health Officers (EHOs), and customers. This study particularly investigated such well-known regional cuisines as *Hausa koko*, *Waakye*, and *Ga kenkey*. The primary issues highlighted by Haleegoah et al. (2020) include food safety concerns, substandard hygiene practices regulatory deficiencies, insufficient financial resources, vendors with low educational attainment, and related health hazards. These problems raise concerns about the general safety of street meals, emphasizing the need for ongoing vendor education, increased consumer awareness, and increased institutional backing for regulation implementation. The findings from Haleegoah et al. (2020) indicated that successful cooperation among stakeholders is crucial in enabling vendors to offer healthier, safer, and culturally relevant local foods to the general population. The most vulnerable urban populations exposed to the health risks of urban food vending include the unemployed,

children, disabled or elderly individuals, formal sector workers with declining or unstable incomes, and those dependent on "crowded" informal sector activities (Evans & Gwynne, 2020).

Larbi et al. (2021) revealed instances where *E. coli*, *Salmonella sp.*, *Staphylococcus aureus*, *Klebsiella sp.*, *Bacillus sp.*, and *Shigella sp.* were the most common pathogenic bacteria detected in most dietary samples. Insufficient access to clean water, contamination of food items by dust and airborne pollutants, insufficient hygiene procedures, inappropriate storage methods, and worsening urban circumstances all contribute to infectious disease transmission in the street food sector. Several weather-related environmental factors, such as precipitation and runoff, which depend on the existing temperature or humidity conditions, influence the survival and growth of microorganisms. Additionally, evidence suggests that the risks of food contamination are particularly apparent in areas characterized by warm and humid climates, since these conditions create optimal environments for bacteria to proliferate and contaminate water and food (Opsteegh & Van Der Giessen, 2011). Despite these obstacles, there are present opportunities, including consumer demand, worldwide awareness of these culinary creations, and progress in packaging and branding.

2.2.1 Common street foods in Ghana

As the frequency of consumption of street foods keeps increasing, the variety and quantity of foods sold on the street increase as well. This is also the case in Ablekumah West Municipality. As relating to Opetekwei in Ablekumah West Municipality, commonly sold street foods are:

- a) **Banku/kenkey:** it is a Ghanaian dish which is cooked by a proportionate mixture of fermented maize and cassava dough in hot water into a smooth, whitish consistent paste. It is served with soup, stew or pepper sauce with fish. It is mostly preferred by the people of the southern part of Ghana especially the Ga ethnic group but also eaten across other

regions in Ghana. It is known as one of the economical staple foods in Ghana (Baidoe et al., 2020).

- b) **Beans:** also termed ‘Red-Red’. It is a popular Ghanaian cooked bean served with fried ripe plantain and often accompanied with *gari* and avocado. It earns its name from the palm oil that tints the bean stew and the bright orange color of the fried ripe plantain (Marrass & AgBendeche, 2016).
- c) **Rice:** Rice can be plain mostly and served with tomato stew made with onions, tomatoes, pepper sauce, and vegetable oil. The rice can also be fried, or made into *Jollof* which is a mixture of rice and stew cooked together (Marrass & AgBendeche, 2016).
- d) **Waakye (Wache):** *Waakye* is a Ghanaian dish of cooked rice and beans colored with the stock of dry millet leaves. It is commonly prepared in the home but, sold by street food vendors. It is prepared by boiling the beans and rice together. It is mostly eaten for breakfast or lunch. A typical *waakye* meal usually consists of the cooked rice, and beans, stew, some macaroni and moist *gari* (both of which are sometimes mixed with oil from the stew), boiled eggs, stewed meat or stewed/fried fish or egg, stewed *wele* (cooked-down cowhide) and vegetable salad (which may include cabbage, lettuce, onions and tomatoes). It is eaten with *Kolawole*, or fried plantain. It is thought to have originated from the northern parts of Ghana (Marrass & AgBendeche, 2016).
- e) **Hausa koko (Millet Porridge):** The Hausa people are found in a diverse number of countries extending from Sudan to Nigeria. They have had an enormous influence in the food culture of West African street foods. One such food is Hausa *koko*, a popular street food often eaten for breakfast, a sweet, soured, and spicy (ginger and chili pepper) smooth millet flour porridge. It has a greyish brown color. It mostly eaten with bread (plain or with

butter) or *koose* (*akara* which is made from ground cowpeas or black-eyed peas) (Marras & AgBendeche, 2016; FAO, 2016).

2.2.2 Street Food Vendors

Street food vendors are individuals who sell food to the public from stalls or carts, which can be either stationary or mobile. They typically operate in areas where pedestrian presence is high, providing a convenient option for both vendors and consumers (Rakha et al., 2022). Although there are no formal education prerequisites for becoming a street food vendor, possessing culinary skills, understanding food safety practices, having strong communication abilities, and adhering to local regulations are essential qualifications that significantly enhance the chances of success in this field (Ma et al., 2019; Addo-Tham et al., 2020; Nkosi & Tabit, 2021). Street food vendors encompasses a diverse group characterized by varying gender representation, age ranges, and economic statuses. Their commonality lies in the vital role they play in providing accessible food options within urban environments. A study in Dhaka, Bangladesh, and Ghanaian Metropolis found that most street food vendors were males, primarily aged 19 to 35 (Hiamey & Hiamey, 2018; Kwame & Ridwan, 2021). However, research from rural South Africa and urban Ghana showed a strong female presence, with about 90.2% of vendors being women, largely single and aged 35 to 44. Considerable number of these female street food vendors had been operating their business for a duration of 1 to 10 years (Haleegoah et al., 2020; Mahopo et al., 2022).

Uncontrolled growth in the number of street vendors has given rise to food safety concerns. The exact number of street food vendors in Ghana is unknown, but an estimated 15,000 vendors operate in the city of Accra, employing over 60,000 people, most of whom are female, have an average age of 34, and have completed basic formal schooling (Marras & Bendeche, 2016). Food handlers can easily contaminate or transmit foodborne pathogens to consumers who purchase their food. A

study by Bintsis (2017) indicated that bacteria such as *Salmonella typhi* and *Escherichia coli* can survive for varying periods on the fingers and other parts of the body. The practice of hand washing and regular screening (that is, subjecting blood samples of vendors to laboratory analysis) can therefore be immensely helpful in the prevention of food-borne illnesses (Odonkor & Odonkor, 2020).

The reason for the former is that the hand is a crucial vehicle for transferring microorganisms from various sources—feces, nose, skin, and other parts of the body—into food, whereas the latter ensures that food vendors are always in good health before they sell to the public. In Ghana, issuing health certificates after screening food vendors is a common means of regulating vended food (Odonkor & Odonkor, 2020).

2.2.3 Street Food Consumers

Street food consumers represent a diverse array of people looking for convenient and budget-friendly food choices sold by street vendors or food trucks (Wiatrowski et al., 2021). In urban areas of developing nations, a substantial number of low- and middle-income people rely on these foods as either their main or additional source of nourishment (Baidoe et al., 2020). Additionally, these foods play a significant role in the agricultural economy, contributing 3% to 10% of employment opportunities (Hamstra, 2023).

Numerous individuals, including workers in the informal sector, public and private employees, students, and schoolchildren, as well as traders, regularly consume street foods in Africa (Tutu & Anto, 2016; Kouamé et al., 2020; Adjalo et al., 2020; Bouafou et al., 2021). Consumers often view street foods as cost-effective and readily available, safeguarding culinary traditions and encouraging dietary variety. However, despite these advantages, street foods are associated with inherent hazards, particularly concerning food safety and cleanliness (Tacardon et al., 2023).

2.3 Food Contamination and Diseases

Street food provides affordable meals to consumers, especially in urban areas, but raises concerns about hygiene and nutrition. Although it serves as a low-cost option, the quality of food can be inconsistent, posing health risks to consumers as it serves as a mode for transmission of foodborne diseases (Bouafou et al., 2021). Foodborne diseases are defined by the Food and Agriculture Organization (FAO) as illnesses resulting from the consumption of food contaminated with pathogenic bacteria, viruses, parasites, or toxins generated by toxic fungus (FAO & WHO, 2019; Osei-Tutu, 2018). Typical manifestations of foodborne diseases include nausea, vomiting, diarrhea, dehydration, abdominal discomfort, headache, and fever (FDA, 2012). Foodborne diseases impose a substantial economic cost, compelling nations to allocate billions of United States dollars (USD) towards medical and legal expenditures. Thus, the 2019 World Bank report on annual healthcare expenditure on foodborne diseases in low and middle income countries ranges from \$15 billion to \$17 billion, leading to a decline in economic output (World Health Organization: WHO, 2024). Furthermore, foodborne diseases in countries with low and moderate incomes cause an overall reduction in output of US\$ 95.2 billion (World Health Organization: WHO, 2024).

Africa, comprising of numerous underdeveloped nations, has one of the greatest rates of foodborne illnesses worldwide (Cudjoe et al., 2022). In developing countries, such as Ghana, these diseases are a primary cause of mortality. In the years 2006–2007, surveys administered by the Department of Public Health of the Ministry of Health documented more than 200 instances of foodborne diseases, resulting in over fifty fatalities associated with contaminated street foods (Bormann et al., 2016).

Poor food handling techniques often lead to food contamination with microorganisms which can remain active on many surfaces, such as dishes, equipment, and kitchen walls, forming biofilms that can negatively impact food quality and help the spread of illness (Opsteegh & Van Der Giessen, 2011). When food workers carry pathogenic bacteria on their hands, they are likely to transfer these bacteria to food during preparation, thereby intensifying disease transmission. The primary method of transmission, known as the fecal-oral route, is the direct or indirect contact of food, water, or hands with feces through unclean hands, filthy water, flies, and contaminated soil (Stein & Chirila, 2017). Furthermore, certain groups, including new born babies, children, the elderly, and those with compromised immune systems, are especially vulnerable and more prone to illnesses caused by bacteria such as *Salmonella*, *Campylobacter*, and *Listeria* (Bintsis, 2017).

2.3.1 Microbial Contamination of Food

Microbial content in food refers to the existence and abundance of microorganisms that inhabit or contaminate it (Cárdenas et al., 2024). These microorganisms include bacteria, fungi, yeast, and viruses. While food production processes intentionally use some microbes, their presence in high numbers or pathogenicity can lead to food spoilage or foodborne illnesses (Cárdenas et al., 2024). The majority of bacteria are not harmful; however, a portion of them suggest the likely existence of dirt, disease-causing agents, or rotting, and a small fraction can cause diseases (Yttri, 2022). The presence of certain bacteria, such as *Escherichia coli*, in food can indicate direct or indirect human or animal fecal contamination (Ekici & Dümen, 2019).

Furthermore, when undesirable microorganisms develop in foods or in humans after eating them, microbial food contamination occurs (Mansour et al., 2019). Microbial food contamination is a significant threat to food safety and public health, as well as the cause of a greater number of foodborne diseases worldwide (Feng & Ding, 2022). Erkmen and Bozoglu (2016) asserted that

microorganisms persistently contribute to food contamination during the various stages of harvesting, processing, storage, and distribution.

Microorganisms can infiltrate food through various pathways, such as food handlers, food utensils, packaging materials, raw materials, ingredients, and the processing environment, as well as through air and dust particles (Cárdenas et al., 2024). The microbial content in food can vary depending on a variety of factors, including the type of food, processing methods, storage conditions, and hygiene practices during production. It is important to control the microbial content in food to ensure its safety and quality (Feng & Ding, 2022).

2.3.2 Bacterial Contamination and Foodborne Illnesses

According to the Food and Agriculture Organization, foodborne diseases are illnesses caused by consuming contaminated food (FAO & WHO, 2019). Microorganisms are widespread and possess the capacity to cause illness, spoil food, or undergo fermentation to alter desirable products, emphasizing the importance of maintaining adequate food hygiene. Moreover, the occurrence of harmful microorganisms in food can arise either from natural sources or as contaminants contributed by the environment, pests, food handlers, or equipment. Furthermore, the food's characteristics and storage conditions can influence the rapid growth of microorganisms, potentially compromising food safety (Ayana et al., 2015).

2.3.2.1 *Salmonella species*

Most of these bacteria are motile with flagella, gram-negative, anaerobic, and belong to the family Enterobacteriaceae. Fermenting glucose produces hydrogen sulfide (H₂S) gas and acid. *Salmonella species* differ from other types of gram-negative bacteria in that they survive at temperatures ranging from 8 to 45 degrees Celsius and in a pH range of 4 to 8. There are currently two recognized species of *Salmonella* bacteria, namely *Salmonella enterica* and *Salmonella bongori*.

Six subspecies of the species *S. enterica* make up a total of more than 2,600 serotypes (Ryan et al., 2017; Gal-Mor et al., 2014).

Most of the illnesses caused by the *Salmonella* serotypes result from ingesting feces-contaminated food. Typhoidal *Salmonella* serotypes may only spread between people and cause foodborne sickness, including typhoid and paratyphoid fever. Typhoidal *Salmonella* enters the bloodstream, invades organs, and releases endotoxins to produce typhoid fever, which can be treated without drugs. Non-typhoidal *Salmonella* can be invasive and induce paratyphoid fever requiring prompt antibiotic therapy (Ryan & Ray, 2004). The viability of *Salmonella sp.* remains unaffected by freezing; however, the use of UV light and heat accelerates their eradication (Beuchat et al., 1975). It is recommended that food be heated to an internal temperature of 75 °C (167 °F) as a preventive measure against *Salmonella* infection (Ma et al., 2009).

Undercooking, poor food handling practices, and cross-contamination may all contribute to the presence of *Salmonella sp.* in street foods. *Salmonella sp.* can penetrate the food supply chain through various means; 1) meats, poultry, eggs, and milk may be contaminated because the animal from which these products are obtained initially harbored *salmonella sp.* 2) The use of manure and litter, potentially contaminated with *Salmonella sp.*, can also pollute the environment, potentially contaminating farm produce like fruits and vegetables. 3) Food items are not separated. For instance, cross-contamination may occur between raw poultry and ready-to-eat foods, such as raw vegetables, in the home or in food service environments. This may lead to salmonellosis. When a carrier mishandles the food they prepare, they can become a source of *salmonella* infection (Bintsis, 2017). An estimated 1.2 million cases and 29 thousand deaths occur annually as a result of *Salmonella* infection in sub-Saharan Africa (Kim et al, 2023).

2.3.2.2 *Escherichia coli* (*E. coli*)

E. coli is a rod-shaped, gram-negative bacteria that has the ability to ferment lactose at a temperature of 44 °C. (Tuttle et al., 2021). The pathogenic strains of *E. coli* are frequently responsible for a range of gastrointestinal ailments, varying from mild diarrhea to conditions resembling dysentery. Consuming contaminated or undercooked food or drink, such as raw milk and ground beef, or coming into oral contact with contaminated surfaces can lead to the acquisition of *E. coli* O157:H7 infection. Less than 10 to 100 colony-forming units (CFU) of this strain are needed to infect a host. Other pathogenic *E. coli* strains usually need over a million CFU to do the same thing (Greig, 2010).

Enterotoxigenic *E. coli* (ETEC) and enteropathogenic *E. coli* (EPEC) are other forms of diarrhea-causing *E. coli*. ETEC bacteria cause four hundred million instances of diarrhea and 400,000 fatalities in low- and middle-income nations each year, with the most impacted being children under five (University of Gothenburg, 2014). *E. coli* can thrive for extended periods on an individual's fingers and body. It is also an inhabitant of humans' intestinal tracts, as well as some warm-blooded animals. Their presence in cooked foods indicates insufficient heat application or less sanitary practices (Centres for Disease Control and Prevention, CDC, 2022).

2.3.2.3 *Bacillus cereus*

This gram-positive bacterium is facultatively anaerobic, forms endospores, and is rod-like in shape. Usually found in soil and vegetation, it thrives at a temperature of 28–35 degrees Celsius. Nevertheless, it can also thrive in temperatures as low as 4°C and as high as 48°C. Usually found in environments with pH ranging from 4.9 to 9.3, it can also survive in a concentrated salt of 7.5% (Tewari & Abdullah 2015).

Bacillus cereus produces toxins, namely emetic toxin and enterotoxins, which can cause two types of gastrointestinal illness: the emetic (vomiting) syndrome and the diarrheal syndrome, respectively. The pathogen in the food produces the emetic toxin, which triggers the illness after consumption. On the other hand, the intestine releases enterotoxins after ingesting *Bacillus cereus*-contaminated food (CDC, 2022).

2.3.2.4 *Staphylococcus aureus*

This is a gram-positive bacterium that is non-moving, has a spherical shape, forms short chains, and appears in pairs. The environment cannot eradicate these abundant bacterial species. Even though heat can kill the bacterium, it can easily contaminate food by producing enterotoxins that can withstand normal cooking temperature. The bacterium grows best at a temperature of 35 degrees Celsius within a pH range of 7.0 to 7.5, but it can also survive in temperatures ranging from 7 - 47.8 °C within a pH range between 4.5 and 9.3. The staphylococcal disease starts between 30 minutes and 8 hours after ingesting food contaminated with the bacterium. The symptoms of the disease include abdominal pains, chills, sweating, a weak pulse, shallow respiration, nausea, and vomiting. The bacterium resides in the nostrils, throat, hands, skin, hair, and fingertips of persons in good health. *Staphylococcus aureus* primarily contaminates meat, poultry, and dairy products (Bintsis, 2017).

2.3.2.5 Yeast

Historically, the term 'yeasts' referred to unicellular fungi involved in the alcoholic fermentation of beverages such as wine and beer, as well as the leavening of dough for bread baking. Over time, researchers discovered that yeasts also include non-fermentive species that cause food spoilage and various pathological conditions in humans and animals (Tuttle et al., 2021). According to Aouizerat et al. (2019), these organisms rely on organic compounds for growth and development,

and their growth is not dependent on sunlight. Certain regions of Africa employ yeasts in the fermentation process of maize to enhance the scent and flavor of food products, such as porridge. Furthermore, the study by Maicas (2020) showed that, yeasts engage in lipolytic activities to generate fatty acids, hence influencing the ultimate flavor profile of many food products. Nevertheless, certain yeast species, like *Candida albicans*, could exploit favorable conditions and become pathogens, leading to infections in human hosts (Talapko et al., 2021). While the consumption of smaller quantities of yeast may not pose immediate health risks, their metabolic processes have the potential to alter the pH levels of cooked food, creating an environment conducive to the proliferation of pathogenic bacteria. Yeasts can cause food spoilage, and it occurs as a result of various factors, including the presence of acids in foods such as fruits, as well as foods with reduced water activity such as cereals, grains, dried fruits and vegetables, honey, seeds, nuts, peanut butter, spices, and herbs (Riešutė et al., 2021). Yeasts inhabit many environments such as the human skin and intestines, as well as the air and soil, owing to the presence of their microscopic spores. The high counts of yeasts in cooked foods serves as an indicator of substandard food handling practices, such as inadequate cooking and failure to properly cover food items (Riešutė et al., 2021).

2.3.2.6 Molds

Molds are a type of microscopic fungi that produce spores characterized by a powdery texture and varying colors (CDC, 2023). Molds produce minute spores that disperse through various means, including human activity, air movement, equipment, water, or food. Molds have the capacity to withstand and proliferate in a diverse range of temperatures and pH levels (Dagnas & Membré, 2013). Molds possess the capacity to survive at extremely low temperatures and demonstrate resistance to pH values spanning from 2.0 to 8.0. Some molds can survive in settings that are dry,

salty, and acidic (US EPA, 2023; Rico-Munoz et al., 2019; Terr, 2009). Researchers have linked two fungi, *Aspergillus flavus* and *Aspergillus niger*, to the production of aflatoxins. According to Wangia et al. (2019) and Mahfuz et al. (2020), children exposed to aflatoxins may experience stunted growth or persistent underweight, as well as lifetime exposure to infectious diseases.

2.3.2.7 *Shigella*

According to Shad and Shad (2020), *Shigella* is a type of Gram-negative bacteria that can survive in oxygen, does not form spores, are immobile, and rod-shaped and causes Shigellosis. Cohen et al. (2019) defined shigellosis as a gastrointestinal infectious disease that arises from the consumption or contact with infected fecal matter. Transmission can take place via ingesting contaminated food or drink or by coming into close contact with contaminated hands. Potential transmission of contamination can occur through the behavior of flies, which can lead to contamination transmission.

The predominant symptoms are diarrhea, fever, nausea, vomiting, and stomach pains; diarrhea accompanied by fecal matter that is watery and uniform; fever; and the presence of blood, pus, or mucus in the feces. The symptoms may manifest within a week after consumption, although they usually begin two to four days later. *Shigella* is well acknowledged as a major causative pathogen in the onset of reactive arthritis.

Shigella is a dominant bacterial pathogen responsible for causing diarrheal diseases worldwide, with an estimated occurrence of 80 to 165 million cases (Zaidi & Estrada-Garcia, 2014). Researchers estimate *Shigella*'s yearly mortality to range from 74,000 to 600,000 (Mani et al., 2016). *Shigella* is one of the top four pathogens responsible for moderate-to-severe diarrhea in children living in African and South Asian environments (Mero et al., 2021).

2.3.2.8 *Vibrio*

The genus *Vibrio* comprises Gram-negative bacteria that exhibit a curved-rod morphology. The pathogen exhibits motility and possesses the ability to survive in both aerobic and anaerobic conditions. The group of *Vibrio* species that are pathogenic includes *V. cholerae*, which is responsible for causing cholera, and commonly associated with undercooked seafood (Paul et al., 2021). Cholera is defined as a rapid depletion of bodily fluids caused by watery diarrhea, vomiting, and muscular cramping (Baker-Austin et al., 2018). Typically, inadequate management of human waste, contaminated water, and insufficient personal and environmental hygiene practices lead to the transmission of *Vibrio* bacteria through the fecal matter of an infected individual (Ali et al., 2015).

Global epidemics caused by *Vibrio cholerae* typically stem from elevated temperatures and contamination of environmental and aquatic ecosystems. The Centers for Disease Control and Prevention anticipate that the global incidence of cholera will range from 1.3 to 4 million cases annually, with a mortality rate of 21,000 to 143,000 individuals (CDC, 2023). According to Hsueh and Waters (2019), improving water and food safety, including water sanitation and appropriate food preparation, is considered the most efficient approach to cholera prevention.

2.4 Health Risks Associated with Street Food Consumption

However, the consumption of street food can pose health risks as it can cause foodborne illness. Risk refers to the likelihood of adverse consequences for human health or ecosystems as a result of exposure to environmental stressors. Thus, stressors may be defined as any physical, chemical, or biological factors that have the potential to induce adverse effects on humans, plants, animals, or ecosystems (USEPA, 2023). Foodborne illnesses can lead to acute poisoning or long-term diseases, such as cancer may lead to long-lasting disability and death (WHO, 2023).

Some important data indicate the presence of health risks associated with street food consumption (Sualeh & Zakir, 2020). Alimi (2016) has indicated that microbiological hazards are a subject of increased concern among consumers of street food in underdeveloped countries. Street meals have been associated with significant food poisoning epidemics in various parts of the world (Rakha et al., 2022). Both pathogenic and non-pathogenic bacteria have contaminated street foods, leading to the development of foodborne diseases (Madilo et al., 2023).

Several factors, such as microbiological contamination, vendors' inadequate knowledge of food safety, and inadequate hygiene standards, contribute to the high incidence of health risks associated with street meals in Africa (Bereda et al., 2016; Cudjoe et al., 2022; Nkosi & Tabit, 2021; Salamandane et al., 2023). The studies have indicated that vendors frequently store street meals at improper temperatures, handle them excessively, and market them in unhygienic conditions, rendering them susceptible to infection.

Mamun and Turin (2016) identified microbial contamination as the primary health hazard associated with street meals, while they also acknowledge environmental pollution as a potential health issue. Other studies have revealed that food vendors occasionally manipulate food products directly using their unprotected hands (Bereda et al., 2016; Mamun & Turin, 2016; The Guardian, 2020). This kind of business activity might make it easier for harmful bacteria like *Salmonella spp.* and *Staphylococcus aureus* to get into food (Abakari et al., 2018; Birgen et al., 2020; Raza et al., 2021; Madilo et al., 2023).

2.5 Knowledge on Food Safety and Food Borne Diseases

The extent to which street food vendors are knowledgeable about foodborne illnesses is a vital factor in guaranteeing the safety and quality of street-vended meals (Desye et al., 2023). Thus,

vendors' knowledge of the possible hazards linked to inadequate food handling procedures can greatly influence their ability to deliver safe and completely uncontaminated food to clients.

Ma et al., (2019) found that street food sellers in Handan, China, had a basic understanding of microbiological foodborne pathogens. While both consumers and street food vendors demonstrated a comprehensive knowledge of food safety, a mere 26.7% of vendors utilized or had complete access to hand-washing facilities, despite the fact that over 60% of vendors adhered to cleanliness and wore masks (Ma et al., 2019).

Food vendors at traditional markets in low- and middle-income countries are aware of the hazards they face and carry a substantial burden in ensuring food safety under challenging conditions (Wallace et al., 2022). However, research from various contexts has consistently highlighted a concerning lack of adequate understanding about foodborne illnesses among street food sellers. For instance, while street food vendors in Polokwane, South Africa, demonstrate a proficient grasp of food safety principles, their compliance with proper food handling practices remains inconsistent (Marutha & Chelule, 2020).

Nkosi and Tabit (2021) found that only 14% of street food selling sites in the Zululand District of South Africa demonstrated a high level of adherence to sanitary standards. A significant majority (76%) of street food sellers exhibited limited understanding of food safety. In Gondar, Northwest Ethiopia, a cross-sectional survey revealed that 79.7% of the vendors possess licenses and expertise in food safety and hygienic procedures. Conversely, 50.6% of the vendors had insufficient knowledge and practices in this area (Azanaw et al., 2022).

The Ejisu-Juaben Municipality conducted research to assess street food vendors' food safety and handling practices. The findings indicated that 98.8% of the vendors exhibited a strong knowledge

of food safety and handling procedures. This high level of understanding was correlated with factors such as training, licensing status, marital status, and religion (Addo-Tham et al., 2020). Similarly, Bawah (2013) reported that 86.7% of food handlers in Tamale Metropolis had a good grasp of food safety.

Nevertheless, a significant obstacle to food safety was the evident lack of training and knowledge among 63.1% of the participants (Odonkor & Odonkor, 2020). Kanda et al. (2020) conducted a study which revealed that food handlers with over six years of professional experience possessed significantly higher levels of knowledge compared to those with less than one year of experience. These findings suggested that the duration of a food handler's experience in the sector directly correlates with the level of expertise they gain about food safety protocols. Similarly, Akabanda et al. (2017) conducted a study to investigate the food safety knowledge, attitudes, and behaviors of institutional food handlers in Ghana. Among the handlers, 81.7% acknowledged that food may transmit typhoid fever, and 87.7% acknowledged that food can transmit bloody diarrhea. However, 76.2% of the handlers were uninformed of *Salmonella* being a foodborne disease, and 70.6% were unaware of Hepatitis A being a foodborne pathogen.

2.3.2 Hygienic practices during food handling

Food vendors play a crucial role in ensuring food safety during food handling. Thus, hygienic practices during food handling are essential to prevent foodborne illnesses and ensure food safety.

Hand washing and cleaning of surfaces and utensils are two of the hygienic practices recommended by the centers for disease control and prevention (CDC, 2023). Washing hands with soap and water before and after handling of food has been found out to be an effective way of preventing the spread of harmful bacteria. Equally, regular cleaning of cutting boards, countertops and utensils,

and other food preparation surfaces with hot, soapy water or a sanitizing solution helps to prevent cross-contamination (CDC, 2023).

Separating raw and cooked foods, cooking food thoroughly and ensuring personal hygiene during food handling helps to reduce the risk of foodborne illnesses and promote food safety for consumers (FDA, 2022). However, street vended foods are consumed directly without further cooking (Rakha et al., 2022). Hence, food vendors must establish adequate basic water supply, and hygiene facilities in their vending area to improve their overall food hygiene practices (Mohammed et al., 2023). In addition, the Codex Alimentarius Commission (CAC) has established general guidelines for food hygiene, which are referred to as the Codex code of practice. These principles offer guidance for achieving good food safety and hygiene standards across a range of industries, including the street food industry (Trafialek et al., 2018).

The elevated occurrence of foodborne illnesses in less developed countries can be ascribed to inadequate hygiene practices and a deficiency in adhering to prescribed protocols for food handling (Stratev et al., 2017). In support to this, Luning et al. (2023) highlighted the risks to public health associated with eating street food due to vendors' frequent non-compliance with environmental hygiene and food handling practices, as well as their limited understanding of food safety. Based on the broad principles of food hygiene from the Codex code of practice and other pertinent texts, a study was conducted to evaluate the hygiene procedures of street food sellers in four Asian and EU nations. In the surveyed EU countries, hygiene of equipment and food preparation generally demonstrated higher conformity than in Asian ones, but the most thorough implementation of personal hygiene principles was found in Thailand (Trafialek et al., 2018).

A study undertaken by Werkneh et al. (2023) in Northern Ethiopia revealed that around 51.7% of the food vendors interviewed engaged in on-site food preparation on the street. However, it was

observed that 45% of these vendors had never been provided with sufficient hand-washing facilities. A sizable proportion, namely 81.1%, of the street vendors demonstrated adherence to personal hygiene practices by regularly cleaning their working clothes. A notable 65.6% of these vendors maintained the cleanliness of their hands and nails. The vast majority, specifically 98.9%, of street vendors engaged in the handling of ready-to-eat food using their bare hands. Additionally, a considerable proportion, up to three-quarters or 75% of these vendors, had never undergone routine medical exams. Furthermore, it was observed that 59.4% of the individuals participating in the study who exhibited signs of illness or sickness were not involved in the activity of food preparation. Most of the respondents (62.8%) utilized an apron, while a considerable proportion (36.7%) wore nose masks during their activities of working or vending street food. Within the scope of this investigation, it was observed that 61.1% of respondents had habitual tendencies of cleaning their hands. A notable proportion of 47.2% of the participants demonstrated an initiative-taking approach such as using food covers, wind barriers, and enclosed display cases in safeguarding their vending stalls against potential environmental factors such as sunlight, wind, and dust.

A study conducted by Negassa et al. (2023) examined the hygienic practices of food vendors in Southern Ethiopia. The study's findings indicate that a mere 2.8% of the vendors engaged in the practice of washing their hands with clean water before handling or selling food. Many street food vendors, about 98.5% of the total, were seen without apron. Approximately 65.4% of the total number of seller's aprons were found to be partially clean and presentable. All of the vendors (99%) engaged in monetary transactions while providing food, with only a small proportion (5.1%) of vendors practicing hand hygiene. Approximately 26.7% of the vendors demonstrated the

practice of hand hygiene by washing their hands after sneezing, coughing, and touching various areas of their face, nose, and other body parts.

A study by Addo-Tham (2020) revealed that majority of food vendors, (85.2%) demonstrated proficient food handling practices during the process of serving. Out of 340 food vendors, (91.1%) served food hot, 84.1% protected their food from flies, and 89.1% did not allow customers to contact the food being served. Furthermore, most of the food vendors (56.4%) did not handle food with their bare hands. A notable observation was that, around 70% of food vendors exhibited a consistent practice of using the same hand for serving meals and managing monetary transactions. Also, most vendors utilized either plates (or bowls) or plain rubber for serving food (92.8% and 96.8%, respectively), whereas few vendors used disposable bowls (takeaway bowls) or newspapers for serving food (7.1% and 2.9%, respectively). While the observed food-handling practices demonstrated strong adherence to safety protocols, there were evident instances of unsafe practices.

2.6 Legal Frameworks on Food Vending

Each country has its own set of national laws that provide the comprehensive structure for regulating and controlling street food sales (Bambu, 2019). Subsequently, cities implement municipal restrictions, such as by-laws, rules, or ordinances, to control the operations of street sellers (Bambu, 2019). The legislative frameworks governing food vending vary worldwide, impacting vendor operations and positioning within urban food systems (Bambu, 2019; Adeosun et al., 2023). Regulatory obstacles such as outdated state retail food rules in places like Los Angeles can impede street vendors from acquiring licenses, therefore affecting their economic stability and successful incorporation into the formal economy (Bennet et al., 2022).

Regulatory frameworks differ between cities, influencing the way vendors handle their activities and assets in the urban food industry (Pulliat et al., 2023). For instance, in New York City, a complex system of municipal and state organizations supervises mobile food vending, guaranteeing food safety and adequate functioning of vending units through strict regulations (Jones, 2016). These regulations often concern the storage temperatures of food, the methods for ensuring cleanliness (including handwashing and the use of protective equipment), and the operational standards that vendors must meet to comply with public health regulations (FDA, 2013).

The primary objective of regulatory frameworks for food vending is to achieve a harmonious equilibrium between public health considerations, the economic prospects for vendors, and the intricate dynamics of urban food systems (Salamandane et al., 2023).

2.6.1 Food Vending Regulatory and Institutional Framework in Ghana

In Ghana, the legal and institutional parameters for food selling encompass an intricate network of national and municipal rules aimed at guaranteeing food safety and establishing operating criteria for street sellers. According to Aragrande and Argenti (2001), institutional frameworks are the official entities tasked with overseeing and controlling food vending operations.

The Food and Drugs Authority (FDA), the Environmental Health and Sanitation Directorate (EHSU), the Ministry of Local Government and Rural Development (MLGRD), municipal, metropolitan, and district assemblies (MMDAs), and the Parliament of Ghana (PoG) are vital regulatory bodies in Ghana. These organizations cooperate to implement and uphold the Food and Drugs Act of 1992 (PNDCL 305B) and the Public Health Act (Act 851) of 2012 (MLGRD, 2021).

The Local Government Act 462 of 1993, which grants local assemblies the authority to enact by-laws, provides the legislative basis for street vending. For instance, the Accra Metropolitan Assembly (AMA) enforces the 2017 Public Markets and Control of Hawkers By-law. The By-laws specify authorized locations for street vending and outline operational guidelines. In addition, the FDA mandates that suppliers get a permit by remitting a reasonable charge of GHC 5.00 (USD 0.73) before commencing their commercial operations. Vendors are required to complete registration, training, and licensing processes (Ghana Web, 2022).

Street food vendors must comply with the Code of Hygiene Practices, which governs cleanliness in food preparation and storage spaces, as well as adherence to appropriate hygiene procedures. In order to demonstrate their competence in food safety protocols, vendors are required to acquire a food handling certificate from the Accra Metropolitan Assembly, which incurs a fee of GHC 40.00. Systematic inspections conducted by the EHSU and FDA guarantee strict compliance with food safety standards (Forkuor et al., 2017).

The FDA's inspections have revealed improvements in food safety protocols, including the use of ice chests for temperature regulation and glass screens to protect food from potentially harmful substances. Nevertheless, there are still obstacles to overcome, such as the need for vendors to undergo yearly medical assessments in order to preserve their health licensing. Failure to adhere to this stipulation may lead to legal proceedings, monetary penalties, or harm to the credibility of the seller (AMA, 2020).

Studies conducted in other urban centres including Techiman Municipality, Tamale Metropolis, Sekondi, and Bolgatanga showed issues like poor sanitation, unsafe food preparation, and inadequate supervision of food processing (Amaami, 2017; Aovare, 2017; Abakari et al., 2018; Agliza, 2019; Aduah et al., 2021). Similarly, studies conducted in Volta, Ashanti, Greater Accra,

and Eastern Ghana have brought to light issues with the storage of food, personal hygiene, and environmental cleanliness (Arthur & Imoro, 2021; Botha et al., 2023). Furthermore, Larbi et al. (2021) revealed instances of coal particles, and dust, at many vending sites, indicating prevailing unhealthy environmental condition. *E. coli*, *Salmonella sp.*, *Staphylococcus aureus*, *Klebsiella sp.*, *Bacillus sp.*, and *Shigella sp.* were the most pathogenic bacteria detected in most dietary samples. Inadequate access to clean water, contamination of food items by dust and airborne pollutants, inadequate hygiene procedures, inappropriate storage methods, and worsening urban circumstances all contribute to the facilitation of infectious disease transmission in the street food sector. Several weather-related environmental factors, such as precipitation and runoff, which depend on the existing temperature or humidity conditions, influence the survival and growth of microorganisms. Additionally, the risks of food contamination are particularly apparent in areas characterized by warm and humid climates, because these conditions create optimal environments for bacteria to proliferate and contaminate water and food (Opsteegh & Van Der Giessen, 2011). Although legislative frameworks and institutional initiatives strive to reconcile public health requirements with economic prospects for vendors and the intricacies of urban food systems, there are ongoing enforcement and compliance. In order to improve food safety procedures and guarantee the successful enforcement of food vending legislation in Ghana, it is imperative to enhance monitoring, education, and resource allocation (Nkosi & Tabit, 2021; Botha et al., 2023).

2.8 Conceptual Framework

The objective of this study is to provide a conceptual framework that offers a thorough comprehension of the many interrelated elements that impact the safety and quality of street food. The framework investigates the impact of demographic and socioeconomic factors, including age, educational background, and experience, on the capacity of vendors of street foods to uphold

sanitary requirements. Three major theories, namely the Health Belief Model (HBM), the Theory of Planned Behaviour (TPB) and Social Cognitive Theory (SCT), are integrated into the framework of this study. Collectively, these theories will investigate how individuals perceive health hazards, their behavioral motivations, and the wider environmental and social factors that impact the food safety procedures of street food sellers.

2.8.1 The Health Belief Model (HBM)

The Health Belief Model (HBM), created in the 1950s by social psychologists in the United States Public Health Service, aims to elucidate preventive health behaviors by analyzing how individuals assess health hazards and make choices influenced by their views of usefulness and probability of favorable results. The model comprises six dimensions: perceived susceptibility (evaluation of risk), perceived severity (calculation of consequences), perceived benefits (assessment of action effectiveness), perceived barriers (hindrances to action), self-efficacy (assurance in carrying out the behavior), and cues to action (indicators for behavior). The HBM focuses on cognitive factors, but critics say it ignores emotional, social, and cultural effects, which makes it less accurate than models that take into account more factors (Alyafei & Easton-Carr, 2024). Investigation reveals inconclusive findings; for example, Strodel et al. (2019) discovered that although persons with prediabetes had a higher level of knowledge about their risk, this awareness did not have a substantial effect on their adoption of lifestyle modifications. Al-Ani et al. (2023) conducted a study that revealed a significant association between susceptibility beliefs, perceived benefits, and self-efficacy in relation to the acceptance of preventive measures such as cervical cancer screening. Additionally, Abdolahian et al. (2020) showed that an education program based on the HBM effectively enhanced screening rates among Iranian women. Despite its limitations, the findings

indicate that the HBM can be useful provided its components are appropriately addressed and customized for the target demographic.

2.8.2 Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB) posits that an individual's desire to participate in a certain action, together with their perceived ability to regulate that conduct, determines their probability of actually carrying out that behavior. The TPB delineates three fundamental belief categories that shape behavioral intentions: behavioral beliefs, linked to perceived outcomes and their evaluations, normative beliefs, influenced by significant individuals or groups and the motivation to conform to their expectations, and control beliefs, linked to perceived factors impacting one's ability to carry out the behavior and exert control over those factors. These beliefs contribute to three dimensions: attitudes toward conduct (formed by behavioral beliefs), subjective norms (driven by normative views), and perceived behavioral control (affected by control beliefs). The hypothesis posits that individuals are more inclined to have an intention to participate in an action when they possess favorable views, sense robust social support, and believe they have significant control over the conduct (Huang et al., 2020). Xu et al. (2024) conducted a study using the TPB, which found that subjective norms and self-efficacy significantly influenced seniors' intentions to participate in health checks. Researchers identified intention as a mediator between attitudes, social norms, perceived behavioral control, and self-efficacy. Zeng and He (2024) extended the TPB by investigating the elements that impact adolescents' engagement in football. They emphasized the significance of attitude, subjective norms, perceived behavioral control, and behavioral intention, noting that these aspects may differ depending on gender and age. Furthermore, Azad et al. (2023) integrated the TPB with machine learning techniques to forecast human behavior. The results showed that combining TPB's psychological insights with machine learning techniques, especially

the Gradient Boosting Classifier, greatly improved the accuracy of predictions, reaching 91% with strong macro F1 scores.

2.8.3 The Social Cognitive Theory (SCT)

The Social Cognitive Theory (SCT) assesses the interplay between internal and external elements in modulating an individual's capacity to participate in particular activities. Principal components comprise self-efficacy (the perceived capability to carry out a behavior), outcome expectancies (the expected consequences of the behavior), behavioral outcomes (such as rewards or disapproval), self-management skills (which improve the success of the behavior), and the behavior itself (measured by metrics such as daily steps or substance use). SCT emphasizes several elements that influence behavior, including skills training, vicarious learning (observing others), verbal persuasion, perceived obstacles, emotional or mental states, the environment, and internal and external signals (Martín et al., 2020). Jeng et al. (2022) used SCT to investigate physical activity in persons diagnosed with Multiple Sclerosis (MS). They found that factors like goal-setting and self-efficacy significantly influenced physical exercise, and that weariness led to a decrease in activity levels. In their 2018 study, Oyibo et al. employed SCT to make predictions about physical activity behaviors among university students from individualist and collectivist cultures. The findings indicated that self-efficacy and self-regulation were significant predictors in individualist societies, but social support had a greater impact in collectivist societies. The study proposed the use of culturally specific persuasive methods, such as self-motivating procedures for cultures that value individualism and socially oriented strategies for cultures that value collectivism. Harris et al. (2021) showed that SCT may increase breakfast consumption in institutional settings by targeting self-efficacy, result expectations, and social effects. They propose improving food service environments and raising awareness through the implementation

of SCT. Islam et al. (2023) emphasized that using theory-based frameworks in healthcare helps to elucidate essential components, comprehend self-management practices, and direct future improvements. Their thorough examination emphasized the importance of using intricate frameworks, seeking advice from specialists, taking cultural and contextual elements into account, and adhering to standardized assessment standards.

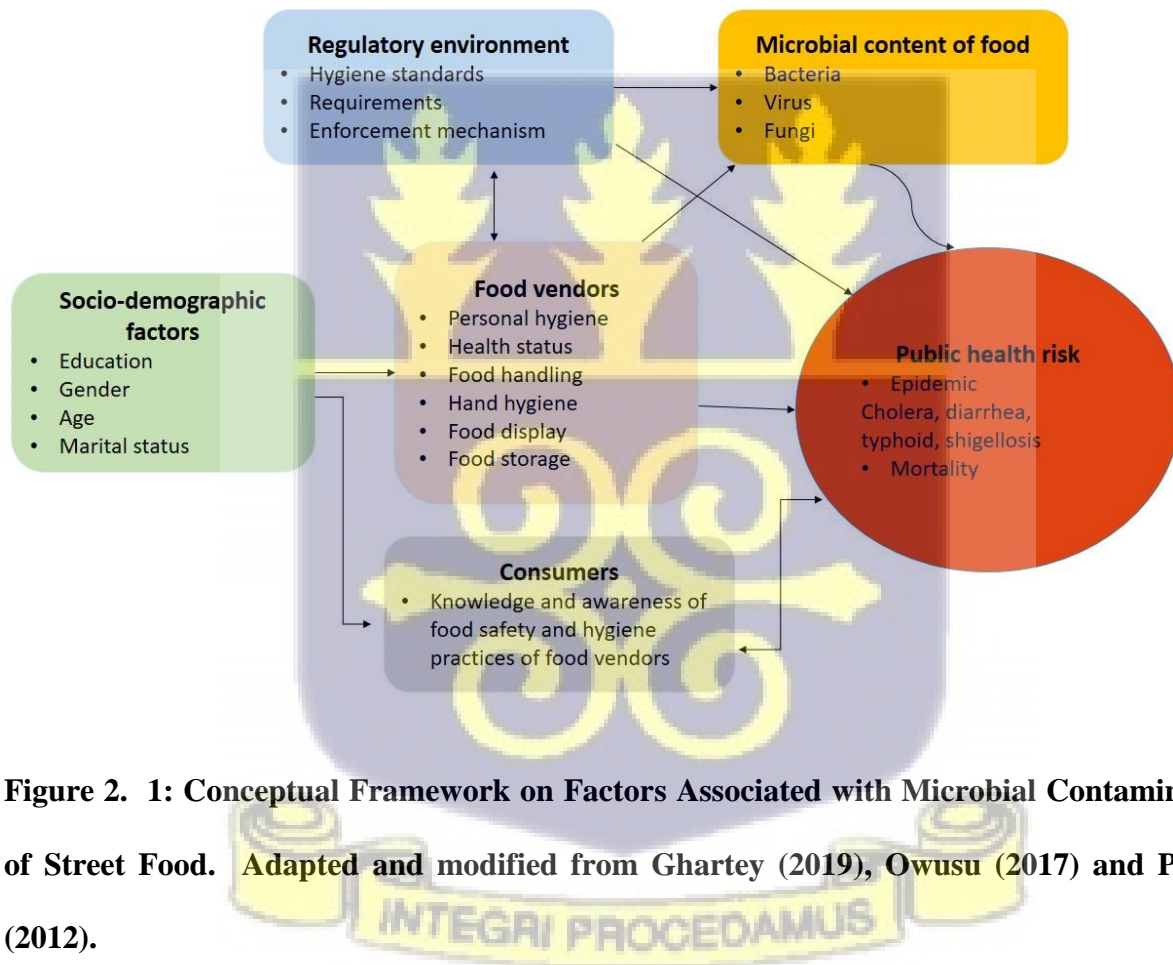


Figure 2. 1: Conceptual Framework on Factors Associated with Microbial Contamination of Street Food. Adapted and modified from Ghartey (2019), Owusu (2017) and Paudel (2012).

The study combined the HBM, TPB, and SCT in this study's conceptual framework to get a full picture of the factors that affect how safe street food is for consumption. The HBM evaluates

vendors' views of the risks, advantages, and obstacles associated with adopting safer food handling operations. The TPB examines how their attitudes, societal influences, and perceived ability to manage hygiene standards influence their intentions to adopt these practices. SCT focuses on the interplay between personal, environmental, and social elements, underscoring the impact of self-efficacy, observational learning, and external support networks on the food safety behaviors of vendors. Collectively, these ideas provide a comprehensive method for understanding and increasing the food safety measures of street food sellers, thereby decreasing the occurrence of foodborne diseases and promoting public health.



CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Background of the Study Area

The study area is Opetekwei (05°31.521'N and 000°16.480'W), a coastal community in the Ablekuma West Municipality, located in the western part of Accra. The community covers approximately 15.01 square kilometers. Residents used the name "Opetekwei" to refer to their nearness to a fisherman named Kwei, who was the first inhabitant. Opetekwei shares boundaries with Gyatakpor waterpark (south) and Dansoman (north).

Geologically, the region consists of coastal sand and a mixture of quartzite and sandstone. The rainy season in the region lasts from April to October, with maximum rainfall of 129.7 mm and 162.4 mm in May and June respectively (Asare-Nuamah & Botchway, 2019). The average annual temperature is around 28°C (82°F), with minimal variation throughout the year. August is the coolest month at 25.7°C (78.3°F), while March is the hottest at 29.3°C (84.7°F), and heavy rain is common in the afternoons and evenings (Asare-Nuamah & Botchway, 2019). Due to its exposure to coastal and wind activity, the area is prone to significant erosion, made worse by the lack of proper drainage systems and low-lying terrain (Akari, 2021). Opetekwei is located in the Savannah zone and experiences an annual rainfall of about 730 mm, mainly during two rainy seasons with brief, intense storms that often cause localized flooding. The average temperature ranges from 24.7°C in August to 28°C in March, with an overall yearly average of 26.8°C. Over the past century, human activities and climate changes have led to a depletion of vegetation (Akari, 2021).

Opetekwei's low-lying landscape makes it particularly vulnerable to drainage and sanitation issues, compounded by the presence of ponds and marshy areas. Its elevation causes even moderate rainfall to lead to substantial water buildup, resulting in frequent flooding that impacts both homes and infrastructure. According to residents, the ponds contribute to the waterlogged nature of the community compounding flooding challenges in the community (Akari 2021). Residents often struggle with limited drainage systems, leading to stagnant water that promotes the spread of disease vectors and raises the risk of waterborne illnesses. The roads in the community are in bad states – untarred, dusty, and turn muddy after downpours (Akari 2021). The Assembly member for the community attributed the poor state of roads to some residents dumping refuse into drains (Akari 2021).

Environmental and sanitation challenges are significant in Opetekwei. Indiscriminate waste disposal and open defecation are common, and tricycles used for refuse collection often dump waste near the community's water body, leading to water contamination. Although National Sanitation Day initiatives attempt to address these issues, they remain persistent. The unregulated expansion of settlements has led to slum growth, congested high-density residential zones, and a lack of adequate gutters and drains. The uncovered condition of many existing gutters allows debris to clog the drainage systems, resulting in frequent flooding. These conditions pose a risk of disease outbreaks, with diarrhea and typhoid among the most prevalent health issues in the area (Ablekuma West Municipal Assembly, 2022).

Despite these environmental and infrastructural challenges, residents continue to live in Opetekwei because of the relatively low cost of land. Fishing is a primary economic activity, with both marine and inland fishing common among the inhabitants. Ga and Twi are the most widely spoken

languages, with Ewe and other languages also in use. The religious makeup includes Christians, Traditionalists, and Muslims.

Figure 3-1, illustrates the boundaries and layout of the Opetekwei in the Ablekuma West Municipality.

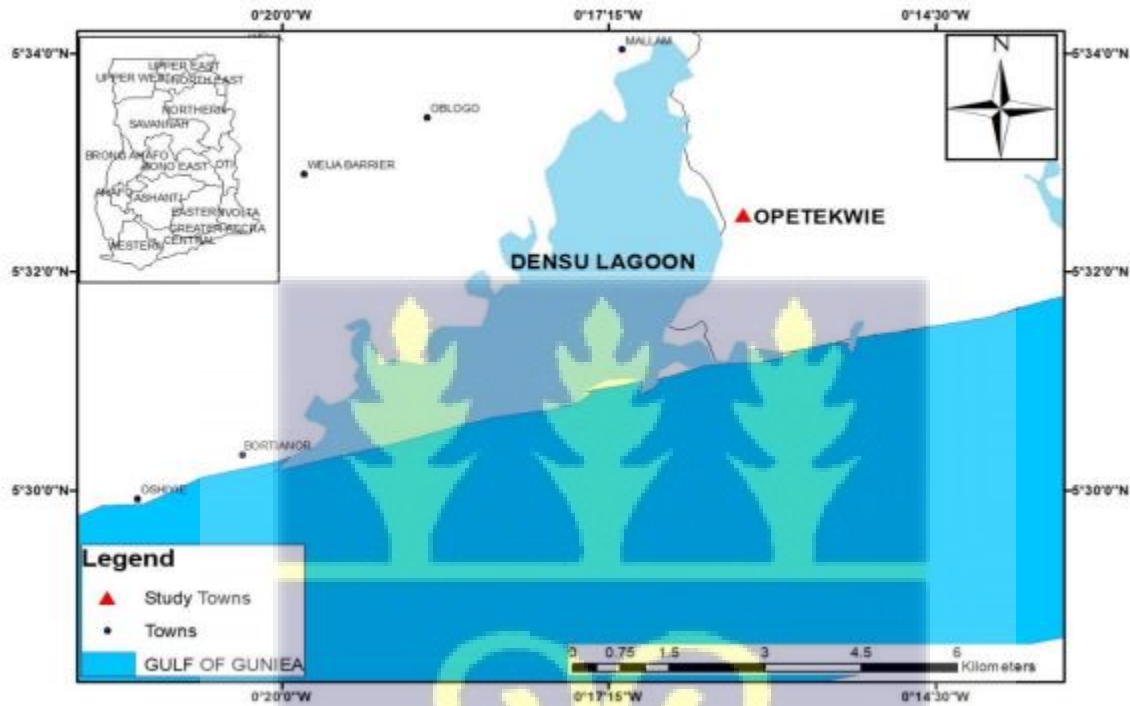
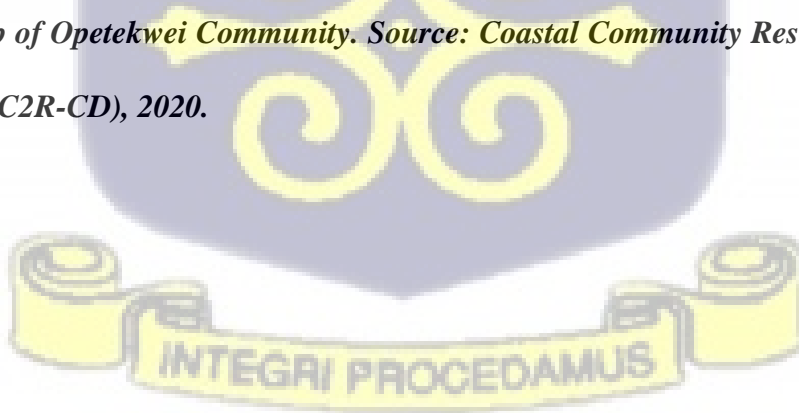


Figure 3-1: Map of Opetekwei Community. Source: Coastal Community Resilience to Climate and Diarrhoea (C2R-CD), 2020.



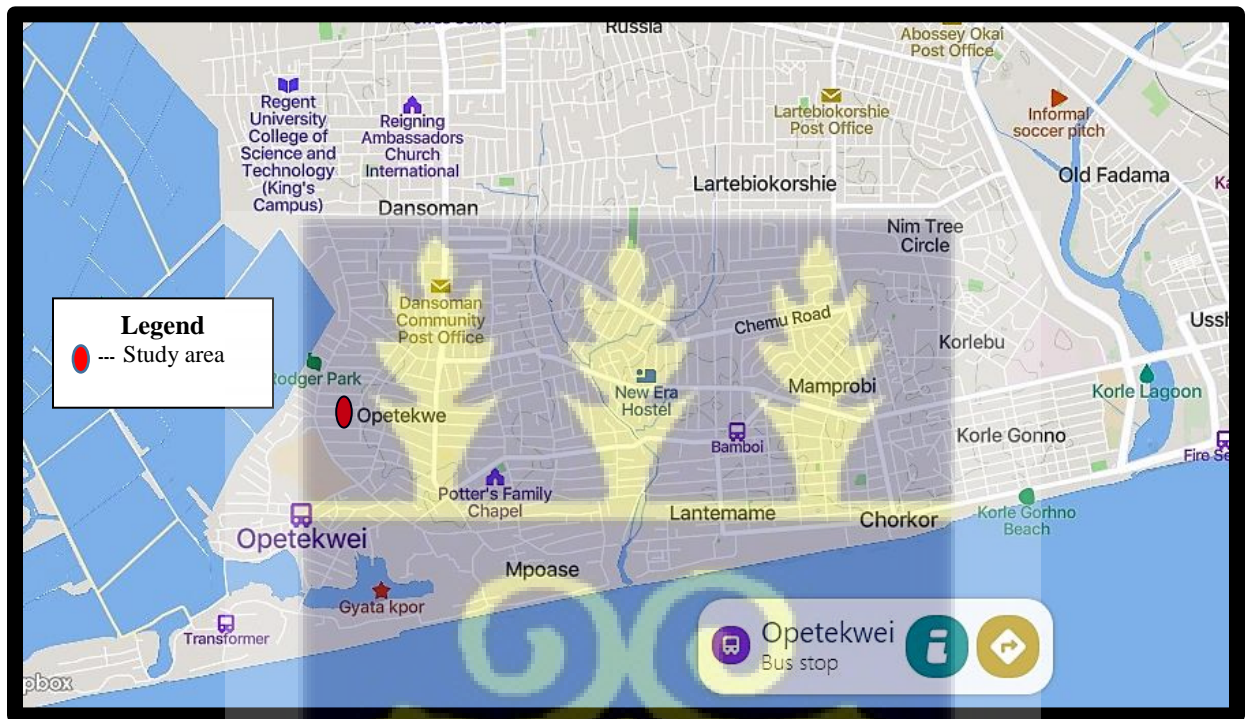
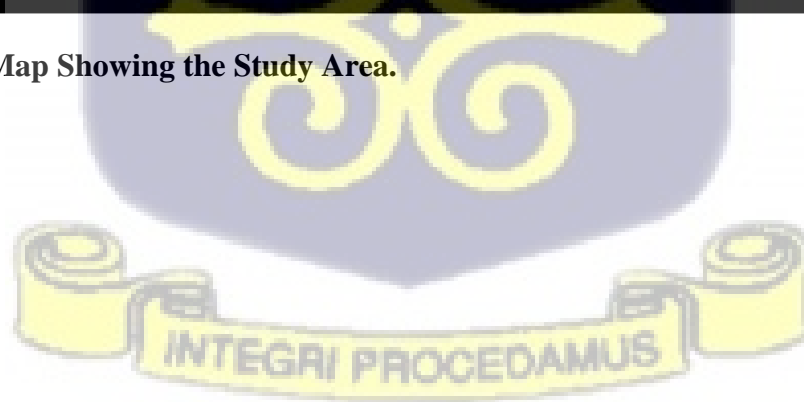


Figure 3. 2: A Map Showing the Study Area.



3.2 Methodology

3.2.1 Study Design

A mixed method approach was used. It included both qualitative and quantitative methods for data collection. Exploratory visit was made to establish working relation with some key influential leaders such as the Municipal Environmental Health Officer and Assemblyman in the study area.

3.2.2 Pre-Testing of Questionnaire

The questionnaire and interview schedule were pilot-tested with a small group of individuals similar to the target respondents in a location outside the main research area. This process helped identify ambiguities, poorly worded questions, inappropriate response options, and estimate the interview duration. Based on the feedback from the pilot test, the instruments were refined, and the improved version was used for data collection (Bansah, 2018).

3.3 Study Population and Sample Size Determination

3.3.1 Study Population

The target population for this study was all stationary street food vendors who sold cooked foods and consumers in the Opetekwei community. Stationary food sellers have a permanent location and are therefore easily tracked and monitored. Mobile food vendors (hawkers) were not included as their mobile nature makes tracing for clarification of responses and observation of their practices challenging. The stationary food vendors sold one or more types of the Ghanaian foods included in this study. The target population for the study included all food vendors who were 18 years and above while the consumers included persons from 15 years and above.

Table 3. 1: Types of foods and the time sold in the study area (Opetekwei)

Types of foods	Condiments	Time sold
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<i>Waakye</i>	Salad, <i>Macaroni</i> , <i>Gari</i>	Morning to afternoon (8am – 2pm)
<i>Banku / kenkey</i>	Red/Green pepper sauce, Chopped onions, Fish	Morning to evening (10am – 8pm)
<i>Indomie</i>	Stir-fried noodles and chopped vegetables	Evening (6pm – 10pm)

* **Condiments** are generally sauces or preparations added to food to enhance flavor, add texture, or a visual element (Whatnall et al., 2023).

3.3.2 Sample Size Determination

A head count revealed that there were 31 stationary street food vendors in Opetekwei in the Ablekuma West municipality at the time of study.

3.4 Sampling Technique

3.4.1 Selection of Respondents

The study involved 31 food vendors (Khalifa, 2020; Indeed Editorial Team, 2022). A pilot study was carried out to gather information about the characteristics of the population. The information gathered during the pilot study included the boundaries of the study area, the types of foods sold, and the number of food vendors in the study area.

The environmental health officer of the Ablekumah West Municipal Assembly was purposively selected as a key informant as his office was directly involved in monitoring and supervision of street food vendors at the local level.

A non-probability sampling method was employed to select 100 street food consumers in the Opetekwei community due to the absence of a comprehensive sampling frame for the total population. This technique is particularly beneficial for studies where drawing a random

probability sample is hindered by time and cost constraints. Estimating the population size necessary to create a random sample of street food consumers in Opetekwei would demand considerable time and multiple methods (Labana et al., 2024). As a result, non-probability sampling was considered the most suitable approach.

The sampling process utilized a two-stage approach: first, the study area was divided into three distinct clusters or zones. In the second stage, street food consumers were chosen using a convenience sampling method from each zone (Yakubu, 2021). This approach allowed for the inclusion of individuals who were easily accessible.

Table 3.2: Divisions of study area

Zone	Description
1	From the first bus station to the lagoon
2	From the second station to the lagoon
3	From the right side of Ebenezer SHS to the lagoon

3.5 Data Collection

Semi - structured questionnaires containing both close and open-ended questions from previously validated questionnaires used in similar studies in other countries (Werkneh et al., 2023; Addo-Tham et al., 2020; Marutha & Chelule, 2020; Ma et al., 2019) were used to obtain information from thirty one (31) food vendors and hundred (100) street food consumers. For convenience and effectively reaching the food vendors in the study area, the questionnaire was administered during selling hours (Bansah, 2018; Fenteng et al., 2023). The questionnaires were administered with the aid of trained field assistants to ensure practicability (Fenteng et al., 2023). Kobo Toolbox software was used in collecting and managing the data from the field survey.

For easy comprehension of the respondents, the questions were interpreted from English to Twi. The questions and responses were coded for further analysis. The questionnaire covered personal and food hygiene practices, and food vendors' knowledge on food borne diseases. The questionnaire for food vendors included the food vendors' knowledge of food safety and their personal and hygienic practices. In addition to using structured questionnaire, direct observations were made on vendors' hygienic practices during questionnaire administration on issues such as the use of aprons by vendors, hand washing among vendors, serving food with bare hands, holding money bare hands, covering of hair, and the environment of the vending site (Aovare, 2017). This direct observation of vendors' hygienic practices was used to validate vendors' reported hygiene practices (Yakubu, 2021).

The street food consumer questionnaire was divided into four parts: 1) Socio-demographic characteristics, reasons and frequency of purchasing street foods, and the factors considered when buying street foods; 2) perception of consumers on street food safety 3) Purchasing choices of consumers; 4) consumers' recommendations on things to be done to render street food in Opetekwei safe.

3.5.1 Food sampling

Eighteen (18) food samples (including macaroni, salad, or 'gari') were collected from 6 waakye sellers; sixteen (16) food samples (including pepper sauce and fish) were obtained from 8 kenkey sellers; whereas sixteen (16) stir-fried indome noodles were bought from 8 indomie sellers in a period of three months (June 2024 to August 2024). In all, 50 food items were obtained from the food vendors. Samples were collected within the hours of 10:30 a.m, 2:00 p.m and 7:00 pm as these were the times that the food samples were cold and most consumers patronize.

Table 3. 2: Food Items Sold by Vendors Categorized by Time of Day

Food	Seller No.	Food items	Time
<i>Waakye</i>	1	<i>Waakye, macaroni, salad</i>	Morning
	2	<i>Waakye, macaroni, salad</i>	
	3	<i>Waakye, macaroni, gari</i>	
	4	<i>Waakye, macaroni, salad</i>	
	5	<i>Waakye, macaroni, salad</i>	
	6	<i>Waakye, macaroni, gari</i>	
<i>Kenkey</i>	1	<i>Kenkey, pepper sauce, fish</i>	Afternoon
	2	<i>Kenkey, pepper sauce, fish</i>	
	3	<i>Kenkey, pepper sauce, fish</i>	
	4	<i>Kenkey, pepper sauce, fish</i>	
	5	<i>Kenkey, pepper sauce, fish</i>	
	6	<i>Kenkey, pepper sauce, fish</i>	
	7	<i>Kenkey, pepper sauce, fish</i>	
	8	<i>Kenkey, pepper sauce, fish</i>	
<i>Indomie</i>	1	Stir-fried noodles	Evening
	2	Stir-fried noodles	
	3	Stir-fried noodles	
	4	Stir-fried noodles	
	5	Stir-fried noodles	
	6	Stir-fried noodles	
	7	Stir-fried noodles	
	8	Stir-fried noodles	

The type of food, time sampled, and the location of food vendor were included in the labels attached to the food samples. Codes were assigned to each food sample for easy identification during the microbial analysis. The codes for the food samples were “W, M, S, G, K, F, P, and In” which indicated *waakye, macaroni, salad, gari, kenkey, fish, pepper sauce, and Indomie* respectively. The food samples were kept in an ice chest containing ice blocks at a temperature of

about $<5^{\circ}\text{C}$ to maintain the condition of the food (Pampoukis et al., 2022). These were then transported to the Nutrition and Food Science Microbiology laboratory of the University of Ghana within one to two hour(s) for microbial analysis.

3.6 Microbial analysis

Food samples were analyzed for the microorganisms: total aerobic bacteria count, yeasts and Molds counts, Total coliform count, *Escherichia coli* (*E. coli*), *Salmonella*, *Shigella* and *Vibrio cholerae*.

3.6.1 Media Preparation

Media preparations were carried out according to the manufacturer's (Oxoid and VWR) protocol for isolating, growing, and preserving microorganisms.

3.6.2 Quality Assurance

To ensure results obtained were reliable, all glass wares, tips and instruments were sterilized by autoclaving at 121°C for 2 hours at a pressure of 15psi for 30 minutes before used to prevent contamination. Mean values of duplicates from the analysis of all the food samples were reported in log cfu/g (Mohamed-Sharif et al., 2023; Nethathe et al., 2023).

3.6.3 Enumeration and Identification of Microorganisms

Twenty-five grams (25 g) of each food sample was homogenized with 225ml of buffered peptone water. Ten (10)-fold serial dilutions were prepared and the appropriate dilutions were plated.

About 1ml aliquot of appropriate dilution was inoculated on tryptic soy agar (TSA) (Oxoid; UK), potato dextrose agar (PDA acidified with 10% tartaric acid to pH of 3.5) (VWR; EC-Belgium) and MacConkey (DifcoTM; USA) agar. The TSA plates were incubated at 37°C for 24 hours in Genlab

incubators. All colonies observed after incubation were enumerated for total aerobic bacteria. PDA plates were incubated at 25°C for 48-72 hours for enumeration of yeast and moulds and MacConkey agar plates were incubated at 37°C for 24 hours for enumeration of total coliforms bacteria and at 44.5 °C for 24h for enumeration of faecal coliforms.

3.6.3.1 Biochemical test for *E. coli*

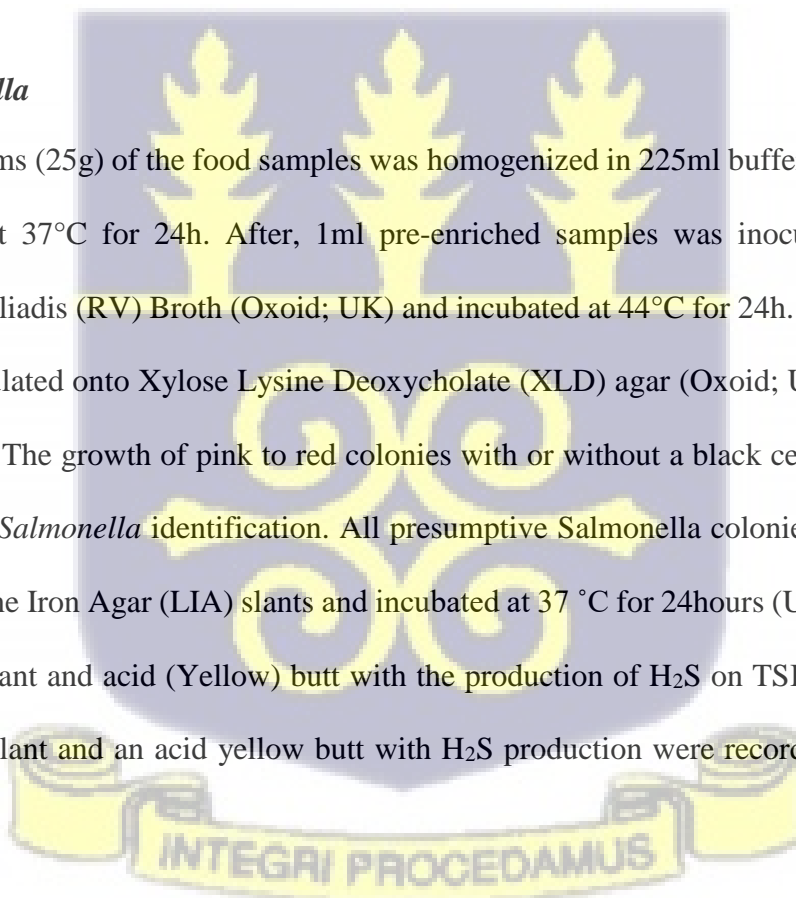
All presumptive faecal coliform colonies were inoculated on Triple Sugar Iron (TSI) agar (Oxoid; UK) and incubated at 37 °C for 24hours (USFDA, 2011). An acid (Yellow) slant and acid (Yellow) butt with gas (bubbles or air spaces) production on TSI slant were recorded positive for *Escherichia coli*.

3.6.3.2 *Salmonella*

Twenty-five grams (25g) of the food samples was homogenized in 225ml buffered peptone water, and incubated at 37°C for 24h. After, 1ml pre-enriched samples was inoculated in 10ml of Rappaport-Vassiliadis (RV) Broth (Oxoid; UK) and incubated at 44°C for 24h. Cultures from RV broth were inoculated onto Xylose Lysine Deoxycholate (XLD) agar (Oxoid; UK) and incubated at 37°C for 24h. The growth of pink to red colonies with or without a black centre were selected and purified for *Salmonella* identification. All presumptive *Salmonella* colonies were inoculated on TSI and Lysine Iron Agar (LIA) slants and incubated at 37 °C for 24hours (USFDA, 2011). An alkaline (Red) slant and acid (Yellow) butt with the production of H₂S on TSI slant, whereas an alkaline purple slant and an acid yellow butt with H₂S production were recorded as positive for *Salmonella*.

3.6.3.3 *Shigella*

Twenty-five grams (25g) of the food samples was homogenized in 225ml buffered peptone water, and incubated at 37°C for 24h. One millilitre of the pre-enriched samples was inoculated onto



Salmonella Shigella (SS) Agar (Oxoid; UK) and incubated at 35 to 37°C for 24h. The growth of colourless colonies without black centres, specific to *Shigella* were isolated and purified for further identification. All presumptive *Shigella* colonies were inoculated on TSI and LIA agar slants and incubated at 37 °C for 24hours (USFDA, 2011). An alkaline (Red) slant and acid (Yellow) butt on TSI slant, whereas an alkaline purple slant and an acid yellow butt were recorded as positive for *Shigella*.

3.6.3.4 *Vibrio cholerae*

Twenty-five grams (25g) of food sample was homogenized in Alkaline Peptone Water (APW) (Oxoid; UK) and incubated at 35-37°C for 6-8hours. One milliliter inoculum was streaked onto Thiosulfate-Citrate-Bile-Sucrose Agar (TCBS) (Oxoid; UK) and incubated at 35-37°C for 24h. The growth of yellow colonies with opaque centers and translucent edges, particular features for *Vibrio cholera* were isolated and purified for further identification tests. All presumptive *Vibrio cholera* colonies were inoculated in TSB-3%NaCl and incubated at 37 °C for 24hours to examine growth. Indole test was also performed to confirm *Vibrio cholera*. A deep blue coloration of Microbact™ Oxidase Detection Strips (Oxoid, UK) after smearing well isolated colonies confirmed the presumptive *Vibrio cholera* isolates. Catalase test was carried out where effervescence observed from drops of hydrogen peroxide were put on well isolated colonies further confirmed the presumptive *Vibrio cholera* isolates.

3.7 Data Analysis

Both qualitative and quantitative analysis were used for this study.

3.7.1 Qualitative Analysis

The study applied established theories to interpret the responses and information. Participants' perceptions and attitudes were precisely assessed using a three-point Likert scale: "very

concerned," "slightly concerned," and "not concerned at all". This thorough approach allowed for the precise quantification of qualitative data, accurately capturing the intensity and severity of the investigated issues. The data was meticulously organized using descriptive statistics and visually summarized using graphs and pie charts to effectively address the research objectives. Observations regarding the food vending environment, food safety measures, and food vendor hygiene practices provided valuable insights. The data was accurately processed, cleaned, and coded in Excel before being carefully analyzed using STATA version 12.0, with results confirmed using Statistical Package for Social Sciences (SPSS) version 27.0.

3.7.2 Quantitative Analysis

The quantitative data was analyzed using the Statistical Package for Social Sciences (SPSS) version 27.0. Demographic data was analyzed using descriptive statistics. To describe categorical variables like gender, age, educational level, marital status, religion and occupation, frequency distributions and percentages were employed. Bar charts and pie charts were created using Microsoft Excel 2013 edition. The questionnaires were analyzed using content and thematic analysis, with response were coded and grouped into related categories. This made it possible to identify the patterns, trends and themes that were recurrent in the data set. Pearson Chi-square was also used to test for association between variables. Interrelated variables were considered statistically significant if P-values were less than 0.05.

The analysis of compliance levels among street food vendors utilized an eight-point Safety Compliance Checklist assessing parameters such as protective clothing, head covering, food protection, water availability, training on food hygiene, medical screening, cleanliness of fingernails, and appropriate kitchenware. Each parameter was rated on a 5-point Likert scale (1 = Very Poor, 5 = Very Good). Data were collected through direct observations and structured

interviews, and mean compliance scores were calculated by averaging scores across all vendors. Compliance levels were categorized into high (4.0–5.0), moderate (3.0–3.9), and low (1.0–2.9) adherence.

The compliance score was calculated by taking the mean score of each compliance criterion across all vendors. The formula used for this calculation was:

$$\text{Compliance Score} = \frac{\sum_{i=1}^n C_i}{n} \quad (1)$$

Where:

- C_i = Compliance score for the i -th vendor
- n = Total number of vendors

Descriptive statistics summarized the data, and a radar chart visualized mean compliance scores to highlight areas of strength and critical gaps. Additionally, Pearson correlation analysis was conducted to examine relationships between vendors' demographic characteristics (e.g., age, education, and years of experience) and compliance scores, identifying weak to moderate correlations that suggest demographic factors may influence certain aspects of hygiene compliance.

The involved analyzing 50 food samples. The data from the microbial analysis of the food samples was entered into Microsoft Excel version 13 and then exported to SPSS version 27.0 for analysis. Descriptive statistics, including means, frequencies, percentages, and standard deviation, were used for the analysis. Bar graphs were used to show the distribution of pathogens in the food samples. Total yeast and mold count, total plate count and Total Coliform Count were calculated using mean and standard deviation (Abakari et al., 2018; Birgen et al., 2020). The mean

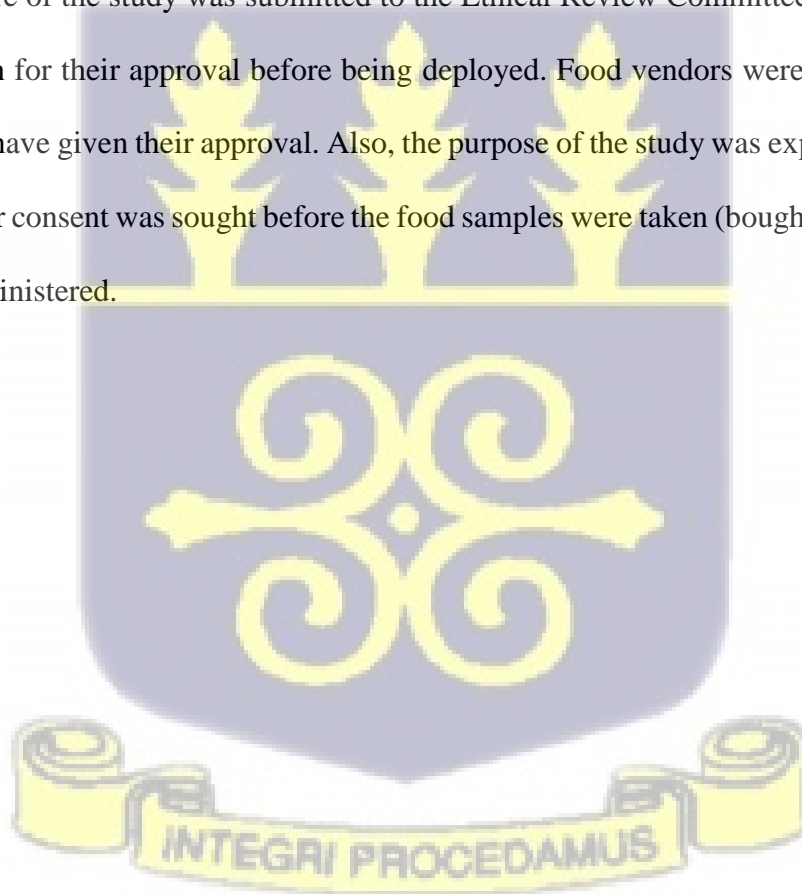
concentrations were converted to log base 10 for the microbial load data. Prevalence of bacteria isolates in the food samples were obtained by the formula (Abakari et al., 2018);

$$Prevalence = \frac{\text{Frequency of Food Type Containing Pathogen}}{\text{Total Number of Food Type}} \times 100 \quad (2)$$

The study also employed one sample T-test to determine the overall microbial contamination level in accordance with specified food safety standards (Health Protection Agency, 2009; Centre for food Safety, 2014; ICMSF, 2011).

3.8 Ethical clearance

The questionnaire of the study was submitted to the Ethical Review Committee of the University of Ghana, Legon for their approval before being deployed. Food vendors were recruited into the study after they have given their approval. Also, the purpose of the study was explained to the food vendors and their consent was sought before the food samples were taken (bought) and the research instruments administered.



CHAPTER FOUR

RESULTS

4.1 Institutional and Regulatory Frameworks

The regulatory framework governing street food vendors in Opetekwei community was examined. Through an interview with the Environmental Health Officer (EHO), the study explored challenges in enforcing food safety regulations and the impact of community dynamics on food safety practices.

Table 4. 1: Identified Themes

Themes	Description
Regulatory Framework and Compliance	Covers the formal rules and requirements for food vendors to follow, including health and safety protocols.
Challenges in Enforcement	Explores difficulties in enforcement due to vendor behavior, inadequate monitoring, and operational challenges.
Interference and Lack of Support	Highlights issues with local authority interference that undermine enforcement efforts, including interventions by chiefs.
Community Sanitation Issues	Focuses on environmental challenges such as illegal dumping and poor sanitation, which complicate the food safety landscape.

Source: Field Work (2024)

4.2.1 Analysis of Qualitative Interview Data

The qualitative analysis revealed several key challenges in enforcing food safety regulations in Opetekwei. The Environmental Health Officer (EHO) highlighted the following issues:

Regulatory Framework and Compliance

The Environmental Health Officer (EHO) of the Ablekumah West Municipality emphasized the critical need for food vendors to comply with the Assembly's by-laws on food safety, stating:

“Food vendors in this area, like those in other areas, are required to follow the rules and regulations governing food safety and vending outlined in the Assembly's by-laws. While we are actively educating vendors, some remain resistant, often reverting to old practices when unsupervised.”

Challenges in Enforcement

The EHO also described difficulties in ensuring compliance, noting,

“Food vendors involve several individuals in food preparation, but not all of them undergo medical screening. This is because when the workers are screened at the vendor's expense, they leave with certification to operate as independent food vendors.”

The EHO continued,

“Ideally, they (food vendors) are to come but they don't. They have to come here for us to go and see the area where they want to put the structure, whether it is suitable for food vending business or not but they don't.”

Interference and Lack of Support

The EHO discussed the complications in enforcing food safety due to local authority interference:

“In cases of non-compliance, vendors are prosecuted. However, there are issues where local authorities intervene on behalf of these vendors. Chiefs and other local authorities often plead for

the vendors, resulting in the vendors going unpunished and continuing to operate in their own way. They don't understand."

Community Sanitation Issues

The community sanitation issues in Opetekwei significantly impact food safety, as highlighted by the Environmental Health Officer (EHO) in the study. The EHO expressed concerns about widespread illegal dumping near water bodies, stating,

"Sanitation is a serious problem in this community. You see the dumpsite along the water body? It is illegal but the chiefs welcome it, nothing is being done. It has even turned into business where monies are taken to dump rubbish at that place".

4.2 Socio-demographic Characteristics of Street Food Vendors

The socio-demographic characteristics of vendors are illustrated in Tables 4.2 below. The findings reveal that a significant proportion of the street food vendors are female (97%) and fall within the age range of 30-34 years (32%). Sixty eight (68%) of the respondents were married. Christians constitute 87%, with Ewe (45%) and Akan (35%) being the predominant ethnic groups. Sixty-one percent (61%) of the food vendors had completed primary education.

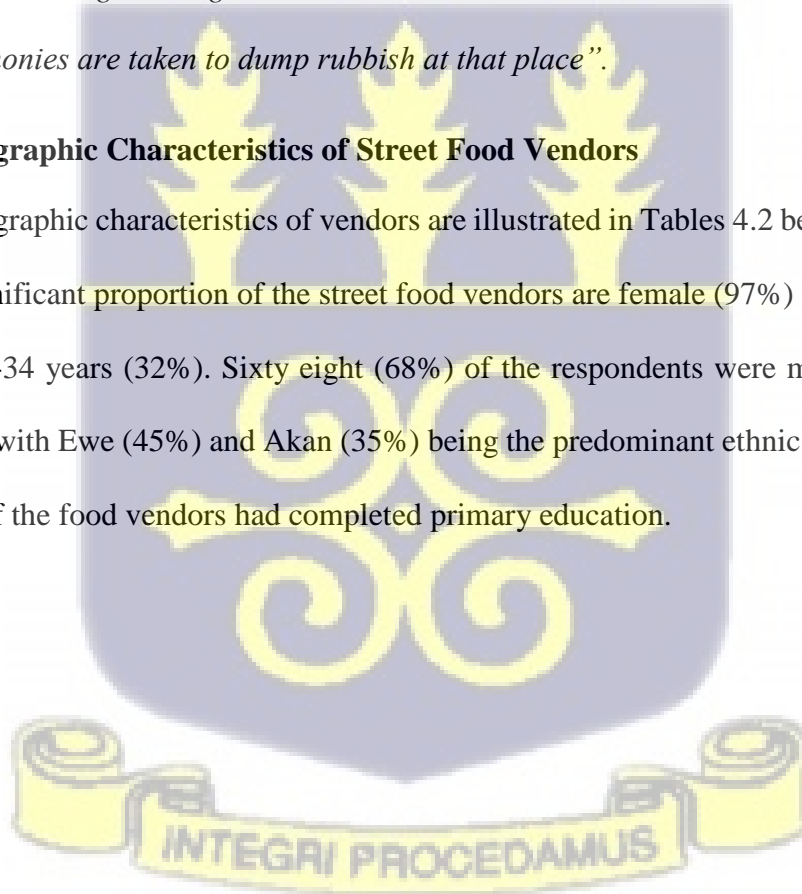


Table 4. 2: Distribution of Socio-demographic Characteristics of the Street Food Vendors.

Variable	Frequency (N)	Percentage (%)
Age (years)		
25 – 29	4	13
30 – 34	10	32
35 – 39	2	6
40 – 44	1	3
45 – 49	7	23
50 - 59	5	16
>60	2	7
Gender		
Male	1	3
Female	30	97
Marital Status		
Single	6	19
Married	21	68
Divorced	3	10
Widow	1	3
Ethnic Group		
Akan	11	35
Ga-Adangbe	4	13
Ewe	14	45
Other	2	7
Religion		
Christian	27	87
Muslim	4	13
Educational Background		
No formal Education	3	10
Primary	19	61
Secondary/Technical	9	29

Source: Field Work (2024)

4.2.1 Years of Experience in the Food Business among Street Food Vendors

Table 4.3 below summarizes the years of experience among food vendors. The findings reveal that 32% of vendors have been in the food business for 1 to 3 years, while 26% have less than or equal

to one year of experience. Those with 4 to 6 years of experience make up 23%, and only 3% have been in the business for 7 to 9 years. Notably, 16% of vendors have a decade or more of experience.

Table 4. 3: Years of Experience in Food Business

Variable	Frequency (N)	Percentage (%)
No of years in Food Business		
≤ 1	8	26
1 – 3	10	32
4 – 6	7	23
7 – 9	1	3
≥10	5	16

Source: Field Work (2024)

4.2.2 Operating Hours of Street Food Vendors

Table 4.4 highlights the daily operating hours of street food vendors. Majority, 51%, operate from morning to evening, representing the longest working hours. Additionally, 29% of the vendors work from morning to afternoon, while 3% operate from afternoon to evening. Meanwhile, 7% sell only in the afternoon, 3% exclusively in the evening, and another 7% solely in the morning.

Variable	Frequency (N)	Percentage (%)
Duration for Selling Food		
Morning – Afternoon	9	29
Morning – Evening	16	51
Afternoon – Evening	1	3
Morning only	2	7
Afternoon only	2	7
Evening only	1	3

Table 4. 4: Operating Hours of Street Food Vendors

4.2.3 Street Food Vendors Receiving Regular Health Checkups

Table 4.5 highlights the proportion of food vendors receiving regular health checkups. The findings show that majority (94%) of the food vendors undergo regular health checkups, while (6%) do not.

Table 4. 5: Proportion of Food Vendors Receiving Regular Health Checkups

Variable	Frequency (N)	Percentage (%)
Regular Health Check		
Yes	29	94
No	2	6

Source: Field work 2024

4.2.4 Locations of Food Preparation

Table 4.6 below shows the distribution of food preparation locations among street food vendors. The finding reveals that 45% of participants prepare food at home, while 55% prepare food at the vending site.

Table 4. 6: Food Preparation Locations of Food Vendors

Variable	Frequency (N)	Percentage (%)
Where Food is Prepared		
Home	14	45
Vending Site	17	55

Source: Field Work (2024)

4.3 Level of Knowledge of Street Food Vendors on Foodborne Diseases

Data presented in Table 4.7 depicts the descriptive study of the knowledge level of food vendors about foodborne diseases. The findings demonstrate that food sellers possess comprehensive

knowledge about foodborne diseases and adherence to rigorous cleanliness protocols. All 31 participants (100%) correctly identified essential practices and concepts, including washing hands with soap and water before and after cooking, avoiding handling food with injured hands, serving cooked meals at a temperature above 60°C, and keeping raw items separate from prepared meals. They understand the importance of preventing pests from entering food preparation areas, germ transmission via soiled napkins, and contamination risk mitigation by wearing protective garments such as aprons and masks. All 31 participants (100%) agreed that consuming polluted food, using unclean water, or using rotting or unwashed materials could potentially cause serious illness. The respondents accurately recognized nausea, diarrhoea, vomiting, fever, and exhaustion as indications of foodborne disease, with 87% also noting the presence of stomach pains. All 31 participants (100%) were aware of foodborne diseases, including their typical causes and the importance of germs in contamination. They acknowledged that bacteria may exist on the body, contaminate food, and proliferate in certain food categories. The summary of the replies, showing that 29.54 participants (99.5%) have a comprehensive knowledge on food safety, whereas just 0.16 participants (0.5%) lack food safety knowledge.

Table 4. 7: Food vendors’ Knowledge Level on Foodborne Diseases (N = 31).

Statement on the knowledge level of street food vendors on foodborne diseases.	Yes (%)	No (%)
Contaminated food makes you sick.	31(100)	0(0)
Contaminated water causes illness.	31(100)	0(0)

Rotten or unwashed ingredients make you sick.	31(100)	0(0)
Nausea is a symptom of foodborne illness.	31(100)	0(0)
Diarrhea is a symptom of foodborne illness.	31(100)	0(0)
Vomiting is a symptom of foodborne illness.	31(100)	0(0)
Fever is a symptom of foodborne illness.	31(100)	0(0)
Fatigue is a symptom of foodborne illness.	31(100)	0(0)
Cramps are a symptom of foodborne illness.	27(87)	4(13)
Diarrhea is a foodborne disease.	31(100)	0(0)
Cholera is a foodborne disease.	31(100)	0(0)
Typhoid is a foodborne disease.	31(100)	0(0)
Expired food causes illness.	31(100)	0(0)
Uncooked food causes illness.	31(100)	0(0)
Improperly cooked food causes illness.	31(100)	0(0)
Germs live on skin, nose, and mouth.	31(100)	0(0)
Germs contaminate food without safety practices.	31(100)	0(0)
Germs grow best in cold food.	31(100)	0(0)
Germs grow best in hot food.	31(100)	0(0)
Germs grow best in warm food.	31(100)	0(0)
Food temperature affects germ growth.	31(100)	0(0)
Germs contaminate food through handling.	31(100)	0(0)
Germs contaminate food with unsafe water.	31(100)	0(0)
Germs contaminate food with unclean utensils.	31(100)	0(0)
Germs contaminate food in unsanitary areas.	31(100)	0(0)
Sick people shouldn't cook.	31(100)	0(0)
Everyone can get sick from contaminated food.	31(100)	0(0)
Overall		
Response	Frequency	
	N (%)	
Yes	30.84 (99.5)	
No	0.16 (0.5)	

4.3.1 Knowledge of Foodborne Diseases

The study specifically focused on several important aspects, including the recognition of food vendors as a possible source of contamination, adherence to proper hand washing practices, the need to avoid food handling with wounds, serving meals at suitable temperatures, maintaining a clear separation between uncooked and prepared foods, preventing pests from entering food preparation areas, and understanding the consequences of using dirty napkins or unclean water. In addition, the study included comprehending the symptoms of foodborne diseases, identifying instances and typical causes of these diseases, pinpointing contaminated sites, and comprehending the influence of germs on food safety.

Table 4.8 displays the results of the Chi-square analysis used to assess the association between knowledge variables, age, educational background, and years of business experience. According to Table 4.8, there was no significant association between street food vendors' age and their knowledge of foodborne diseases, as indicated by p-values of 0.306 and $\chi^2 = 7.16$. A p-value of 0.54 and $\chi^2 = 1.24$ depicted no significant association between the level of education of the street food vendors and their knowledge on foodborne diseases, in contrast, the association between the number of years someone has worked in the food business and their knowledge of foodborne diseases was significant which was shown by the p-value of 0.047 and $\chi^2 = 55.46$.

Table 4. 8: Association between Knowledge of Foodborne Diseases, Age, Educational Level, and Years in the Food Business.

Variable	Chi-square (χ^2)	p-value
Age	7.16	0.31
Educational level	1.24	0.54
Number of years in food business	55.46	0.04

Source: Field Work (2024)

4.4 Hygienic Practices of Street Food Vendors

The hygienic practices of street food vendors in Opetekwei, focusing on how they manage key aspects of food safety was assessed. The assessment covered environmental and location hygiene, personal hygiene, food display and serving practices, food storage, leftover handling, and garbage disposal.

4.4.1 Environment and Location Hygiene of Food Vendors

Table 4.9 highlights the hygiene conditions of the environment and location where food vendors in Opetekwei operate. The findings reveal that all vendors (100%) work in environments where garbage is present. Only a small proportion (10%) of vendors operate in environments with flies or stagnant water. Additionally, a significant number of vendors (77%) are located near dusty roads, while 77% are located near drains or open gutters. All (100) the vendors had no potable water or running water at their vending sites.

Table 4.9: Environment and Location Hygiene of Food Vendors

Statement	Yes (%)	No (%)
Environment with garbage	31 (100)	0 (0)
Environment with flies present	3 (10)	28 (90)
Environment with stagnant water	3 (10)	28 (90)
Vending close to a dusty road	24 (77)	7 (23)
Vending close to a drain/open gutter	24 (77)	7 (23)
Vending close to a toilet facility	0 (0)	31 (100)
Vending close to a rubbish dump	0 (0)	31 (100)
Potable or running water	0 (0)	31 (100)

Source: Field Work (2024)

4.4.2 Personal Hygiene of Food Vendors

Table 4.10 highlights the personal hygiene practices of food vendors in Opetekwei. The findings show that only 45% of vendors wear clean aprons or protective garments, while (55%) do not. However, all vendors (100%) have short fingernails. Regarding hair or head coverings, 84% of vendors ensure their hair is covered while working, but 16% do not. A smaller proportion (26%) of vendors handle food with bare hands, indicating that most use proper utensils. A significant majority (87%) handle money while serving food, with only 13% avoiding this practice. Only 3% of vendors wash their hands with clean water before serving food, while 97% do not. Notably, no vendors blow air into polythene bags or blow their nose/cough while serving food.

Table 4.10: Personal Hygiene of Food Vendors

Statement	Yes (%)	No (%)
Vendor wears clean apron	14 (45)	17 (55)
Vendor has short fingernails	31 (100)	0 (0)
Vendor's hair is covered	26 (84)	5 (16)
Vendor handles food with bare hands	8 (26)	23 (74)
Vendor handles money while serving food	27 (87)	4 (13)
Vendor washes hands before serving	1 (3)	30 (97)
Vendors blow air into polythene bags	0 (0)	31 (100)
Vendors blow nose/cough while serving food	0 (0)	31 (100)

Source: Field Work (2024)

4.4.3 Food Display and Serving Practices

Table 4.11 presents the food display and serving practices among street food vendors in Opetekwei. The findings indicate that only 13% of vendors display their food in a mosquito net container. Regarding the display case, 48% use a glass case. A significant portion of food (39%) is exposed without any cover. When it comes to serving utensils, only 26% use plates or utensils to serve, while the majority (74%) do not. Similarly, takeaway containers and cups are used by

only 26% and 7% of vendors, respectively, and 16% use leaves to serve food. Interestingly, none of the vendors use newsprint to serve food. Polythene bags are the most commonly used serving option (97%), with very few vendors covering their utensils (7%). Furthermore, 16% of food is exposed to vectors, such as flies. While 13% of vendors wipe their serving plates and spoons with a napkin before serving, none of the vendors wash their utensils with soap under running water, and only 13% use soap and water in a bowl before serving. A notable 71% of the vendors do not have their customers eating at the vending site.

Table 4. 11: Food Display and Serving Practices

Statement	Yes (%)	No (%)
Food displayed in mosquito net container	4 (13)	27 (87)
Food displayed in glass case	15 (48)	16 (52)
Food displayed on bare table top	12 (39)	19 (61)
Food on ground level	0 (0)	31 (100)
Plates/utensils used	8 (26)	23 (74)
Takeaway containers used	8 (26)	23 (74)
Cups used	2 (7)	29 (94)
Leaves used	5 (16)	26 (84)
Newsprints used	0 (0)	31 (100)
Polythene bags used	30 (97)	1 (3)
Utensils covered	2 (7)	29 (93)
Food exposed to flies	5 (16)	26 (84)
Plates/spoons wiped with napkins	4 (13)	27 (87)
Plates/spoons washed with soap and water	0 (0)	31 (100)
Plates/spoons washed with soap in bowl	4 (13)	27 (87)
Customers do not eat at site	22 (71)	9 (29)

Source: Field Work (2024)

4.4.4 Food Storage and Leftover Management

Table 4.12 highlights the food storage and leftover management practices among food vendors in Opetekwei. The results indicate that no vendors (0%) throw away leftover food. Nineteen percent (19%) of the food vendors reported eating leftovers at home, while 55% store leftovers in the refrigerator, reheat, and sell them the next day. Twenty six percent (26%) of vendors do not have any leftovers.

Table 4.12: Food Storage and Leftover Management

Statement	Yes (%)	No (%)
Vendors throw away leftovers	0 (0)	31 (100)
Vendors eat leftovers at home	6 (19)	25 (81)
Vendors store leftover in fridge, reheat, and sell	17 (55)	14 (45)
No leftovers	8 (26)	23 (74)

Source: Field Work (2024)

4.4.5: Garbage disposal practices of street food vendors

The findings in Table 4.13 show that none of the vendors dispose of garbage near bushes (0%) or in drains/open gutters (0%). Sixteen percent (16%), disposed of garbage near a rubbish dump, while eighty-seven percent (87%) use other means (tricycles/waste collectors/ burning) for garbage disposal.

Table 4. 13: Garbage disposal practices

Statement	Yes (%)	No (%)
Vendors dispose of garbage near bush	0 (0)	31 (100)
Vendors dispose of garbage in drain/open gutter	0 (0)	31 (100)
Vendors dispose of garbage nearby rubbish dump	5 (16)	26 (83)
Vendors dispose of garbage with other means (tricycles/waste collectors/ burning)	27 (87)	4 (13)

Source: Field Work (2024)

4.4.6 Cooked Food Storage and Serving Conditions of street food vendors

Table 4.14 shows that 23% of vendors keep cooked food in pans on fire before serving, while 58% store food in pans without heating before serving. Forty-two percent (42%) use warmers to keep food warm before serving, and 16% store food in glass sieves.

Table 4.14: Cooked Food Storage and Serving Conditions

Statement	Yes (%)	No (%)
Cooked food is kept in pans on fire before serving	7 (23)	24 (77)
Cooked food is kept in pans but not on fire before serving	18 (58)	13 (42)
Cooked food is kept in warmers before serving	13 (42)	18 (58)
Cooked food is kept in glass sieves before serving	5 (16)	26 (84)

Source: Field Work (2024)

4.4.1 Determinants of Hygienic Practices of Street Food Vendors

The Chi-Square analysis in Table 4.15 below revealed varying influences of demographic factors on the hygienic practices of street food vendors. Age showed no significant association with hygienic practices ($p = 0.217$). Educational level demonstrated significant relationship ($p = 0.006$). The number of years a vendor has worked in the food business also showed no significant association with hygienic practices ($p = 0.160$).

Table 4. 15: Chi-Square Analysis of the Association between Hygienic practices of Food Vendors, Age, Educational Level, and Years in the Food Business.

Variables	Chi-Square (x^2)	p-Value
Age	61.8	0.217
Educational Level	36.6	0.006
Number of Years in Food Business	44.3	0.160

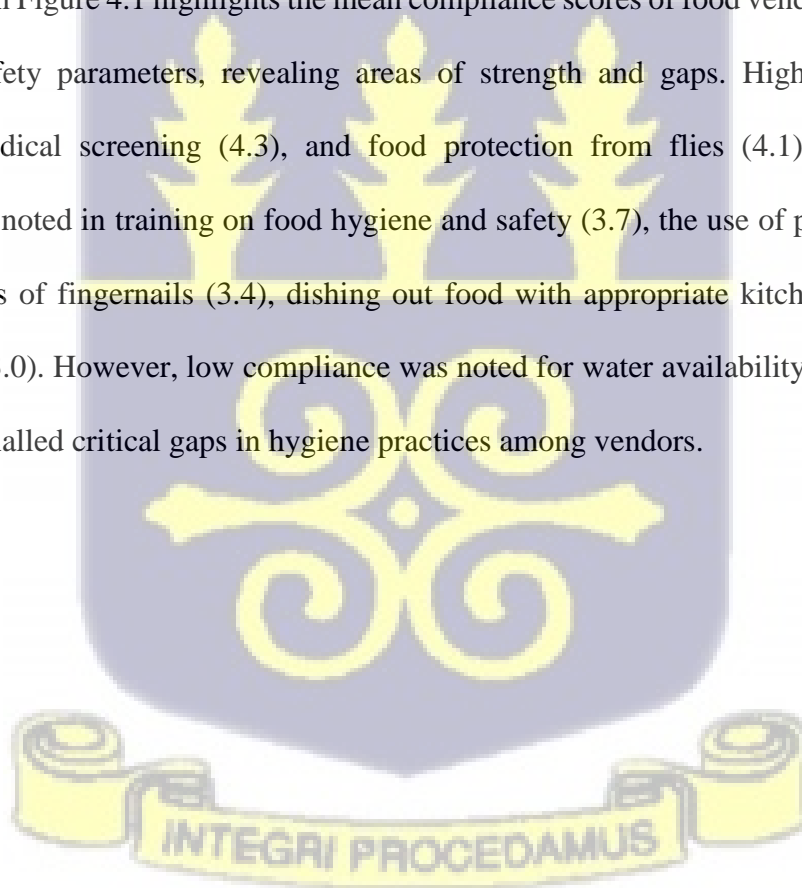
Source: Field Work (2024)

4.5 Compliance Level of Street Food Vendors in Opetekwei

Vendors' compliance with established safety and hygiene standards is critical for public health safety. The compliance levels of street food vendors in Opetekwei was evaluated based on an eight-point Safety Compliance Checklist, which includes criteria such as the use of protective clothing, head covering, food protection from flies, and water availability at vending points.

This assessment uses a 5-point Likert scale to measure adherence, ranging from 5 (Very Good) to 1 (Very Poor). Data were collected from vendors through direct observation and interviews, focusing on their practices and infrastructure to maintain food safety and hygiene.

The radar chart in Figure 4.1 highlights the mean compliance scores of food vendors across various hygiene and safety parameters, revealing areas of strength and gaps. High compliance was observed in medical screening (4.3), and food protection from flies (4.1), while moderate compliance was noted in training on food hygiene and safety (3.7), the use of protective clothing (3.5), cleanliness of fingernails (3.4), dishing out food with appropriate kitchenware (3.3), and head covering (3.0). However, low compliance was noted for water availability at vending points (1.8). These signalled critical gaps in hygiene practices among vendors.



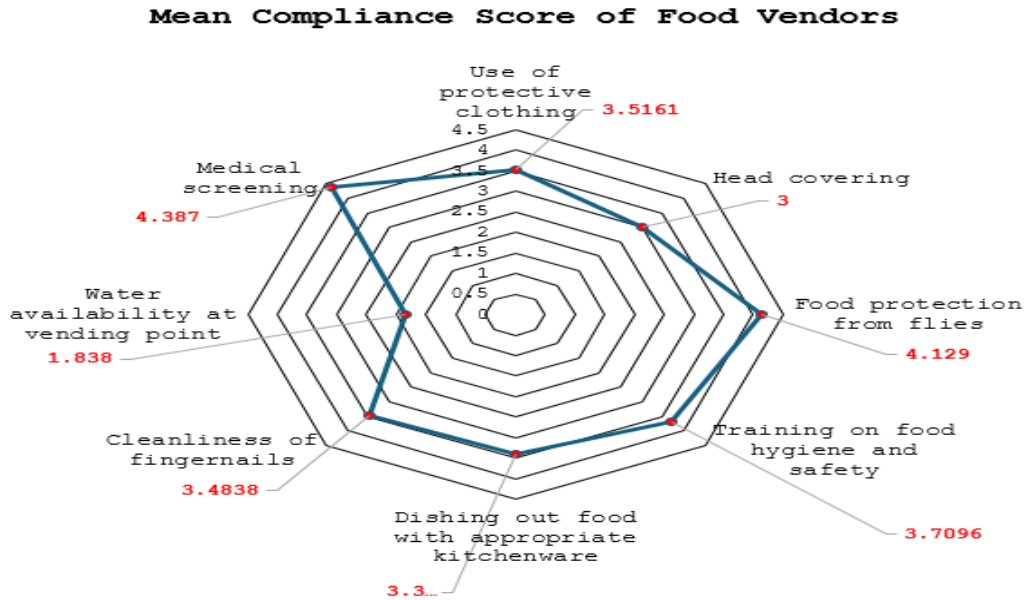


Figure 4. 1: Radar Diagram of Compliance Scores

The heatmap illustrates the correlation coefficients (r-values) between demographic variables (such as sex, age, education, and years of experience) and compliance parameters related to food hygiene and safety among food vendors. It reveals that age has a strong positive correlation with education ($r = 0.73$) and years of experience ($r = 0.81$), indicating that older vendors tend to have longer experience. Similarly, education correlates positively with years of experience ($r = 0.68$) and site preparation ($r = 0.52$), suggesting that better-educated vendors are more likely to adopt proper vending practices.

Training on food hygiene and safety shows a strong positive relationship with dishing out food with appropriate kitchenware ($r = 0.84$), highlighting the effectiveness of training in promoting safe practices. Additionally, training correlates with cleanliness of fingernails ($r = 0.52$) and water availability at vending points ($r = 0.42$), underlining its broader impact. The use of protective clothing is moderately correlated with head covering ($r = 0.57$) and site preparation ($r = 0.41$),

suggesting an interconnection among hygiene practices. Conversely, gender negatively correlates with several hygiene behaviors, including use of protective clothing ($r = -0.28$), head covering ($r = -0.32$), and food protection from flies ($r = -0.36$), pointing to possible gender-based disparities. Similarly, age has a negative correlation with training on hygiene ($r = -0.36$) and food protection from flies ($r = -0.39$), implying that older vendors may be less engaged in or exposed to hygiene interventions. Water availability also correlates with medical screening ($r = 0.31$), while cleanliness of fingernails shows moderate correlations with both appropriate kitchenware ($r = 0.52$) and training ($r = 0.52$).



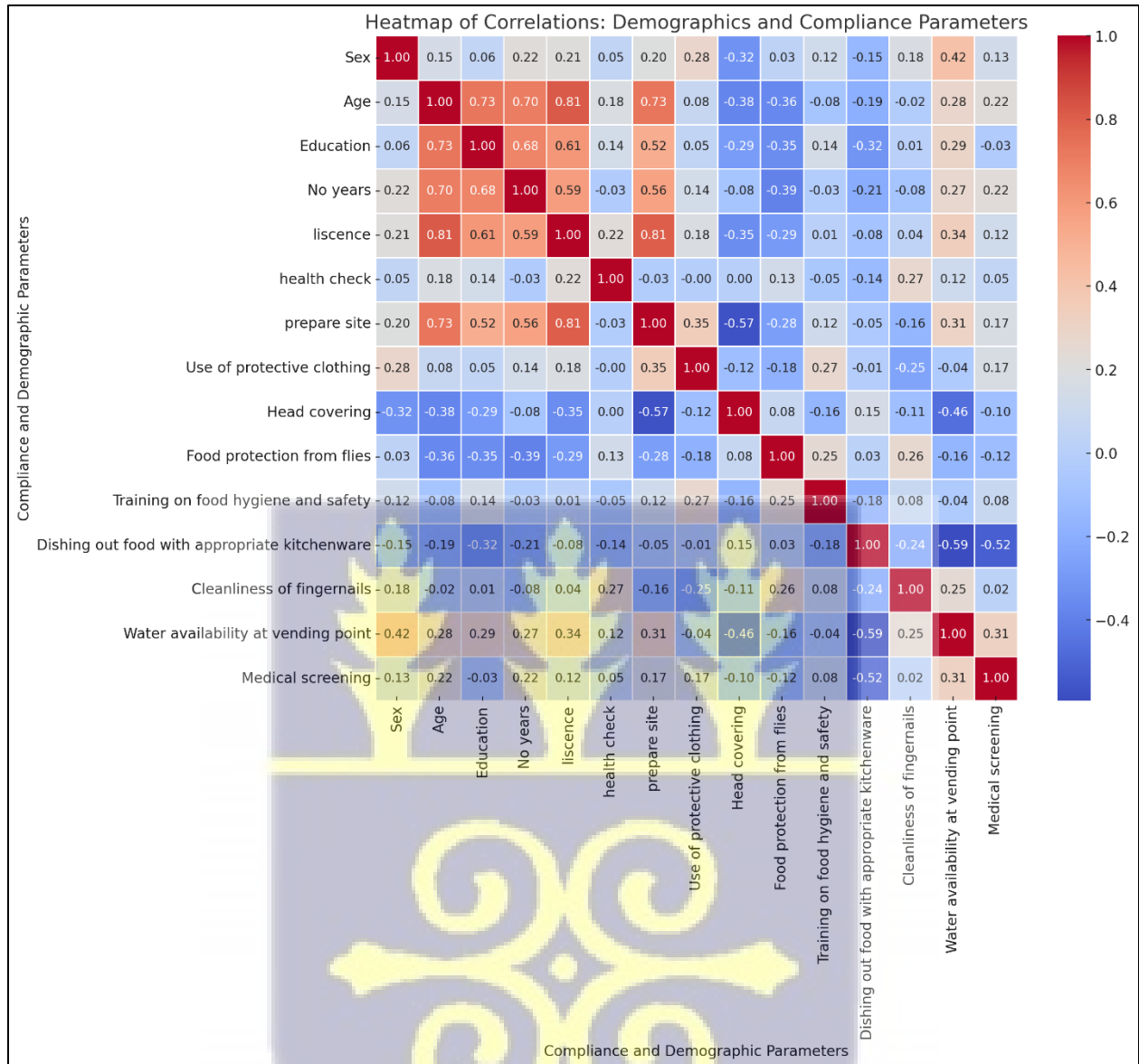


Figure 4. 2: Heatmap of Correlations between Demographics and Compliance Parameters

4.6 Socio-demographic Characteristics of the Street Food Consumers

The results in Table 4.16 indicate that most street food consumers fall within the age range of 26 to 35, comprising 40% of street vendors, with 64% identifying as male and 36% as female. The majority of individuals were single (68%). Akan was the main group (60%), followed by Ewe

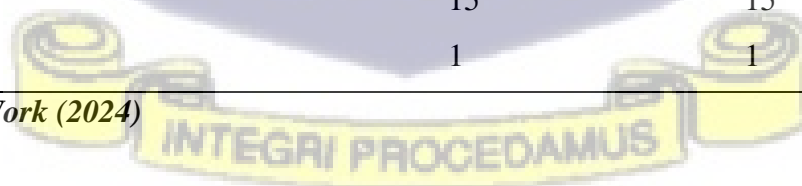
(19%) and Ga-Adangbe (17%) in terms of ethnicity. Self-employed individuals constituted 40% of the workforce, while students (20%), and other professions comprised the remaining 40%. Muslims comprise 4% of the population, while Christianity was the most prevalent religion (96%). The majority of participants have completed primary education (50%), followed by secondary education (29%), tertiary education (8%), and no formal education (13%). In terms of community tenure, the majority of participants have been a part of the community for 15-20 years (35%), while a smaller number have resided there for less than 3 years (1%) or more than 27 years (1%).

Table 4. 16: Distribution of Socio-demographic Characteristics of the Street Food Consumers.

Variable	Frequency (N)	Percentage (%)
Age		
15-25	36	36
26-35	40	40
36-45	18	18
46-55	3	3
≥56	3	3
Gender		
Female	36	36
Male	64	64
Marital Status		
Single	68	68
Married	32	32
Ethnic Group		
Akan	60	60
Ga-Adangbe	17	17
Ewe	19	19

Sisala	2	2
Dagomba	1	1
Wasa	1	1
Occupation		
Self-employed	40	40
Civil servant	5	5
Unemployed	8	8
Student	20	20
Mechanic	7	7
Driver	10	10
Seamstress	9	9
Bus Conductor	1	1
Religion		
Christian	96	96
Muslim	4	4
Educational Background		
No formal Education	13	13
Primary	50	50
Secondary	29	29
Tertiary	8	8
Number of Years in Community		
3-8	30	30
9-14	19	19
15-20	35	35
21-26	15	15
≥27	1	1

Source: Field Work (2024)



4.7 Consumers' Perception on Safety of Food Provided by Street Food Vendors

Consumers' perceptions of the safety of street foods in Opetekwei was assessed, focusing on factors such as food safety awareness, concerns about hygiene practices, and the perceived risks associated with consuming street food.

4.7.1 Reasons for Buying Street Food

The primary reason for patronizing street foods was affordability which recorded 56% of consumers, whereas 36% values fast service rendered by the food vendors. None (0%) of the consumers thought hygiene of vendors was the reason for buying street foods. Only (1%) of the consumers considers street food as having better taste than home-cooked meals.

Table 4.17: Reasons for Buying Street Food

Reasons	Yes (%)	No (%)
Cheap	56.0	44.0
Fast consumer service	36.0	64.0
Variety of food	0.0	100.0
Tastes better than home-cooked food	1.0	99.0
Hygienic	0.0	100.0
Close to work or home	17	83

Source: Field Work (2024)

4.7.2 Awareness of Street Foods among Consumers

Table 4.18 presents the sources through which consumers become aware of street foods. Eighty percent (80%) of consumers discover street food by passing by vendors' stalls, while 56% learn through recommendations. Two percent (2%) are influenced by advertisements, and 6% know the vendor personally.

Table 4.18: Awareness of Street Foods Among Consumers

Source of Awareness	Yes (%)
Advertisement	2.0
Recommendation	56.0
Passed by stall	80.0
Knows vendor	6.0

Source: Field Work (2024)

4.7.3 Frequency of Buying Street Foods

Table 4.19 details the frequency of street food purchases among consumers. Sixty-three percent (63%) of consumers reported buying street food daily, while 13% purchase it once a week. One percent (1%) buy street food once a month, and another 1% purchase it twice a month. Seven percent (7%) buy street food rarely, and 5% buy it more than twice a week.

Table 4.19: Frequency of Buying Street Foods

Frequency	Yes (%)
Once a week	13.0
Once a month	1.0
Twice a month	1.0
Rarely	7.0
Daily	63.0
More than two times a week	5.0

Source: Field Work (2024)

4.7.4 Time Street Foods Are Purchased

Table 4.20 shows the distribution of times at which street foods are purchased. Breakfast is the most common meal, with 88% of consumers purchasing street foods during this time, followed by lunch (76%) and dinner (63%).

Table 4.20: Time Street Foods Are Purchased

Time	Yes (%)	No (%)
Breakfast	88.0	12.0
Lunch	76.0	24.0
Dinner	63.0	37.0

Source: Field Work (2024)

4.7.5 Types of Foods Bought as Breakfast

Table 4.21 provides the types of street foods bought as breakfast. Waakye (66%) and Hausa porridge (61%) are the most popular breakfast choices, while Kenkey (30%) and Banku (19%) are less common. Indomie is rarely chosen as breakfast (1%).

Table 4.21: Types of Foods Bought as Breakfast

Food Type	Yes (%)	No (%)
Hausa porridge	61.0	39.0
Waakye	66.0	34.0
Banku	19.0	81.0
Kenkey	30.0	70.0
Indomie	1.0	99.0

Source: Field Work (2024)

4.7.6 Types of Foods Bought as Lunch

Table 4.22 summarizes the types of foods bought as lunch. Waakye (48%), Banku (45%), and Kenkey (45%) are the preferred options, while Hausa porridge (2%) and Indomie (0%) are rarely chosen.

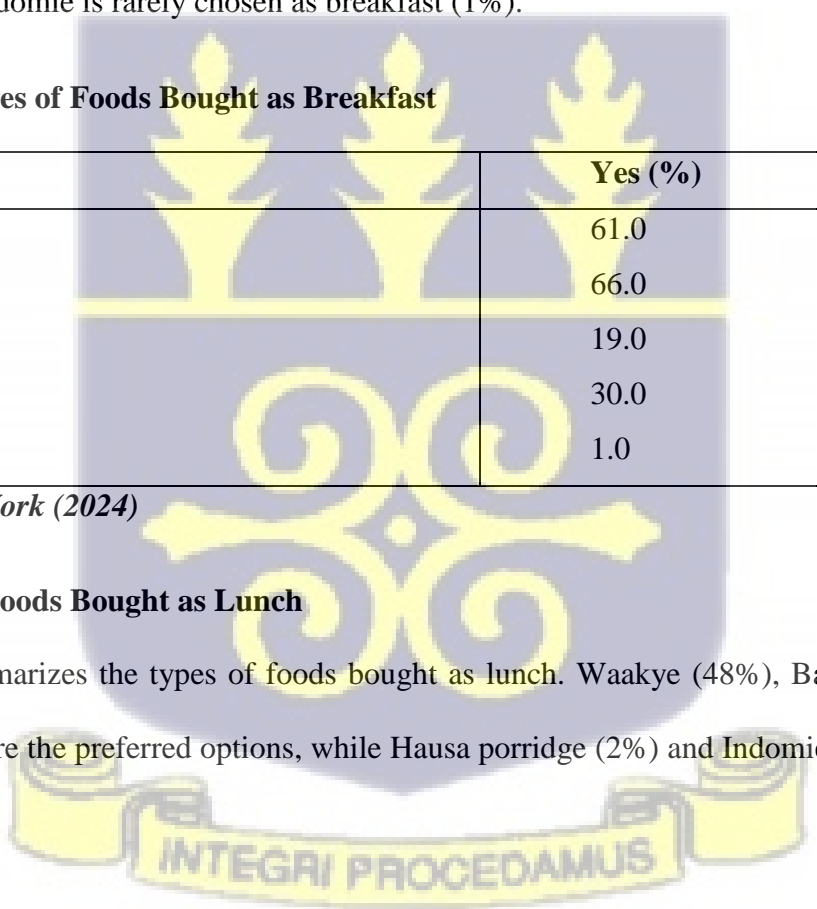


Table 4.22: Types of Foods Bought as Lunch

Food Type	Yes (%)	No (%)
Hausa porridge	2.0	98.0
Waakye	48.0	52.0
Banku	45.0	55.0
Kenkey	45.0	55.0
Indomie	0.0	100.0

Source: Field Work (2024)

4.7.7 Types of Foods Bought as Dinner

Table 4.23 details the types of foods bought as dinner. Indomie is the most preferred choice (80%), followed by Kenkey (55%) and Banku (51%). Waakye (23%) and Hausa porridge (4%) are less popular.

Table 4.23: Types of Foods Bought as Dinner

Food Type	Yes (%)	No (%)
Hausa porridge	4.0	96.0
Waakye	23.0	77.0
Banku	51.0	49.0
Kenkey	55.0	45.0
Indomie	80.0	20.0

Source: Field Work (2024)

4.7.8 Concerns about Food Safety, Hygiene, and Cleanliness

Table 4.24 outlines consumers' concerns about food safety and cleanliness. Thirty-five percent (35%) of consumers are very concerned about food safety, while 34% are slightly concerned. Similarly, 41% are very concerned about hygiene and cleanliness, with 29% being slightly or not concerned.

Table 4. 24: Concerns about Food Safety, Hygiene, and Cleanliness

Concern	Yes (%)	No (%)
Very concerned about safety of street food	35.0	65.0
Slightly concerned about safety of street food	34.0	66.0
Not concerned about safety of street food	29.0	71.0
Very concerned about hygiene and cleanliness	41.0	59.0
Slightly concerned about hygiene and cleanliness	29.0	71.0
Not concerned about hygiene and cleanliness	29.0	71.0

Source: Field Work (2024)

4.7.9 Factors Influencing Purchasing Decisions

Table 4.25 presents factors influencing purchasing decisions. Taste (66%) and price (60%) are the most significant factors, while availability of variety (9%) and distance (34%) are less influential.

Table 4. 25: Factors Influencing Purchasing Decisions

Factor	Yes (%)	No (%)
Price	60.0	40.0
Taste	66.0	34.0
Availability of variety of foods	9.0	91.0
Distance	34.0	66.0

Source: Field Work (2024)

4.7.10 Affordability and Price Comparisons

Table 4.26 highlights affordability and price comparisons. Fifty-four percent (54%) of consumers find street food affordable, and 59% compare prices before buying. However, only 12% believe that cheap food is linked to lower quality and health risks.

Table 4. 26: Affordability and Price Comparisons

Aspect	Yes (%)	No (%)
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Street food in Opetekwei is affordable	54.0	46.0
Compare prices of street food before buying	59.0	41.0
Cheaply priced foods lead to low quality/health risks	12.0	88.0

Source: Field Work (2024)

4.7.11 Eating Habits and Preferences

Table 4.27 outlines eating habits and preferences. Seventy-four percent (74%) prefer vending sites with a clean environment, and 57% prefer sites with portable water. Only 31% eat at vending sites.

Table 4. 27: Eating Habits and Preferences

Aspect	Yes (%)	No (%)
Eat at the vending sites	31.0	69.0
Prefer vending sites with portable water	57.0	43.0
Prefer vending sites with a clean environment	74.0	26.0

Source: Field Work (2024)

4.7.12 Health Concerns

Table 4.28 highlights health concerns among consumers. Ninety percent (90%) are aware of potential health risks, and 78% are concerned about their health when buying street food. Health issues like diarrhea (66%), typhoid (37%), and cholera (27%) were reported.

Table 4. 28: Health Concerns

Health Concern	Yes (%)	No (%)
Concerned about health status	78.0	22.0
Awareness of potential health risks	90.0	10.0
Experienced diarrhea	66.0	34.0
Experienced typhoid	37.0	63.0
Experienced cholera	27.0	73.0

Source: Field Work (2024)

4.7.13 Influence of Vendors' Hygienic Practices

Table 4.29 examines the influence of vendors' hygienic practices. Fifty-five percent (55%) of consumers state that good hygienic practices influence their purchasing decisions, while only 18% have confidence in the hygienic practices in Opetekwei.

Table 4.29: Influence of Vendors' Hygienic Practices

Aspect	Yes (%)	No (%)
Good hygienic practices influence purchasing	55.0	45.0
Confidence in hygienic practices	18.0	82.0

Source: Field Work (2024)

4.7.14 Awareness and Enforcement of Regulations

Table 4.30 illustrates awareness and enforcement of regulations of food consumers. Sixty percent (60%) of consumers are aware of regulations governing hygiene practices, but none believe these regulations are enforced satisfactorily (0%).

Table 4. 30: Awareness and Enforcement of Regulations

Aspect	Yes (%)	No (%)
Aware of regulations governing hygiene	60.0	40.0
Regulations enforced satisfactorily	0.0	100.0

Source: Field Work (2024)

4.7.15 Consumers' Perceptions on Safety of Food Provided by Street Food Vendors

The assessment of consumers' perceptions of street food safety in Opetekwei was done by focusing on factors such as reasons for purchasing street food, knowledge about street foods, frequency and timing of purchases, types of foods bought for different meals, concerns about food safety and hygiene, factors influencing purchasing decisions, affordability, eating habits and preferences, health concerns, the influence of vendors' hygienic practices, and awareness and enforcement of regulations.

The Chi-square analysis was used to determine whether there is a statistically significant association between demographic characteristics (age, gender, marital status, religion, educational background, etc.) and consumer perceptions of street food safety in Opetekwei.

Table 4.31 presents the Chi-Square analysis results, revealing no statistically significant associations between consumer perceptions of street food safety and demographic characteristics, as all p-values exceeded the standard significance threshold of 0.05. Specifically, age ($\chi^2 = 634.6$, $p = 0.22$), gender ($\chi^2 = 27.8$, $p = 0.14$), marital status ($\chi^2 = 16.5$, $p = 0.74$), religion ($\chi^2 = 14.4$, $p = 0.84$), ethnicity ($\chi^2 = 100.6$, $p = 0.60$), educational background ($\chi^2 = 63.9$, $p = 0.44$), occupation ($\chi^2 = 145.0$, $p = 0.50$), and years of residence in the community ($\chi^2 = 463.6$, $p = 0.22$) showed no significant differences in consumers perceptions of street food safety.

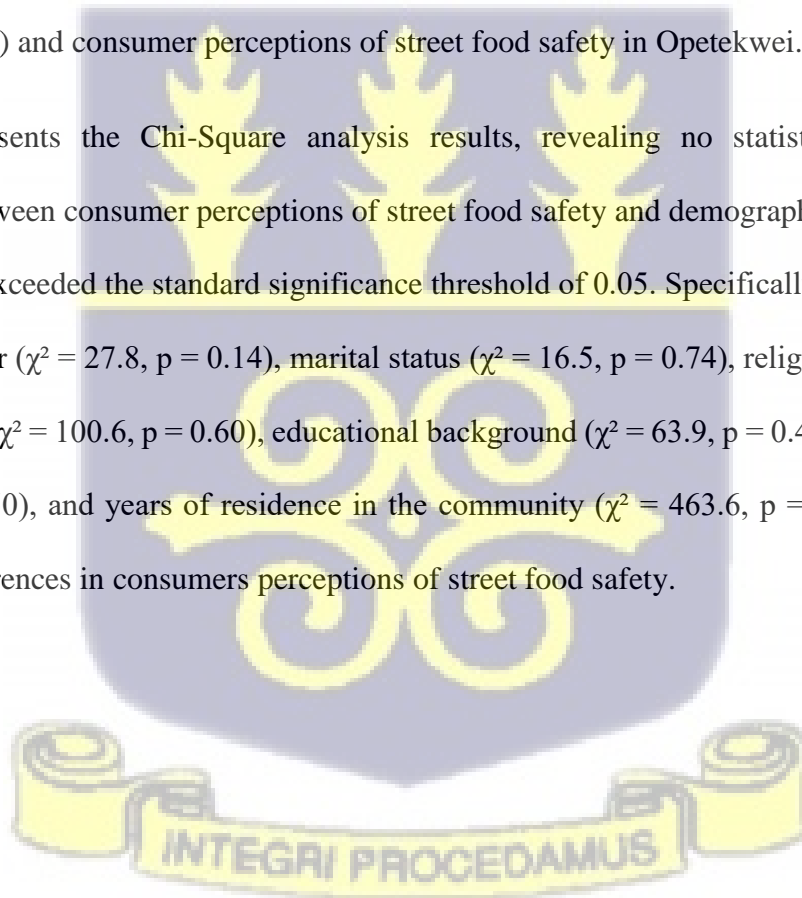


Table 4. 31: Chi-Square Analysis for the Association between Consumer Perceptions of street food safety and Demographics characteristics.

Variables	Chi-Square (x^2)	P-Value
Age	634.6	0.22
Gender	27.8	0.14
Marital status	16.5	0.74
Religion	14.4	0.84
Ethnic group	100.6	0.60
Educational background	63.9	0.44
Occupation	145.0	0.50
Years in the community	463.6	0.22

Source: Field Work (2024)

4.8 Disease Causing Microorganisms and their Levels in Food Sold by Vendors

The presence and quantities of the levels of microbial pathogens in selected street-vended foods from the Opetekwei were assessed. The food items tested include *waakye* (W), *macaroni* (M), *salad* (S), *gari* (G), *kenkey* (K), fish (F), pepper sauce (P), and *Indomie* (In). The analysis assessed total aerobic bacterial counts, yeast and mold counts, and total coliform counts, all expressed as log Colony-Forming Units per gram (logCFU/g). Additionally, the study investigated the presence of specific microbial pathogens [-] was used for absent, while [+] indicated present), including *Escherichia coli* (*E. coli*), *Salmonella* spp., *Shigella* spp., and *Vibrio cholerae*, to evaluate potential health risks associated with these foods. The microbial contamination levels in the food samples were assessed in accordance with specified food safety standards set by recognized organizations, including the Health Protection Agency (2009), the Centre for Food Safety (2014), and the International Commission on Microbiological Specifications for Foods (ICMSF, 2018). These standards provide guidelines on acceptable microbial loads in food products and help determine

whether the detected levels pose a risk to public health. Table 4.32 below shows a detailed breakdown of the microbial load in food samples from different street vendors.

4.8.1 Total Aerobic Bacteria

The mean counts for Total Aerobic Bacteria in the food samples varied widely, ranging between >1 log CFU/g and ≥ 9.0 log CFU/g across the food samples. Samples classified as "satisfactory" (<3 log CFU/g) (Health Protection Agency, 2009; Centre for Food Safety, 2014; ICMSF, 2018) include W1, M1, K3, K4, K6, K7, and K8, which are within acceptable bacterial limits. "Intermediate" samples (3–5 log CFU/g), suggesting moderate microbial contamination levels, include S1, W2, W3, G3, W4, W5, In6, K5, F5, and F6. However, a considerable number of samples (M2, M3, S4, M4, M5, S5, W6, M6, G6, In 1, In 7, In 8, F2, P3, P4, P6, P7, P8, and F8) fell within the "unsatisfactory" range (>5 log CFU/g), posing potential health risks due to elevated bacterial counts. Notably, samples M3 (9.24 log CFU/g) had the highest bacterial count, while K8 (1.80 log CFU/g) recorded the lowest. The high prevalence of samples in the unsatisfactory category indicates a significant risk due to the potential presence of foodborne pathogens, requiring intervention to mitigate contamination risks.

4.8.2 Yeast and Mould Counts

Yeast and mould counts, measured in log CFU/g, also showed counts ranging between <1 log CFU/g and ≥ 8.0 log CFU/g across the food samples, with counts exceeding 3 log CFU/g being classified as unsatisfactory (Health Protection Agency, 2009; Centre for Food Safety, 2014; ICMSF, 2018). Samples such as M2 (7.05 log CFU/g), M4 (8.11 log CFU/g), M5 (7.07 log CFU/g), and K8 (8.12 log CFU/g) exhibited significantly high yeast and mold counts, raising

microbial safety concerns. Tukey's post-hoc test ($p > 0.05$) showed no statistically significant differences in microbial loads among the groups, indicating similar contamination levels."

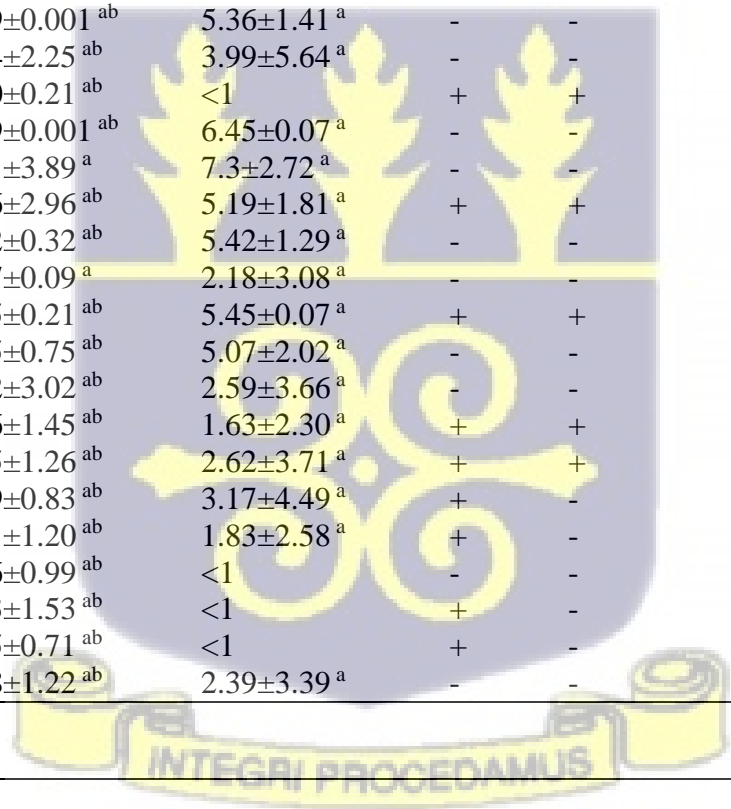
4.8.3 Total Coliform Count

Total coliform counts, expressed in log CFU/g, ranged between <1 log CFU/g and ≥ 10.0 log CFU/g across the food samples. Samples with counts less than 2 log CFU/g, considered "satisfactory," included G3, In3, K7 and K1, indicating low levels of coliform contamination. Conversely, samples such as M2 (7.35 log CFU/g), S2 (5.99 log CFU/g), W3 (5.36 log CFU/g), W4 (6.45 log CFU/g), M4 (7.30 log CFU/g), P8 (5.81 log CFU/g), F3 (6.29 log CFU/g) and K8 (8.49 log CFU/g) exceeded the 4 log CFU/g threshold, classifying them as "unsatisfactory" and highlighting potential fecal contamination risks (Health Protection Agency, 2009; Centre for Food Safety, 2014; ICMSF, 2018). Tukey's test results showed no significant differences in coliform counts among certain samples ($p > 0.05$), indicating shared contamination levels within these groups. The high prevalence of unsatisfactory coliform levels underscores the need for stringent monitoring and intervention to improve microbial quality.



Table 4.32: Microbial load and presence of pathogens in food samples from street food vendors in Opetekwei.

Food sample codes	Microbial load (logCFU/g)			Pathogen Occurrence				
	Total Bacteria	Aerobic Count	Yeast and Mould Count	Total Coliform Count	<i>E. coli</i>	<i>Salmonella sp.</i>	<i>Shigella sp.</i>	<i>Vibrio cholera</i>
W1	2.36±3.34 ^{bcd}	<1	<1	-	-	+	+	
M1	2.69±3.81 ^{abcd}	5.34±3.59 ^{ab}	4.59±6.50 ^a	-	-	-	-	
S1	4.28±6.05 ^{abcd}	1.47±2.07 ^{ab}	1.33±1.88 ^a	+	+	+	+	
W2	3.63±0.25 ^{abcd}	5.94±0.79 ^{ab}	4.99±0.71 ^a	-	-	-	-	
M2	8.44±0.56 ^{abc}	7.05±1.30 ^a	7.35±5.36 ^a	-	-	-	-	
S2	7.29±2.44 ^{abcd}	4.69±0.51 ^{ab}	5.99±0.72 ^a	+	+	+	+	
W3	3.81±0.68 ^{abcd}	6.49±0.001 ^{ab}	5.36±1.41 ^a	-	-	-	-	
M3	9.24±0.24 ^a	4.24±2.25 ^{ab}	3.99±5.64 ^a	-	-	-	-	
G3	4.96±0.27 ^{abcd}	3.10±0.21 ^{ab}	<1	+	+	+	+	
W4	4.78±0.66 ^{abcd}	4.99±0.001 ^{ab}	6.45±0.07 ^a	-	-	-	-	
M4	8.71±0.72 ^{ab}	8.11±3.89 ^a	7.3±2.72 ^a	-	-	-	-	
S4	9.21±0.06 ^a	4.86±2.96 ^{ab}	5.19±1.81 ^a	+	+	+	+	
W5	4.79±1.84 ^{abcd}	4.72±0.32 ^{ab}	5.42±1.29 ^a	-	-	-	-	
M5	7.98±0.50 ^{abcd}	7.07±0.09 ^a	2.18±3.08 ^a	-	-	-	-	
S5	8.15±1.62 ^{abcd}	5.35±0.21 ^{ab}	5.45±0.07 ^a	+	+	+	+	
W6	6.19±0.16 ^{abcd}	5.95±0.75 ^{ab}	5.07±2.02 ^a	-	-	-	-	
M6	8.32±0.02 ^{abc}	5.02±3.02 ^{ab}	2.59±3.66 ^a	-	-	-	-	
G6	7.11±0.27 ^{abcd}	3.46±1.45 ^{ab}	1.63±2.30 ^a	+	+	+	+	
In 1	6.32±1.02 ^{abcd}	3.45±1.26 ^{ab}	2.62±3.71 ^a	+	+	+	+	
In 2	5.85±0.92 ^{abcd}	4.19±0.83 ^{ab}	3.17±4.49 ^a	+	-	+	-	
In 3	5.26±0.09 ^{abcd}	3.41±1.20 ^{ab}	1.83±2.58 ^a	+	-	+	-	
In 4	5.29±0.41 ^{abcd}	3.56±0.99 ^{ab}	<1	-	-	+	+	
In 5	5.55±0.19 ^{abcd}	5.13±1.53 ^{ab}	<1	+	-	+	-	
In 6	4.89±1.33 ^{abcd}	2.45±0.71 ^{ab}	<1	+	-	+	-	
In 7	6.37±0.19 ^{abcd}	4.28±1.22 ^{ab}	2.39±3.39 ^a	-	-	+	-	



Food sample codes	Total Bacteria Count	Aerobic Count	Yeast and Mould Count	Total Coliform Count	<i>E. coli</i>	<i>Salmonella sp.</i>	<i>Shigella sp.</i>	<i>Vibrio cholerae</i>
In 8	6.09±0.57 ^{abcd}		3.56±1.03 ^{ab}	2.40±3.40 ^a	+	-	-	-
K1	5.49±2.17 ^{abcd}		3.77±1.71 ^{ab}	<1	-	-	-	-
P1	5.97±1.66 ^{abcd}		7.34±0.02 ^a	5.49±7.76 ^a	+	+	+	+
F1	5.95±0.46 ^{abcd}		3.73±0.10 ^{ab}	2.69±3.81 ^a	+	+	+	+
K2	5.42±1.37 ^{abcd}		5.49±2.55 ^{ab}	4.51±6.38 ^a	-	-	-	-
P2	5.93±0.38 ^{abcd}		6.78±0.72 ^a	3.85±0.17 ^a	+	+	+	+
F2	6.51±0.17 ^{abcd}		4.16±1.70 ^{ab}	3.28±4.64 ^a	+	+	+	+
K3	2.58±0.64 ^{bcd}		5.89±3.84 ^{ab}	7.17±4.29 ^a	-	-	-	-
P3	6.36±1.49 ^{abcd}		4.88±0.55 ^{ab}	4.59±0.47 ^a	+	+	+	+
F3	5.49±1.44 ^{abcd}		4.47±2.28 ^{ab}	6.29±2.32 ^a	+	+	+	+
K4	2.23±0.38 ^{bcd}		5.39±0.01 ^{ab}	3.65±5.16 ^{ab}	-	-	-	-
P4	6.36±0.18 ^{abcd}		4.82±0.64 ^{ab}	<1	+	+	+	+
F4	5.46±1.44 ^{abcd}		3.69±0.06 ^{ab}	2.39±3.39 ^a	+	+	+	+
K5	4.15±1.72 ^{abcd}		6.87±2.00 ^a	10.23±1.62 ^a	-	-	-	-
P5	5.88±0.55 ^{abcd}		6.83±0.76 ^a	5.56±2.55 ^a	+	+	+	+
F5	4.58±1.15 ^{abcd}		3.54±0.27 ^{ab}	2.27±3.22 ^a	+	+	+	+
K6	1.95±0 ^{cd}		5.28±3.09 ^{ab}	3.64±2.81 ^a	-	-	-	-
P6	6.25±0.35 ^{abcd}		4.86±0.61 ^{ab}	2.97±0.39 ^a	+	+	+	+
F6	4.94±0.79 ^{abcd}		4.32±0.83 ^{ab}	3.33±1.19 ^a	+	+	+	+
K7	2.83±1.67 ^{abcd}		3.4±1.00 ^{ab}	1.85±2.61 ^a	-	-	-	-
P7	6.76±0.83 ^{abcd}		5.02±1.92 ^{ab}	4.25±0.36 ^a	+	+	+	+
F7	5.83±1.74 ^{abcd}		3.46±0.47 ^{ab}	4.1±0.002 ^a	+	+	+	+
K8	1.80±2.55 ^d		8.12±0.35 ^a	8.49±0.99 ^a	-	-	-	-
P8	6.86±0.67 ^{abcd}		4.20±0.57 ^{ab}	5.81±0.51 ^a	+	+	+	+
F8	6.54±0.85 ^{abcd}		4.80±0.89 ^{ab}	2.59±3.66 ^a	+	+	+	+

*Food samples with the same numbers are served as a dish. Mean values with the same letter ("a", "ab", "abc", "abcd", "bcd", "cd", or "d") in the same column are not significantly different according to tukey test ($p > 0.05$). Waakye (W), macaroni (M), salad (S), gari (G), kenkey (K), fish (F), pepper sauce (P), and Indomie (In).

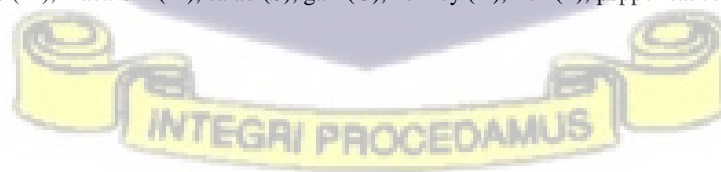


Table 4.33 depicts the prevalence of selected pathogens in street food samples varied widely across different food types. *E. coli* was detected in 9.09% of *Waakye* samples, 81.82% of *Macaroni*, 66.67% of *Salad*, 18.75% of *Kenkey*, 75% of *Pepper sauce*, 37.5% of *Fish*, and 37.5% of *Indomie* samples. *Salmonella sp.* was present in 6.25% of *Kenkey*, 25% of *Fish*, and 6.25% of *Indomie* samples, but absent in *Waakye*, *Macaroni*, *Salad*, *Gari*, and *Pepper sauce*. The prevalence of *Shigella sp.* was 18.18% in *Waakye*, 81.81% in *Macaroni*, 33.33% in *Salad*, 12.5% in *Kenkey*, 18.75% in *Pepper sauce*, 43.75% in *Fish*, and 43.75% in *Indomie*. Interestingly, no pathogens was detected in the *Gari* samples. *Vibrio cholerae* was present in 9.9% of *Waakye*, 36.36% of *macaroni*, 11.11% of *salad*, 6.25% of *kenkey* and *pepper sauce*, 37.5% of *fish*, and 12.5% of “*Indomie*.”.

Table 4.33: Prevalence of Selected Pathogens of Specific types of Street Foods sold in Opetekwei.

Food samples	Frequency (n)	<i>Escherichia coli</i>	<i>Salmonella sp.</i>	<i>Shigella sp.</i>	<i>Vibrio cholera</i>
		Percentage (%)			
<i>Waakye</i>	11	9.09	0	18.18	9.09
<i>Macaroni</i>	11	81.82	0	81.81	36.36
<i>Salad</i>	9	66.67	0	33.33	11.11
<i>Gari</i>	5	0	0	0	0
<i>Kenkey</i>	16	18.75	6.25	12.5	6.25
<i>Pepper sauce</i>	16	75	0	18.75	6.25
<i>Fish</i>	16	37.5	25	43.75	37.5
<i>Indomie</i>	16	37.5	6.25	43.75	12.5

Source: Laboratory Analysis (2024)

CHAPTER FIVE

DISCUSSION

5.1 Demographic Characteristics of Street Food Vendors

The socio-demographic characteristics of street food vendors offer valuable insights into their role within the informal food sector. Women dominate this industry, with 97% of vendors being female, highlighting their pivotal contribution to street food vending as a source of livelihood. This finding mirrors the work of Tuglo et al. (2021), who reported similar trends among street food vendors in Ghana, where 84.3% were female. This prevalence underscores the reliance of women on informal economic activities, which often provide the flexibility and accessibility needed to support their families and communities.

The age distribution, with 32% of vendors falling within the 30–34 age range, highlights that street food vending is predominantly undertaken by individuals in their prime working years. This suggests that vending serves as an accessible economic opportunity for young adults seeking income stability during a pivotal stage of their lives, often balancing work with family responsibilities. Similarly, Azanaw et al. (2022) found that in Gondar City, the majority of vendors (60.8%) were aged between 21 and 30, further emphasizing the significant role of young adults in informal food markets. This age group is often drawn to vending due to its flexibility, low entry barriers, and potential for financial independence.

The marital status of vendors, with 68% being married, highlights the critical role of street vending as a source of income to sustain families. Similarly, Nilakusmawati et al. (2019) found that street vending is predominantly undertaken by married individuals, with nearly 87.5% of vendors falling into this category. This pattern emphasizes the significance of street vending as a key livelihood

activity, enabling married individuals to provide financial support for their households and contribute meaningfully to their family's well-being.

The cultural and religious composition of the vendors reflects the demographics of the community. Christianity is the predominant religion (87%), and the majority of vendors belong to the Ewe (45%) and Akan (35%) ethnic groups. These cultural dynamics may influence food preparation practices and hygiene standards, as cultural and religious norms often play a role in shaping behaviors (Jamaludin et al., 2018).

Education levels among street food vendors present challenges in implementing food safety practices, with 61% having only primary education. This aligns with Salifu et al. (2025), who report that 39.7% of vendors have secondary education, 38.2% primary, 17.9% higher secondary or above, and 4.2% no formal education. While most vendors possess basic education, the limited representation of higher education suggests difficulties in adopting advanced safety protocols.

5.2.1 Years of Experience in the Food Business among Street Food Vendors

The experience levels of vendors reveal that 32% have been in the culinary sector for only 1–3 years, indicating that many are relatively new to the profession. This limited experience may impact their familiarity with food safety measures, though it also presents an opportunity for targeted training to enhance their knowledge and practices. Romero et al. (2024) emphasized how important experience is in shaping the operations of street food vendors, showing that many rely on street vending as their main source of income. While this extensive experience reflects a strong understanding of the trade, it also suggests that some long-standing practices might resist modern food safety improvements.

5.2.2 Operating Hours of Street Food Vendors

The operating hours of street food vendors indicate a strong commitment to meeting customer demands throughout the day, with 51% working from morning to evening, representing the longest working hours. This reflects the dedication of vendors to cater to multiple meal times, ensuring a steady income. Additionally, 29% work from morning to afternoon, 7% sell only in the afternoon, 3% exclusively in the evening, and another 7% solely in the morning highlighting varied operational strategies tailored to market demands. These findings are consistent with FAO (2016), who noted that street food vendors often work long hours to increase profitability, with many adapting their schedules to customer needs. However, long working hours can introduce risks such as fatigue and compromised food safety due to prolonged exposure to environmental conditions. Vendors who operate throughout the day may also face challenges in maintaining consistent hygiene and food quality.

5.2.3 Street Food Vendors Receiving Regular Health Checkups

The findings indicate that the majority of food vendors (94%) undergo regular health checkups, reflecting a positive adherence to public health practices. This high participation rate suggests that most vendors recognize the importance of health monitoring in maintaining food safety and preventing the spread of foodborne illnesses. Regular health checkups are crucial in identifying potential health risks, such as communicable diseases, that could impact both vendors and their customers. However, the 6% of vendors who do not participate in regular health checkups highlight a gap that could compromise overall food safety standards. This small proportion may face barriers such as lack of awareness, financial constraints, or limited access to healthcare services. Similar findings were reported by Nkosi and Tabit (2021), who noted that some street

food vendors in South Africa failed to comply with health check requirements due to logistical and economic challenges.

5.2.4 Locations of Food Preparation

The distribution of food preparation locations among street food vendors indicates that 55% prepare food at the vending site, while 45% prepare food at home. Preparing food at the vending site offers distinct advantages for maintaining hygiene and minimizing contamination risks. Immediate cooking and serving at the vending site allow vendors to better manage food safety under potentially supervised or regulated conditions. However, ensuring the vending site is equipped with essential facilities, such as access to clean water, waste disposal systems, and adequate storage, is critical for sustaining food safety standards. These factors help mitigate risks and foster consumer trust. On the other hand, the 45% of vendors who prepare food at home might face unique and multifaceted challenges, including access to clean water, proper waste disposal, and effective pest control measures. Transportation of food from home to the vending site further exacerbates contamination risks due to inadequate storage conditions and improper handling during transit. A study conducted in Gondar, Ethiopia, highlighted a significant gap in food safety knowledge among vendors, revealing contamination risks during preparation and transit (Azanaw et al., 2022). Similarly, research from Nigeria emphasized that poor transportation and storage practices contribute to foodborne illnesses, advocating for stricter safety regulations to address these concerns (Nneoma, 2024).

5.3 Institutional and Regulatory framework

The management of street food safety in developing nations is contingent upon local legislation, resource availability, and infrastructural quality (Mazi et al., 2023). A common technique entails the establishment of regulations for food service and mass catering, while enforcement may vary

(Huynh-Van et al., 2022). These rules generally pertain to essential domains such as food hygiene, sanitation, waste disposal, communicable disease testing, and license prerequisites. Street vendors, sometimes functioning in both public and private open-air settings, modify their activities and investments according to the prevailing legislative framework. These rules seek to regulate pedestrian and vehicular traffic, guarantee the safety and quality of food items, and uphold economic stability within the food market. These steps are essential for safeguarding public health and promoting a dynamic and sustainable street food economy (Pulliat et al., 2023).

The qualitative evaluation of the regulatory environment for street food vendors reveals significant challenges with food safety standards and compliance. A critical issue is the need for a thorough regulatory structure, as specified in the Assembly's by-laws. Notwithstanding continuous educational efforts, several vendors demonstrate inconsistent compliance, often neglecting regulations when active supervision is lacking. This observation corroborates the findings of Adaku et al. (2024), which highlight that resistance to change undermines the effectiveness of food safety legislation and suggests a troubling trend of normalized non-compliance among vendors. In the same survey, participants acknowledged a widespread awareness of insufficient food safety requirements, with some vendors admitting to willfully violating regulations for financial gain. Moreover, customer feedback revealed that while providers may momentarily comply with safety rules when confronted, they often revert to unsafe practices thereafter. The informal nature of street food businesses fosters anonymity, obstructing enforcement and complicating individual vendor identification, thereby posing significant public health risks. Forkuor et al. (2020) also talk about how important it is for local regulators to have their own ideas and opinions on how street food regulations should develop. They say that their freedom of choice could lead to important regulatory parts being ignored, which could compromise food safety. Moreover, suppliers do not

only comply with regulations but actively engage in influencing policy implementation, highlighting the complexity of achieving consistent regulatory enforcement.

Furthermore, the research identifies significant challenges in enforcing food safety compliance among street food vendors. Vendors frequently bypass the requirement for authorities to assess the suitability of their locations, complicating enforcement and increasing food safety risks. Also, their ability to establish operations autonomously further exacerbates these challenges, leading to inconsistent compliance due to logistical hurdles and reluctance to follow regulations. This finding aligns with the study by Botha et al. (2023), which emphasized the urgent need for regulatory agencies in Ghana, such as the FDA and EHS, to enhance enforcement efforts through public education, capacity building, monitoring, microbiological testing, and penalties for non-compliance. In the same study, contaminated food posed serious risks, including death and economic loss, threatening progress toward Sustainable Development Goal (SDG) 2, which aims to eradicate hunger and ensure food security. Similarly, Mwiinga (2016) points out barriers to enforcing street vending regulations in Lusaka, such as resistance from vendors and stakeholders, insufficient political will, and ethical dilemmas. Furthermore, many vendors refuse to leave the streets, relying on street vending as their primary income source, while political interference limits local authorities' enforcement capabilities. Also, the prevalence of street vending in low-income areas underscores the need for better-organized markets. Additionally, although 60% of vendors are aware of regulations against street vending, enforcement remains inconsistent, with the study concluding that the primary issue is poor implementation despite a comprehensive legal framework.

Also, the study reveals significant obstacles to enforcing food safety regulations, particularly due to interference from local authorities. Further, chiefs and other influential figures often intervene

to protect food vendors from legal action for non-compliance, allowing them to operate without adhering to safety standards. This intervention undermines accountability and enforcement efforts, enabling vendors to bypass safety norms with the support of community leaders, thereby disrupting the balance between regulatory enforcement and local dynamics, which jeopardizes public health and safety in food vending practices. Zhang et al. (2021) demonstrated a negative association between government intervention and food safety performance, initially underestimating this impact by excluding local government competition. According to the study, when competition is considered, government actions not only worsen food safety in the local area but also have negative spillover effects on neighboring regions, ultimately leading to a "race to the bottom." The study indicated that government intervention consistently results in negative total, direct, and indirect effects on food safety, compounded by a feedback loop. Furthermore, regions typically strive for better food safety than geographically similar areas, but they perform worse than regions with similar economic development levels. McNeil (2019) also outlined several factors that influence food handlers' and businesses' adherence to safety standards, emphasizing the crucial roles of social, economic, and regulatory elements in compliance. The study revealed that noncompliance increases the risk of foodborne illnesses, highlighting the urgent need for government authorities to enhance regulatory knowledge and promote proactive adherence. Furthermore, fast food owners should assume more responsibility for certification, and food safety inspectors (FSIs) should be held accountable for enforcing standards. FSIs should not only focus on compliance but also serve as educators and supporters, recognizing the diverse contexts in which fast food enterprises operate to effectively improve food safety practices.

Furthermore, the study revealed that local leaders who profit from issuing dumping permits tolerate the illegal dumping of waste near water bodies, highlighting significant sanitation

challenges. This not only undermines cleanliness efforts, but also increases environmental pollution and health risks, as contaminated water sources directly impact food safety and public health. Furthermore, the interaction of local customs, financial incentives, and weak enforcement mechanisms reveals systemic failures in maintaining sanitary conditions. This situation parallels findings from Fadhullah et al. (2022), which reported low rates of waste segregation among respondents, with compostable food waste and recyclable plastics frequently disposed off together. The same study encouraged local authorities to support community-based composting initiatives, which require minimal investment to enhance waste management practices. Likewise, Lissah et al. (2021) identified critical challenges in Ghana's solid waste management landscape, including insufficient infrastructure, financial limitations, and poor governance. The study also revealed that irregular waste collection and reliance on outdated equipment have contributed to public health issues such as cholera. Furthermore, sociocultural factors, as well as negative community attitudes toward waste disposal, obstructed progress.

5.4 Knowledge Levels of Street Food Vendors on Foodborne diseases.

Food-borne diseases or food poisoning will continue to be a major concern on all sides of the world in the future, despite several important national initiatives to restrict the presence of certain pathogens in food supplies. Furthermore, the understanding of food-borne diseases is constantly progressing, both in terms of identifying the causative factors or transmission agents and devising preventive control measures (Almaary, 2023).

The study found no significant association between street food vendors' age and their knowledge of foodborne diseases, indicating that age does not influence this knowledge area. The consistently high level of foodborne disease awareness among vendors, regardless of age, accounts for this lack

of correlation. Most vendors demonstrated a strong understanding of foodborne diseases, which aligns with the findings of Ankomah-Appiah et al. (2023). In their assessment of food vendors' knowledge of food hygiene practices, they found that 85% of respondents had a robust understanding of food safety. A significant majority (95.2%) recognized that food contamination could arise from their actions, and 89.2% were aware of the risks linked to contaminated kitchen towels and unclean surfaces. Additionally, 63% acknowledged the oversight of a government agency in monitoring their practices, and they recognized the importance of medical exams for food workers. Despite this high level of knowledge, 29.8% admitted to not removing jewelry while handling food, and 27.4% were unaware that refrigeration helps inhibit microbial growth. Furthermore, 42.9% did not regularly engage in food hygiene education programs, and a worrying 83.3% reported operating near open gutters, presenting significant hygiene risks. Similarly, Meher et al. (2022) explored the relationship between socio-demographic variables and food safety knowledge among street food vendors. Their findings revealed no significant differences in food safety knowledge based on gender, age, marital status, or years of experience, with most p-values exceeding 0.05. Furthermore, even though male vendors had a slightly higher average knowledge score than their female counterparts, this difference was not statistically significant. Interestingly, younger age groups, particularly those under 18, demonstrated a notable percentage of acceptable knowledge levels.

The study discovered no significant relationship between education level and knowledge of foodborne infections, with virtually all street food sellers (99.5%) displaying understanding of prevention, symptoms, and safe handling procedures, regardless of educational background. This indicates that practical experience, training, or public health measures may have had a higher impact on foodborne diseases knowledge than formal schooling. Addo-Tham et al. (2020)

emphasized the critical role of training and licensing in promoting safe food-handling behaviors among food vendors. Their study found that training significantly improved food safety practices ($p < 0.001$), highlighting its effectiveness in equipping vendors with the knowledge and skills necessary for maintaining hygiene standards. Licensing was also strongly associated with better adherence to food safety requirements ($p = 0.002$), likely due to the regulatory oversight and accountability it enforces. Interestingly, demographic factors such as age, gender, educational level, and years of experience were not statistically significant predictors of food-handling habits, suggesting that structured interventions like training and licensing have a more direct and impactful influence on behavior than individual characteristics. Similarly, Fekadu et al. (2024) found no significant relationships between food safety procedures and most socio-demographic characteristics, including gender ($p = 0.335$), age ($p = 0.446$), and education level ($p = 0.619$). However, contract workers followed more food safety measures than permanent or temporary employees, indicating a strong relationship between employment status and better procedures ($p = 0.034$).

Additionally, the study's findings on the relationship between years of experience in the food business and knowledge of foodborne diseases reveal a complex picture. There was a potential association between longer industry tenure and greater knowledge, however, findings revealed that the relationship between experience and knowledge may be inconsistent. This inconsistency suggests that factors beyond mere experience, such as targeted training programs or public health initiatives, might play a more crucial role in shaping foodborne disease knowledge among vendors. Supporting this notion, Werkneh et al. (2023) observed that vendors with 2–5 years of experience exhibited poorer food safety practices than those with over 5 years; however, this association lost statistical significance after adjusting for other factors. Also, food safety knowledge and attitudes

seemed to be related to practices at first, but these links did not become statistically significant after they were adjusted. This suggests that knowledge and attitude alone cannot reliably predict how people will handle food without taking into account other factors. In alignment with this, Nortey et al. (2024) reported that individuals who received food safety training had a slightly lower percentage of high knowledge (36.0%) compared to those without training (26.9%), yet this difference was not statistically significant ($p = 0.128$).

5.5 Hygienic Practices Among Street Food Vendors.

The study revealed no significant association between age and the cleanliness of street food vendors. Several factors may explain this lack of significant correlation. Vendors, regardless of age, might share similar experiences in their daily routines, which could neutralize any anticipated differences in hygiene practices. Additionally, factors such as workplace experience and exposure to environmental conditions may have a more substantial impact on hygiene practices than age alone. This observation aligns with findings from Htway (2019), which indicated that while most street food vendors in Taunggyi Township demonstrated strong food safety knowledge, their actual hygiene practices were inconsistent. The study's p-value of 0.398 further supports the notion that age is not a decisive factor in maintaining cleanliness among vendors. Furthermore, the absence of a relationship between food safety training and vendors' knowledge or practices highlights that, although vendors may possess adequate information about food safety, training alone is insufficient to ensure consistent adherence to proper hygiene practices. In contrast, the study by Hadgu et al. (2024) identifies younger vendors (under 25 years) as more likely to maintain good hygiene. Additionally, the findings emphasize the importance of specific hygienic practices of street food vendors, such as handwashing after using the toilet and avoiding serving food with bare hands, both of which are linked to significantly improved hygiene outcomes. The significant role

of using alcohol as a sanitizing agent further highlights the need for vendors to adopt effective sanitation methods.

Furthermore, there was a strong link between the vendors' level of education and their hygienic practices. Several factors contribute to the strong correlation between the vendor's level of education and their hygienic practices. Educated vendors tend to have a better understanding of food safety standards and the risks associated with poor hygiene, leading to increased awareness and compliance with hygiene practices. Higher education also provides access to resources and training programs, enhancing their knowledge of food safety. Additionally, educated individuals are more likely to adopt modern practices, invest in quality raw materials and sanitation supplies, and participate in networks that prioritize food safety, fostering a culture of accountability among peers. This finding aligns with the results of Islam et al. (2023), who performed a bivariate correlation study on food safety knowledge and behaviors. Their study revealed a substantial positive association between education level and knowledge of foodborne illnesses ($r = 0.177$, $p = 0.001$), suggesting that persons with higher education levels had a greater comprehension and awareness of foodborne diseases. Similarly, Leslie et al. (2021) looked at how education level affected food safety and hygiene practices among food vendors in Ikenne LGA. They found a statistically significant difference in practices based on education level ($t = 52.559$, $p = 0.000$). This result led to the rejection of the null hypothesis, reinforcing the notion that education plays a vital role in improving food safety practices, with vendors of higher educational attainment demonstrating superior hygiene practices compared to their less-educated counterparts.

5.6 Compliance Level of Street Food Vendors in Opetekwei

According to Segbedzi et al. (2023), factors such as irregular training, insufficient equipment, inadequate monitoring, and a weak food safety culture significantly contribute to poor compliance

with food safety standards. These challenges elevate the risk of foodborne illnesses like cholera and diarrhea, which are likely to escalate without prompt and effective intervention.

The findings from this study highlight the multifaceted nature of compliance among street food vendors in Opetekwei, revealing a combination of strengths and gaps that reflect systemic and behavioral challenges in food safety. High compliance scores were observed in visible hygiene practices, such as protective clothing (3.5), head covering (3.0), fingernail cleanliness (3.4), and use of appropriate kitchenware (3.3). In contrast, low compliance in critical areas such as water availability (1.8) mirrors findings from studies in similar low-resource contexts, where personal hygiene and infrastructural deficits are recurring challenges. These results align with Monney et al. (2014), who reported a marginally good overall compliance (OC) score of 0.67 (on a 0–1 scale) with food hygiene and safety principles. Their study found higher compliance in Dormaa-Ahenkro (OC = 0.71) compared to Bibiani (OC = 0.62). While compliance was excellent for medical screening (C = 0.91), it was notably poor for the use of protective clothing (C = 0.38), emphasizing disparities across key hygiene practices. The lack of access to clean water, in particular, has been widely documented as a fundamental barrier to maintaining food safety in informal vending environments, underscoring the need for infrastructural improvements to support hygiene (Tseole et al., 2022).

Demographic factors further illustrate disparities in compliance. Female vendors demonstrated higher adherence to hygiene practices, such as wearing protective clothing ($r = 0.28$) and ensuring water availability ($r = 0.42$), supporting findings by Eriksson et al. (2022) that women are often more diligent in maintaining cleanliness due to traditional roles emphasizing household hygiene. On the other hand, older vendors exhibited lower compliance in areas like head covering ($r = -0.38$) and food protection from flies ($r = -0.36$). This is consistent with research by Thanh and Duy

(2024), which suggests that older vendors may struggle with physical limitations or resistance to adopting new practices, necessitating tailored interventions.

The weak correlations between education and compliance parameters, such as medical screening ($r = -0.03$) and food hygiene training ($r = 0.14$), align with findings by Afolaranmi et al. (2015), which emphasize that formal education alone has limited impact on food safety adherence. Instead, practical, context-specific training is critical to bridging gaps in knowledge and behavior. Licensing status, strongly correlated with preparation site compliance ($r = 0.81$), supports evidence from Barnes et al. (2024) showing that regulatory frameworks and regular inspections significantly improve adherence to food safety protocols.

5.7 Consumers' Perceptions on Safety of Food Provided by Street Food Vendors.

Food consumption has markedly transformed due to variables like changing lifestyles, altering family dynamics, and insufficient time for meal preparation. There has been a substantial increase in the consumption of meals and snacks outside the house. Moreover, as their preferences, conveniences, and tastes evolve, customers frequent several food-selling platforms in search of convenience and value (Chaudhary & Lall, 2023).

The study found no significant correlations between age and marital status; rather, it observed a trend impact related to marital status. Gender did not show a significant link, whereas a notable likelihood ratio indicated a potential relationship that was not entirely reflected by the chi-square test. Other demographic characteristics, such as religion, ethnicity, educational attainment, employment, and duration of residence in the neighborhood, also demonstrated no significant correlations with the examined outcomes.

These findings indicate that personal experiences and preferences significantly influence perceptions more than demographic data alone. Personal experiences, cultural exposure, and social interactions may exert a greater effect on customers' sentiments about street food than age or marital status. The swift globalization of food culture may obscure conventional demographic divisions, resulting in analogous sentiments among various age groups and marital circumstances. Moreover, elements such as convenience, flavor, and cost are likely to exert a more immediate influence on customer behavior, eclipsing the potential effects of demographic characteristics. This suggests that a more sophisticated comprehension of customer views may necessitate an emphasis on psychological and environmental factors rather than exclusively demographic considerations. The above finding aligns with the study by Hiamey and Hiamey (2018) who found that socio-demographic variables such as age, gender, educational level, income, and working hours were not significant determinants of street food consumption, despite these factors contributing to a 74 percent increase in the model's predictive power. However, Fenteng et al. (2023) conducted an analysis of consumers' perceptions of food safety in relation to gender, revealing significant differences. The test result ($p = 0.021$) indicated a statistically significant association between gender and opinions on the safety of street food at an alpha level of 0.05, suggesting that gender influences perceptions of street food safety. The study argued that these differences stemmed from many females' preference for cooking at home, which provided them with greater control over food preparation. Males, on the other hand, are more likely to rely on street-vended foods due to time constraints and limited cooking skills.

Also, Mwove et al. (2024) analyzed gender, age, education level, income, and employment status to predict the knowledge of food hygiene and safety among street food consumers (SFCs), including personal hygiene, food preparation, and general knowledge scores. Among these factors,

only education level ($p = 0.0274$) and age ($p = 0.0205$) were significant predictors of personal hygiene scores. SFCs with only primary education were significantly less likely ($p = 0.0016$) to achieve excellent personal hygiene scores compared to those with a university education. Additionally, SFCs over 55 years old were five times more likely to score well than those under 26. The majority of SFCs identified key factors in choosing street-vended foods, such as product availability, lack of preparation required, affordability, hygienic preparation, sufficient quantity, clean and sanitized booths, proper packaging, clean utensils, and courteous service. Similarly, Ali et al. (2023) highlighted the significant influence of price on consumers' selection of street-vended foods, suggesting that price can also encourage the use of more sustainable and eco-friendly food sources that pose less environmental harm.

5.8 Disease Causing Microorganisms and their Levels in Food Sold by Vendors

The findings of this study reveal significant variations in microbial contamination levels across different street-vended foods in the Opetekwei community, raising critical public health concerns. The presence of high microbial loads in many samples underscores inadequate food safety practices among vendors, compounded by systemic challenges like poor sanitation and insufficient regulatory enforcement.

The mean counts for Total Aerobic Bacteria highlight a broad spectrum of contamination levels across various food types. Foods like waakye (W1, M1), kenkey (K3, K4, K6, K7, K8), and fish (F5) fell within the "satisfactory" range ($<3 \log \text{CFU/g}$), indicating proper handling. However, foods such as macaroni (M3, $9.24 \log \text{CFU/g}$), salad (S4, $9.21 \log \text{CFU/g}$), and Indomie (In 1, $6.32 \log \text{CFU/g}$) exhibited "unsatisfactory" levels ($>5 \log \text{CFU/g}$), far exceeding safety thresholds established by the Health Protection Agency (2009), Centre for Food Safety (2014), and ICMSF (2018). These findings suggest lapses in food preparation, handling, and storage, similar to

observations by Dela et al. (2023), who reported high contamination levels of total bacteria in banku and stew, and Addo et al. (2014), who noted substantial microbial loads in macaroni (5.54 ± 1.64 CFU/g) and salad (5.34 ± 1.35 CFU/g).

Yeast and mold contamination was particularly high in foods like macaroni (M4, 8.11 log CFU/g), pepper sauce (P1 7.34 log CFU/g), and kenkey (K8, 8.12 log CFU/g). These unsatisfactory levels (>3 log CFU/g). Wang et al. (2024) reported similar trends, linking high yeast and mold counts to inadequate storage practices, which can lead to spoilage and mycotoxin production. Foods like gari showed relatively lower contamination levels, with some vendors (G2 and G3) exhibiting no detectable pathogens.

Total coliform counts also revealed alarming trends, with foods like Macaroni (M2, 7.35 log CFU/g), kenkey (K3, 7.17 log CFU/g), and Kenkey (K8, 8.49 log CFU/g) exceeding the unsatisfactory threshold (>4 log CFU/g), suggesting potential fecal contamination. This aligns with findings from Were et al. (2020) and Omorodion and Ogunekum (2022), who observed high coliform levels in foods due to the usage of unsafe water. Foods like gari (G1, G3) and rice were notable exceptions, showing satisfactory coliform levels, likely due to minimal handling during preparation.

Pathogen analysis revealed significant risks associated with several food types. Macaroni and salad showed the highest prevalence of *E. coli* (81.82% and 66.67%, respectively), reflecting fecal contamination from inadequate cooking or handling. Similarly, *Shigella sp.* was detected in 81.81% of macaroni and 43.75% of Indomie samples, posing serious gastrointestinal health risks. *Salmonella sp.* were detected in fish (25%) and kenkey (6.25%), consistent with findings by Bansah (2018) and Alelign et al. (2023), who reported high pathogen prevalence in fish and ready-

to-eat foods. Gari showed no pathogens, due to its dryness with low water activity to support microbial growth (Samuel & Ugwuanyi, 2014).

The variability in microbial loads across food types underscores the need for targeted interventions. Foods like macaroni and salad require stricter controls during preparation and storage, given their susceptibility to contamination. Conversely, foods like gari and kenkey, which generally exhibit lower contamination risks, could serve as models for safer food preparation practices.

The widespread detection of pathogens such as *E. coli*, *Salmonella sp.*, *Shigella sp.*, and *Vibrio cholerae* in multiple food types highlights the urgent need for improved hygiene and sanitation practices among vendors. For instance, total coliform count for macaroni (M2, 7.35 log CFU/g) kenkey (K5, 10.23 log CFU/g) and pepper sauce (P1, 5.49 log CFU/g) exhibited contamination levels that reflect systemic lapses in food safety practices, similar to observations by Addo et al. (2014), who linked high contamination in foods like salad and stew to poor handling. High prevalence of *Shigella sp.* (81.81% in macaroni) and *Vibrio cholerae* (notable in waakye, 9.09%) emphasizes the risks of gastrointestinal illnesses, particularly in high-risk populations such as children and immunocompromised individuals.

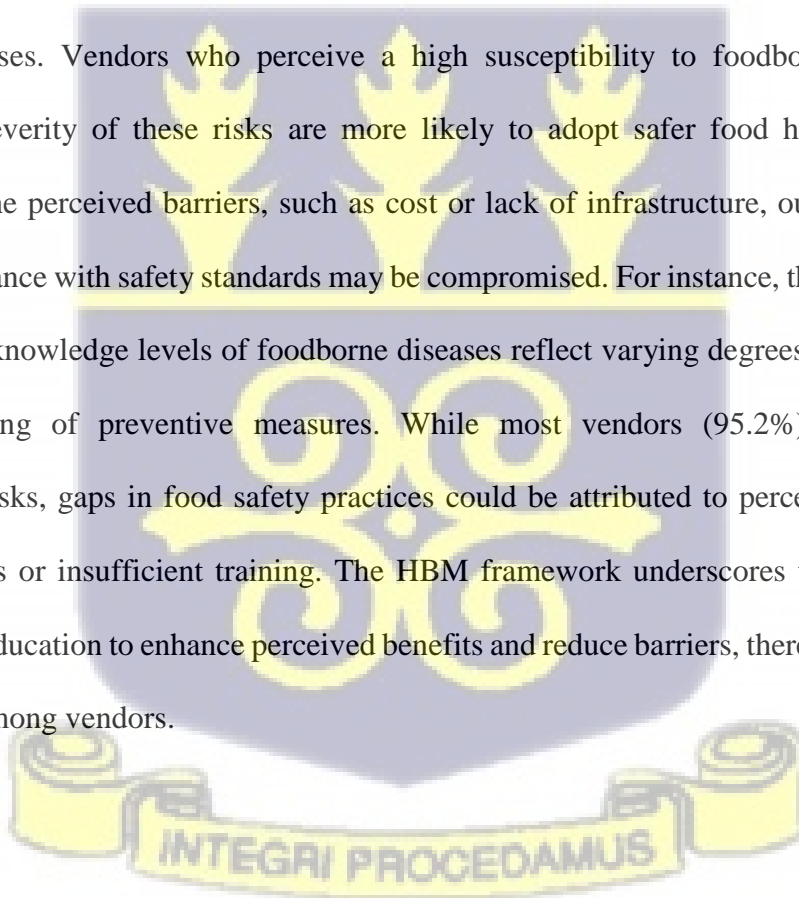
5.9 Integration of Theories

In this study, three key theories—Health Belief Model (HBM), Theory of Planned Behavior (TPB), and Social Cognitive Theory (SCT)—are employed to provide a structured understanding of street food vendors' behaviors and the factors influencing their compliance with food safety regulations. Integrating HBM, TPB, and SCT provides a comprehensive understanding of the cognitive, social, and environmental factors influencing street food vendors' behaviors. While HBM focuses on individual perceptions of risk and benefits, TPB addresses intention formation influenced by social expectations and perceived control. SCT complements these models by

emphasizing learning through observation and community influence. Together, these frameworks underscore the need for multi-faceted interventions that not only educate vendors but also address environmental barriers and social norms to enhance food safety compliance.

5.9.1. Health Belief Model (HBM)

The Health Belief Model (Rosenstock, 1974) suggests that individuals' health-related behaviors are influenced by their perceptions of susceptibility to health risks, the severity of those risks, the benefits of taking preventive action, and the barriers to doing so. In the context of street food vending, the HBM can be applied to understand vendors' awareness and attitudes towards foodborne diseases. Vendors who perceive a high susceptibility to foodborne illnesses and recognize the severity of these risks are more likely to adopt safer food handling practices. Conversely, if the perceived barriers, such as cost or lack of infrastructure, outweigh perceived benefits, compliance with safety standards may be compromised. For instance, the study's findings on the vendors' knowledge levels of foodborne diseases reflect varying degrees of perceived risk and understanding of preventive measures. While most vendors (95.2%) were aware of contamination risks, gaps in food safety practices could be attributed to perceived barriers like limited resources or insufficient training. The HBM framework underscores the importance of targeted health education to enhance perceived benefits and reduce barriers, thereby fostering safer food handling among vendors.



5.9.2. Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (Ajzen, 1991) posits that an individual's behavior is driven by their intentions, which are influenced by attitudes, subjective norms, and perceived behavioral control. In the case of street food vendors, attitudes toward food safety, social pressures (subjective norms), and confidence in their ability to practice safe food handling (perceived behavioral control) play critical roles in their compliance with food safety standards. The study's findings on vendors' hygienic practices and compliance levels suggest that while some vendors are committed to maintaining hygiene, others may be influenced by community norms or limitations in perceived control—such as lack of access to clean water or adequate storage facilities. TPB highlights the need for community-level interventions that not only educate vendors but also create social expectations around food safety to reinforce positive behaviors.

5.9.3. Social Cognitive Theory (SCT)

Social Cognitive Theory (Bandura, 1986) emphasizes the role of observational learning, social experiences, and reciprocal determinism in shaping behavior. Vendors often learn food safety practices through social interactions, observations of peers, and collective experiences. SCT also highlights the importance of self-efficacy—vendors' belief in their capability to handle food safely under varying conditions. The study's results on the experience levels of vendors indicate that long-standing practices may resist modern safety improvements. SCT suggests that enhancing self-efficacy through hands-on training and peer-led workshops can empower vendors to adopt safer food handling practices. Additionally, community-based monitoring and support can reinforce positive behaviors and gradually shift cultural norms towards improved food safety standards.

The application of these theories in the Opetekwei context suggests that strengthening regulatory frameworks, increasing awareness of health risks, and building community-driven safety standards could significantly improve food safety practices among street food vendors.



CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study examined the hygiene practices of street food vendors and analyzed the microbial content of selected food items sold in Opetekwei. It was organized around four key variables: the institutional and regulatory frameworks governing street food vending and the compliance levels of vendors in Opetekwei; the vendors' knowledge of foodborne diseases and their hygienic practices; consumers' perceptions of the safety of food sold by street vendors; and the microbial quality of specific food samples obtained from these vendors.

6.1.1 Institutional and Regulatory framework guiding food vending in Opetekwei

Various regulatory measures including standards created by the Ghana Standards Authority (GSA), along with documents from the Food and Drugs Authority (FDA) and Assembly's by-laws, were found to regulate street food vending in Opetekwei, yet there is weak enforcement due to limited monitoring and food vendors inconsistent adherence to the regulations.

6.1.1.1 Compliance Level of Street Food Vendors in Opetekwei

The compliance of street food vendors with food safety standards revealed a mixed results. According to the eight-point Safety Compliance Checklist rating system, medical screening which scored 4.3 and food fly prevention averaged 4.1 which indicating high compliance. Training on food hygiene and safety (3.7), use of protective clothing (3.5), cleanliness of fingernails (3.4), and head covering (3.0) registered moderate compliance. However, a compliance score of 1.8 for the presence of potable water at various vending points raises an important concern that require attention.

6.1.2 Knowledge Level among Street Food Vendors on Food Borne Diseases

The study indicated that Opetekwei street food vendors display an appreciable food borne diseases awareness alongside the necessary hygiene practices. The participants correctly understood basic food safety information that explains food borne disease origins, prevention methods, and their related symptoms. The vendors understood food contamination sources, which included unclean water, unwashed or spoiled ingredients, and improper handling of food items. The study revealed that the street food vendors accurately recognized foodborne illness symptoms, which included nausea, vomiting, diarrhoea, fever, and feelings of fatigue.

6.1.2.1 Hygiene Practices Among Street Food Vendors

The satisfactory understanding did not translate into consistent or proper cleaning practices among the vendors. The study demonstrated that the street food vendors understood the significance of handwashing and food security protocols, nevertheless only 3% utilized clean water for handwashing before serving, 87% handle money when serving food, and 77% of the vendors conducted business near drains or dusty roads, and none had proper access to safe drinking water.

6.1.3 Consumers' Perceptions on Safety of Food Provided by Street Food Vendors

The majority of consumers (90%) of the consumers knew about health risks associated with street foods, fifty-six percent (56%) chose food based on affordability and thirty-six percent (36%) based on speed rather than hygiene or quality factors. The results showed that vendor hygiene did not influence customers' street food purchasing decisions.

This study revealed that 35% of consumers pronounced their extreme concern about safety and 41% acknowledged their worries about cleanliness levels of street food vendors. The concern consumers showed for hygiene of street food did not lead to trust because only 18% of them believed vendors maintained safe practices, yet 55% acknowledged those practices affected their purchasing decisions.

Health-related concerns were prevalent among consumers since 66% experienced diarrhea, while 37% had cases of typhoid and 27% were diagnosed with cholera. Survey results indicated that 60% of consumers were acquainted with hygiene regulations, but no one considered these regulations to receive proper enforcement.

6.1.4 Disease Causing Microorganisms and their Levels in Food Sold by Vendors

The microbial analysis showed that street-vended foods such as macaroni, salad, pepper sauce, and fish from Opetekwei contained high counts of aerobic bacteria, yeast, and mold, as well as total coliforms, indicating improper hygienic practices during preparation, handling, and storage. The highest recorded bacterial loads in the food samples belonged to macaroni M3 at 9.24 log CFU/g, and the yeast and mold along with coliform counts were highest in kenkey K8 at 8.12 log CFU/g and 8.49 log CFU/g, respectively.

The microbial testing of street foods demonstrated *Escherichia coli* as the dominant pathogen since it was detected in 81.82% of macaroni, 75% of pepper sauce, and 66.67% of salad samples due to improper hygiene conditions in food preparation or handling procedures. A total of 81.81% of macaroni samples and 43.75% of samples of fish and Indomie tested positive for *Shigella* sp. *Vibrio cholerae* was detected in 37.5% of fish and 36.36% of macaroni, and *Salmonella* sp. was primarily found in 25% of fish, although minor amounts were detected in kenkey and Indomie (6.25% each). Test samples drawn from Gari failed to identify any pathogens, hence demonstrating a comparatively safe status.

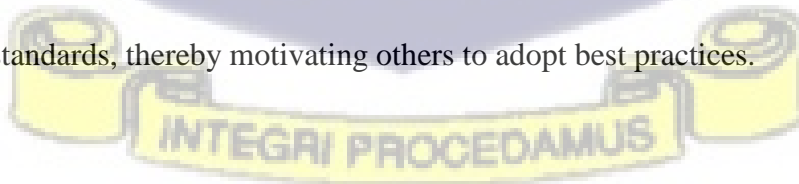


6.2 Recommendations

Based on the findings of the study, recommendations are made to the Ablekuma West Municipal Assembly, Environmental Health Unit, and key stakeholders including street food vendors and consumers. These recommendations are geared toward improving personal hygiene among food vendors, ensuring safer food handling practices, and enhancing regulatory enforcement within the municipality.

6.2.1 Ablekuma West Municipal Assembly (AWMA)

1. The Municipal Assembly must intensify public awareness campaigns to educate food vendors on the importance of maintaining high standards of personal and food hygiene.
2. The Assembly should organize quarterly health education programs in collaboration with the Municipal Health Directorate to equip vendors with knowledge on personal and environmental hygiene. This will help reduce the risk of foodborne illnesses and improve food safety in the community.
3. The Assembly should construct or designate safe, clean, and accessible vending areas equipped with potable water and waste disposal facilities to support hygienic food vending practices.
4. A reward scheme should be instituted to recognize vendors who consistently maintain high hygiene standards, thereby motivating others to adopt best practices.



6.2.2 Environmental Health Unit – Ablekuma West Municipal Assembly

5. The Environmental Health Unit should intensify the promotion of safe food preparation and handling practices through local media channels, community outreach, and visual educational materials at vending sites.
6. The Unit should enforce biannual mandatory medical screenings for all food vendors to ensure that only healthy individuals are allowed to operate, in compliance with public health standards.
7. Public Health Act 851 (2012) and the Municipal by-laws on food safety should be strictly enforced against non-compliant food vendors. Repeat offenders must be sanctioned to deter unsafe practices.
8. Quarterly monitoring should be carried out, especially targeting vendors who operate at night or in unregulated areas, to ensure compliance with hygiene and licensing regulations.

6.2.3 Street Food Vendors and Consumers

9. Street food vendors must commit to consistent hygienic practices including handwashing with clean water, using protective clothing, and maintaining clean vending environments away from drains and dusty roads.
10. Vendors should avoid handling money and food simultaneously and must adopt methods that minimize direct hand contact with food items.
11. Consumers must demand higher hygiene standards by purchasing only from vendors who meet visible safety criteria and by reporting unhygienic vendors to the appropriate authorities.

12. Public health education should be extended to consumers to enhance their understanding of foodborne diseases and encourage more informed choices when purchasing street food.

6.2.5 Government of Ghana

13. The Government should invest in the street food sector by improving infrastructure, supporting food hygiene training programs, and allocating adequate logistics to agencies responsible for food safety regulation.
14. Future research should not only examine bacterial contamination in street foods but also include parasitic analysis (e.g., *Ascaris*, *Planaria*) and microbial assessments of vendors' hands and equipment.



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APPENDIX

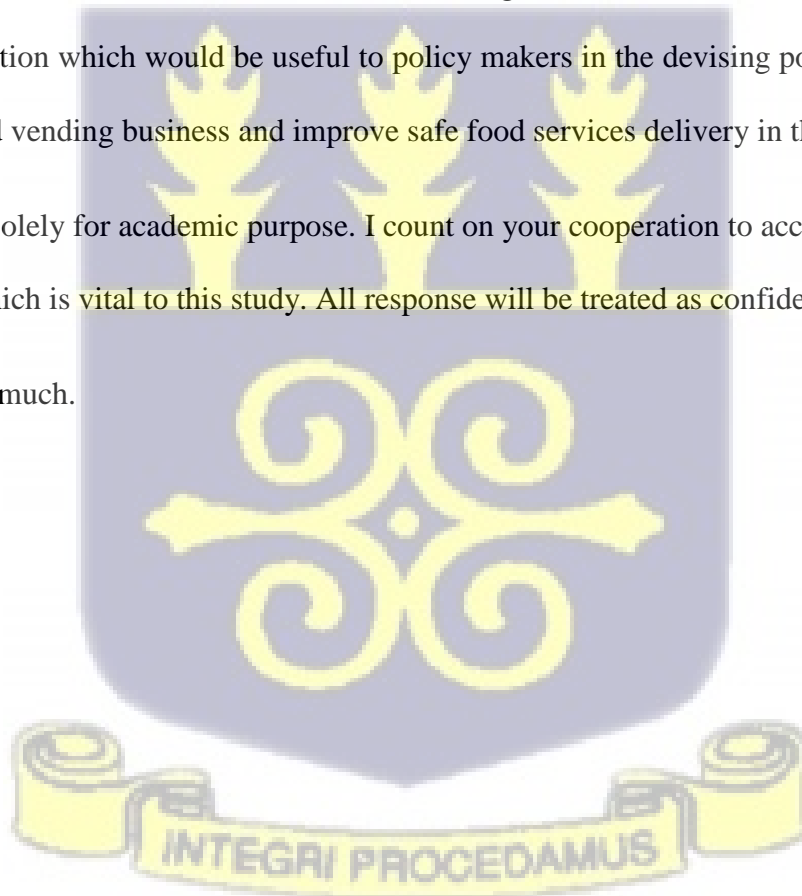
QUESTIONNAIRE/INTERVIEW SCHEDULE FOR STREET FOOD VENDORS IN OPETEKWEI, ABLEKUMA WEST MUNICIPALITY.

INTRODUCTION

I am LOIS BOATEMAA BOATENG a final year MPhil student of the Institute for Environment and Sanitation Studies (IESS) of the University of Ghana. This study aims to determine the hygienic practices of food vendors and their knowledge on food-borne illness so as to obtain relevant information which would be useful to policy makers in the devising policies particularly in the street food vending business and improve safe food services delivery in the study areas.

The research is solely for academic purpose. I count on your cooperation to accurately respond to the questions which is vital to this study. All response will be treated as confidential.

Thank you very much.



SECTION B: KNOWLEDGE IN FOOD SAFETY AND FOODBORNE ILLNESSES

12. Food vendors can be a source of food contamination.

Yes No Don't know

13. Hands must be washed with soap under running water before and after cooking.

Yes No Don't know

14. Food vendors with wounds or cuts on their hands should not sell food.

Yes No Don't know

15. Cooked meal should be served hot (above 60°C).

Yes No Don't know

16. Uncooked food ingredients must be kept separately from a prepared meal.

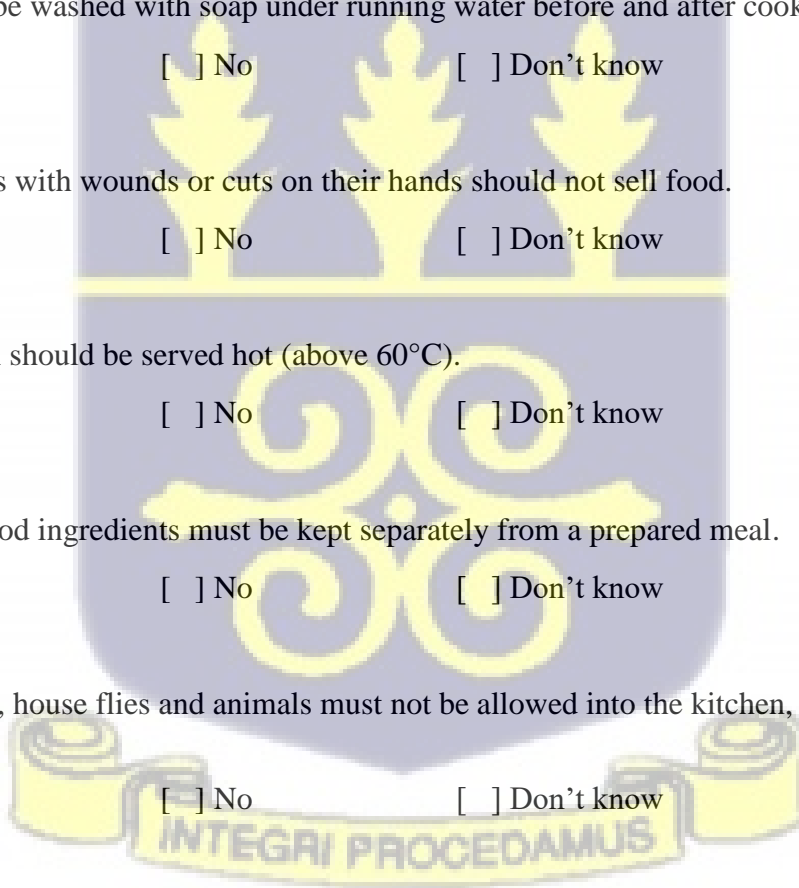
Yes No Don't know

17. Cockroaches, house flies and animals must not be allowed into the kitchen, cooking or selling area.

Yes No Don't know

18. The use of napkin to wipe plates and serving devices can spread germs (microorganisms) when dirty and cause disease.

Yes No Don't know



19. Wearing protective equipment and clothes such as apron, face mask and cap can reduce the risk of food contamination.

Yes No Don't know

20. Eating contaminated food and beverages can make one sick.

Yes No Don't know

21. Use of unclean or contaminated water for food preparation can make consumers sick.

Yes No Don't know

22. Use of rotten or unwashed food ingredients for food preparation can make consumers sick.

Yes No Don't know

23. Which of the following are symptoms of foodborne illness?

nausea diarrhoea vomiting abdominal cramps
 fever fatigue Others, please specify

24. Which of these are examples of foodborne illness? Please tick all that apply.

Diarrhoea, Cholera Typhoid Others, please specify

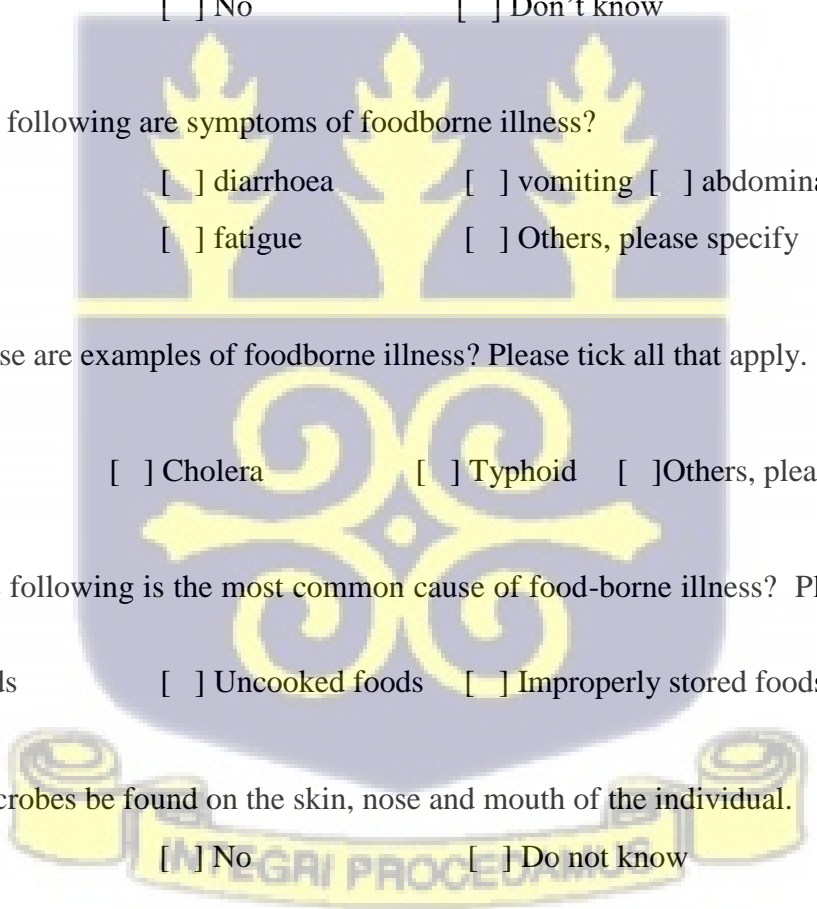
25. Which of the following is the most common cause of food-borne illness? Please tick all that apply.

Expired foods Uncooked foods Improperly stored foods

26. Germs or microbes be found on the skin, nose and mouth of the individual.

Yes No Do not know

27. Germs can contaminate food if food safety practices are not observed.



Yes No

28. Germs can grow best in which of the following types of food? Please tick all that apply.

Cold food Hot food Warm food
 Temperature of food has no effect on the growth of germs

29. Germs can contaminate food through which of the following ways? Please tick all that apply.

Poor handling of food Use of unsafe water
 Use of improperly cleaned utensils
 Lack of cleanliness and sanitation in cooking or selling area

30. Anyone who is sick should not cook food for people.

Yes No Do not know

31. Everybody including children, healthy adults, pregnant women and the elderly can fall sick and even die when they eat contaminated food.

Yes No Don't know

SECTION C: CHECKLIST ON FOOD VENDOR PRACTICES

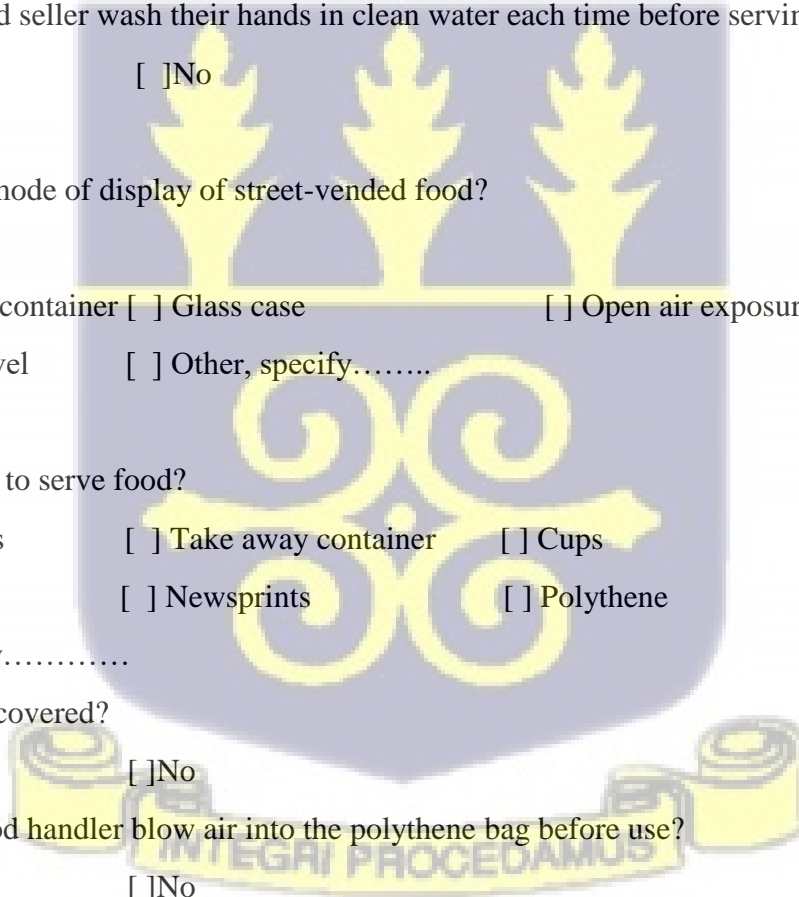
32. How clean is the immediate environment where food is sold?

clean Garbage/littered Flies present
 Stagnant water present Other, please specify.....

33. The vending site is close to

Dusty road Drain/open gutter Toilet
 Rubbish dump None of the above Other, please specify soil

34. The food vendor wears clean apron/protective garments? Yes No
35. Is there portable water at the site or close to the site? Yes No
36. Is adequate hand washing facilities available? Yes No
37. The food vendor has short finger nails. Yes No
38. The food vendor's hair (head) is covered? Yes No
39. The food vendor handles food with bare hands? Yes No
40. Does the food handler handle money while serving food? Yes No
41. Does the food seller wash their hands in clean water each time before serving food?
 Yes No
42. What is the mode of display of street-vended food?
 Mosquito net container Glass case Open air exposure
 On ground level Other, specify.....
43. What is used to serve food?
 Plates/utensils Take away container Cups
 Leaves Newsprints Polythene
 Other, specify.....
44. Are utensils covered?
 Yes No
45. Does the food handler blow air into the polythene bag before use?
 Yes No
46. Does the food seller blow nose or cough while serving food?
 Yes No
47. What do you do with daily left-over food?



- Throw away Stored at room temperature, reheat and sold next day
 Eaten at home Kept in the refrigerator, reheat and sold next day
 No left-over Other, specify.....

48. Where do you dispose of your refuse/garbage?

- Near bush Drain/open gutter Nearby Rubbish dump
 All the above Other, please specify.....

49. Is vended food exposed to vectors (example: flies)?

- Yes No If yes, specify vector(s).....

50. How do you clean your serving plates and spoons before being used to serve?

- Wipe with napkin Wash with soap and water under running water
 Wash with soap and water in a bowl Other, specify.....

51. How is cooked food kept before service?

- In pans on fire In pans but not on fire In warmers
 Others, please specify.....

SAFETY COMPLIANCE CHECKLIST FOR STREET FOOD VENDORS

This safety compliance checklist evaluates adherence to safety standards in food preparation, handling, and hygiene. Each criterion is assessed on a 5-point Likert scale:

(5 – Very Good, 4 – Good, 3 – Moderate, 2 – Poor, 1 – Very Poor)

1. Use of protective clothing

- 5 - Very Good: All protective clothing (e.g., gloves, aprons) consistently and correctly used.
 4 - Good: Mostly used, with rare lapses.
 3 - Moderate: Inconsistent use of protective clothing.
 2 - Poor: Minimal effort to use protective clothing.
 1 - Very Poor: No protective clothing observed.

2. Head covering

- 5 - Very Good: Proper head covering consistently worn by all food handlers.
 4 - Good: Mostly worn, with occasional lapses.
 3 - Moderate: Some inconsistencies in wearing head coverings.

2 - Poor: Minimal effort to use head coverings.

1 - Very Poor: No head covering used.

3. Food protection from flies

5 - Very Good: All food is completely covered and protected from flies.

4 - Good: Mostly protected, with minor lapses.

3 - Moderate: Some exposure to flies but generally acceptable.

2 - Poor: Food is frequently exposed to flies.

1 - Very Poor: No effort made to protect food from flies.

4. Training on food hygiene and safety

5 - Very Good: All staff are well-trained and follow hygiene protocols.

4 - Good: Most staff are trained, with minor knowledge gaps.

3 - Moderate: Some staff trained, but inconsistencies in practice observed.

2 - Poor: Few staff trained, with minimal adherence to protocols.

1 - Very Poor: No staff training on food hygiene and safety.

5. Dishing out food with appropriate kitchenware

5 - Very Good: Always uses appropriate, clean kitchenware to handle food.

4 - Good: Mostly uses kitchenware, with rare lapses.

3 - Moderate: Some use of appropriate kitchenware but inconsistencies observed.

2 - Poor: Minimal effort to use kitchenware properly.

1 - Very Poor: No use of appropriate kitchenware.

6. Cleanliness of fingernails

5 - Very Good: Fingernails are short, clean, and dirt-free at all times.

4 - Good: Generally clean, with minor lapses in hygiene.

3 - Moderate: Acceptable cleanliness, but occasional signs of poor hygiene.

2 - Poor: Frequently dirty or improperly maintained.

1 - Very Poor: No effort to maintain fingernail hygiene.

7. Water availability at vending point

- 5 - Very Good: Clean water is always available for cooking, cleaning, and drinking.
- 4 - Good: Mostly available, with rare interruptions.
- 3 - Moderate: Water is inconsistently available.
- 2 - Poor: Rarely available, with frequent shortages.
- 1 - Very Poor: No clean water available at the vending point.

8. Medical screening

- 5 - Very Good: All staff have up-to-date medical screening records.
- 4 - Good: Most staff have valid screenings, with minor gaps.
- 3 - Moderate: Some staff are screened, but significant gaps exist.
- 2 - Poor: Few staff have undergone medical screening.
- 1 - Very Poor: No medical screening records available.

QUESTIONNAIRE/INTERVIEW SCHEDULE FOR STREET FOOD CONSUMERS IN OPETEKWEI, ABLEKUMA WEST MUNICIPALITY.

INTRODUCTION: I am LOIS BOATEMAA BOATENG a final year MPhil student of the Institute for Environment and Sanitation Studies (IESS) of the University of Ghana. This study aims to understand your perception about street foods so as to obtain relevant information which would be useful to policy makers in devising policies for street food vending business and improve safe food services delivery in the study area. The research is solely for academic purpose. I count on your cooperation to accurately respond to the questions which is vital to this study. All response will be treated as confidential. Thank you very much.

PART I: DEMOGRAPHIC INFORMATION

1. Gender ()male ()female
2. Age In years
3. Marital status ()single ()married ()divorce ()others, please specify

4. Religion Christianity Islam African Tradition Others, please specify
5. Ethnic group Akan Ga-Adangbe Ewe Dagomba Mamprusi Others, please specify
6. Educational background no formal education primary school secondary school tertiary education others, please specify
7. Occupation student drivers civil servants self employed unemployed others, please specify
8. How long have you living or working in this community?
9. Do you purchase street foods in Opetekwei? yes no
10. If yes to question above, what are your reasons for buying street foods in Opetekwei? please select all that apply
cheap convenience offers fast consumer service variety of food tastes better than home-cooked foods close to home or workplace hygienic others, please specify
11. How do you get to know about street food in Opetekwei? please select all that apply
advertisement recommendation passed by the food stall others, please specify
12. How often do you buy street food in Opetekwei?
daily once a week more than two times a week once a month twice a month
rarely
13. Do you buy street food as breakfast? yes no
14. Do you buy street food as lunch? yes no
15. Do you buy street food as dinner? yes no
16. What types of food do you buy for breakfast? please select all that apply
hausa porridge waakye banku kenkey indomie others, please specify
17. What types of food do you buy for lunch? please select all that apply
hausa porridge waakye banku kenkey indomie others, please specify
18. What types of food do you buy for dinner? please select all that apply
hausa porridge waakye banku kenkey indomie others, please specify

PART III: PERCEPTION OF CONSUMERS TOWARDS STREET FOODS IN OPETEKWEI

19. How concerned are you about the safety of street foods in Opetekwei?
very concerned slightly concerned not concerned
20. How concerned are you about the hygiene and cleanliness of street food vendors in Opetekwei?
very concerned slightly concerned not concerned
21. Does the price influence your decision to purchase street food in Opetekwei? yes no
22. Does the taste influence your decision to purchase street food in Opetekwei? yes no
23. Does the availability of variety of foods influence your decision to purchase street food in Opetekwei?
yes no
24. Do you consider the distance when going to buy a street food? yes no
25. Rate how the following influence your decision to buy street food in Opetekwei
- I. Price very slightly not at all
 - II. Taste very slightly not at all
 - III. Food safety very slightly not at all
 - IV. Hygiene and cleanliness of vendors very slightly not at all
 - V. Convenience very slightly not at all
26. Do you think street food in Opetekwei is affordable nowadays? yes no
27. Do you compare prices of the street foods before buying in Opetekwei? yes no
28. Do cheaper-priced street foods lead to low quality of food and higher health risks? yes no
29. Do you eat the food at the vending site in Opetekwei? yes no
30. Do you prefer to buy your food at a vending site with available portable water at or close to the site?
yes no
31. Do you prefer to buy your food at a vending site with clean environment and far from rubbish, waste water, toilet facilities, open drains and animals? yes no
32. Are you concerned about your health status when purchasing street food? yes no

33. Are you aware of the potential health risks associated with consuming street food? ()yes ()no
34. Have you or someone you know ever experienced a foodborne illness related to street food consumption in Opetekwei? ()yes ()no
35. If yes in the question above, please what was the foodborne illness encountered? select all that apply
()diarrhoea ()typhoid ()cholera ()others, please specify
36. Does the good hygienic practices of food vendors influence your decision to purchase street food? ()yes ()no
37. Are you confident in the hygienic practices of street food vendors in Opetekwei? ()yes ()no
38. Are you aware of any local regulations governing the hygiene practices of street food vendors in Opetekwei? ()yes ()no
39. If yes, do you think they are being enforced satisfactorily? ()yes ()no
40. Do you know that food borne illness can be transmitted by consuming contaminated foods including street foods? ()yes ()no
41. How concerned are you of contracting a food borne illness from street foods?
()very concerned ()moderately concerned ()not concerned at all
42. Are there any street foods you do not buy because of food safety?
()yes ()no
43. If yes, please list the foods
44. Do you look for the food selling license of the street food vendor before purchase? ()yes ()no ()not sure
45. What do you think can be done to ensure the safety of street foods in Opetekwei? please select all that apply
()more education ()more regulations ()more enforcement of rules

PART IV: RECOMMENDATION FROM CONSUMERS

46. What improvements would you suggest to enhance the hygiene practices of street food vendors in this area?
47. Are there any specific measures you think could be implemented to ensure the safety of street food?
48. How important do you think the personal hygiene practices of food vendors are in ensuring the safety of street food?

49. Do you think there is a need for more educational initiatives to inform consumers about the importance of hygiene in street food?
50. Considering the hygienic practices and concerns, how satisfied are you with the street food options in Opetekwei?

