Faculty of Social Sciences and Humanities

Food Hygiene Knowledge, Attitude, Practices and Environmental Cleanliness in Rural School Kitchens and Canteens in Rural Schools: A Case Study in Betong, Sarawak, Malaysia

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Doctor of Philosophy
2026

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A thesis submitted

In fulfillment of the requirements for the degree of Doctor of Philosophy

(Sociology)

Faculty of Social Sciences and Humanities
UNIVERSITI MALAYSIA SARAWAK
2026

DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date: 6 June 2025

ACKNOWLEDGEMENT

I would like to take this opportunity to thank those who have contributed to my research.

My sincere gratitude to the Centre for Graduate Studies for the advice and support given during my period of study at Universiti Malaysia Sarawak.

Finally, I would like to thank the management of Universiti Malaysia Sarawak for making it possible for me to complete my studies here in Sarawak. Thank you all.

ABSTRACT

Food-borne diseases cause millions of deaths every year around the world. The food preparation process, lifestyles, physical cleanliness and water supply are the major factors contributing to food-borne diseases and the prevalence of food poisoning among students. Mismanagement of food by food handlers and students’ and food handlers’ poor knowledge of food hygiene are key public health issues. The objectives of this study are to investigate how food handlers carry out food preparation, to determine students’ and food handlers’ levels of knowledge, attitudes and behaviours regarding food hygiene, to assess the physical cleanliness of school canteens and the purity of their water supply and to develop guidelines for the prevention of food poisoning. The aspects investigated in this study are the food preparation process, knowledge of food hygiene, physical cleanliness and food poisoning prevention methods. The study was conducted at eight schools in Betong, Sarawak. The focus groups comprised students and food handlers. This study adopted a quota sampling technique for sample selection. In-depth interviews were conducted, and questionnaires were distributed to the students and food handlers. Focus group discussions (FGDs) were conducted in the field. The findings showed that the sampled students and food handlers had adequate knowledge in food hygiene and food safety, but had poor knowledge and behaviour in certain aspects. Therefore, health policy changes are crucial by adopting sociocultural and behavioural health aspects into the food preparation processes to prevent food poisoning in rural schools. This study will have an impact on Malaysia’s health policy concerning food-borne diseases.

Keywords: Food-borne diseases, food poisoning, sociocultural, knowledge, attitude & behavioural (KAPs) and behavioural insights, Sarawak

Pengetahuan, Sikap, Amalan Kebersihan Makanan dan Kebersihan Persekitaran di Dapur dan Kantin Sekolah Luar Bandar: Kajian Kes di Betong, Sarawak, Malaysia

ABSTRAK

Penyakit bawaan makanan mengakibatkan kematian yang tinggi setiap tahun di seluruh dunia. Proses penyediaan makanan, gaya hidup, kebersihan fizikal dan bekalan air merupakan faktor utama yang menyumbang kepada penyakit bawaan makanan. Kelaziman keracunan makanan adalah dalam kalangan pelajar. Salah urus makanan serta pengetahuan kebersihan yang lemah dalam kalangan pengendali dan pelajar merupakan isu utama. Kajian ini bertujuan untuk mengkaji amalan penyediaan makanan, tahap pengetahuan, sikap dan tingkah laku terhadap kebersihan, keadaan fizikal kantin dan bekalan air, serta membangunkan garis panduan pencegahan keracunan makanan. Aspek yang dikaji dalam kajian ini ialah proses penyediaan makanan, pengetahuan tentang kebersihan makanan, kebersihan fizikal dan kaedah pencegahan keracunan makanan. Kajian telah dijalankan di lapan buah sekolah di Betong, Sarawak. Kumpulan fokus ialah pelajar dan pengendali makanan. Kajian ini menggunakan teknik persampelan kuota untuk pemilihan sampel. Data dikumpul menggunakan kaedah temu bual mendalam dan perbincangan kumpulan focus (FGDs). Borang soal selidik juga digunakan bagi mendapatkan respon dari pelajar dan pengendali makanan. Dapatan kajian menunjukkan pelajar dan pengendali makanan mempunyai pengetahuan yang mencukupi mengenai kebersihan makanan dan keselamatan makanan tetapi lemah dalam aspek tertentu. Oleh itu, perubahan dasar kesihatan amat penting dengan mengambilkira aspek sosiobudaya dan tingkah laku kesihatan dalam proses penyediaan makanan, khususnya bagi mencegah keracunan makanan di sekolah luar bandar. Kajian ini dijangka memberi impak terhadap dasar kesihatan Malaysia berkaitan penyakit bawaan makanan.

Kata kunci: *Penyakit bawaan makanan, keracunan makanan, sosiobudaya, pengetahuan, sikap & tingkah laku (KAPs) dan tingkah laku kesihatan, Sarawak*

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LIST OF ABBREVIATIONS

UNIMAS	Universiti Malaysia Sarawak
SPSS	Statistical Package for the Social Science
SPU	State Planning Unit
MOH	Ministry of Health
CATI	Computer-Assisted Telephone Interview
CAPI	Computer Assisted Personal Interview
KAPs	Knowledge, Attitude & Practice
KPM	Kementerian Pendidikan Malaysia
FDG	Focus Group Discussion
NHMS	National Health and Morbidity Survey
IPTK	Institute Penyelidikan Tingkah Laku
SD	Standard Deviation
FBDs	Foodborne diseases
CDC	Centre for Disease Control and Prevention
FoSIM	Food Safety Information of Malaysia
LPM	Latihan Pengendalian Makanan
KKM	Kementerian Kesihatan Malaysia
SLPM	Food Operator Training School
RMT	Rancangan Makanan Tambahan
WHO	World Health Organisation

CHAPTER 1

INTRODUCTION

1.1 Introduction

This study seeks to deepen the understanding of the causes, factors and control of foodborne diseases and food poisoning through a multidisciplinary lens, incorporating sociology, behavioural health, public health, food safety management, and policy analysis. By examining the current epidemiological trends, risk factors, and preventive strategies, the study aims to contribute to the development of more effective interventions and regulatory frameworks that ensure safer food systems globally. Ultimately, this research seeks to bridge the gap between scientific knowledge and practical implementation, highlighting the critical importance of food safety in achieving sociological and behavioural health sustainability.

Chapter 1 also discusses the prevalent incidences of food poisoning that occurred in rural schools in Betong, Sarawak, using raw data and statistics from the ground. The statistics showed that food poisoning cases increased from year to year, which caught the researcher's curiosity to investigate deeper into the causes of high food poisoning in the rural school at Betong. The research objectives of this study were created based on the real problem in the field; the outcome of this study will fill the research gaps and create new knowledge contributions to the sociological field.

1.2 Background of Research

Foodborne illnesses such as cholera, typhoid fever, hepatitis A, dysentery, and food poisoning result from eating food tainted with harmful microorganisms or toxic substances

(Sharifa Ezat, Netty & Sangaran, 2013). Among the most common causes of these illnesses worldwide are Salmonella bacteria, which are often transmitted to humans through contaminated animal products like eggs, poultry, meat, and milk (World Health Organization, 2019). This study focuses on foodborne diseases, particularly examining cases of food poisoning among school-aged children. There is a close connection between the causes of foodborne illnesses and individuals' lifestyles. The researcher therefore wishes to study how food handlers' and students' lifestyles or hygiene could affect the prevalence of food poisoning.

According to Soon (2011), the majority of food poisoning incidents are linked to improper food handling and inadequate cleanliness during food preparation. Additionally, Cowan (2019) highlighted that poor personal hygiene among food handlers also contributes significantly to these cases. Studies found that knowledge of, attitudes towards and practices regarding hygiene are the key factors in the reduction of food-borne disease (Zyoud et al., 2019). Md Mizanur, Taha & Zainab (2012) found that the broader social, cultural and daily context appeared to have an impact on food handling, hygiene and risks. Although the study of food-borne diseases is still in its infancy, many researchers (Soon, 2011; Sharifa Ezat et al., 2013; Abdul-Mutalib et al., 2015; Cowan, 2019; Zyoud et al., 2019) have studied the topic.

Food hygiene is important for food preparation and food handling as the food might become contaminated during processing, cleaning, storage and preparation (Abdul-Mutalib, 2015). Food-borne diseases and death might have occurred due to a lack of adequate food hygiene (Abdul-Mutalib, 2015). More than 50 per cent of food poisoning episodes in Malaysia are caused by insanitary food handling procedures (Sharifa Ezat, Netty & Sangaran, 2013). Abdul-Mutalib et al. (2015) noted that Malaysia is one of the countries with a high rate of foodborne disease occurrences. Food hygiene plays a pivotal role in ensuring the safety and quality of food during its preparation, handling, storage, and processing. Inadequate hygiene practices can lead to food contamination, which in turn contributes to the spread of foodborne diseases and food poisoning (Abdul-Mutalib, 2015). In Malaysia, foodborne illnesses remain a persistent public health issue, with more than 50 per cent of reported food poisoning episodes attributed to unsanitary food handling practices (Ezat et al., 2013). Abdul-Mutalib et al. (2015) further emphasised that Malaysia is among the countries with a high rate of foodborne disease occurrences.

These findings underscore a critical need for comprehensive research into the underlying causes of foodborne diseases within the Malaysian context, particularly in Betong, Sarawak. Despite existing guidelines and regulatory frameworks, the recurring incidence of food poisoning points to a gap between policy and practice, as well as a potential lack of awareness or training among food handlers. This study is driven by the urgency to address these issues through a systematic exploration of food safety practices, risk factors, and the effectiveness of current preventive measures in both formal and informal food sectors.

By investigating the behavioral, environmental, and regulatory dimensions of food hygiene in Malaysia, specifically in Betong, Sarawak, this research aims to contribute to the development of targeted interventions, public health strategies, and evidence-based policy recommendations. Ultimately, the study seeks to strengthen food safety systems and reduce the burden of foodborne illnesses, aligning with broader national and global health priorities.

An increase in food poisoning cases can be linked to food handlers overlooking the significance of proper food safety measures and appropriate food preparation techniques in the kitchen (Abdul-Mutalib et al., 2015). Similarly, a study in New Zealand identified unsafe food handling practices as a key factor contributing to foodborne diseases. As a result, it is essential to explore the underlying reasons behind these poor practices (Al-Sakkaf, 2013). Recent studies have increasingly linked the rise in food poisoning cases to the neglect of fundamental food safety practices by food handlers. Abdul-Mutalib et al. (2015) observed that food handlers in Malaysia often overlook the importance of proper food preparation and hygiene, directly contributing to foodborne illnesses. Similar trends have been reported in international contexts; for example, Al-Sakkaf (2013) identified unsafe food handling behaviours as a key driver of foodborne disease in New Zealand. These findings suggest that food safety failures are not solely due to infrastructural or regulatory limitations. However, they are also deeply rooted in human behaviour, workplace culture, and possibly gaps in training and awareness.

This highlighted the need for an in-depth exploration of the psychological, educational, and organizational factors influencing food handlers' practices. This investigation is uniquely positioned to address these gaps by employing comprehensive, multidisciplinary research approaches, ranging from qualitative interviews to behavioural assessments and policy analysis. Such a study would contribute critical insights toward developing targeted interventions, enhancing food safety education, and reducing the incidence of foodborne diseases in Malaysia and beyond.

Despite inspections of school premises and training provided to school food handlers on safe food practices, incidents of food poisoning persist (New, Ubong &

Premarathne, 2017). A significant number of these cases have been linked to inadequate food safety measures and poor hygiene, with most outbreaks occurring in school canteens, hostel kitchens, and market stalls (Mohd Yusof et al., 2018). Other factors may be food prepared too early, incorrect food handling methods, food kept at the ambient temperature until served, and unhygienic practices (Ezat et al., 2013). Although various preventive measures have been implemented, including routine inspections and training for food handlers, food poisoning remains a recurring issue in schools (New, Ubong & Premarathne, 2017). The continued prevalence of these incidents suggests that existing interventions may be insufficient or inadequately enforced. Mohd Yusof et al. (2018) emphasize that the root causes often lie in inadequate food safety practices and poor hygiene standards, particularly in school canteens, hostel kitchens, and nearby food stalls. Furthermore, Ezat et al., (2013) highlight several operational weaknesses, such as premature food preparation, incorrect handling techniques, and failure to maintain appropriate food temperatures.

These findings underscore the need for a more comprehensive understanding of the factors influencing food safety compliance in school settings. While current research identifies the "what" of the problem, less is known about the "why", why food handlers continue to exhibit poor practices despite training, and why inspection protocols fail to curb recurring outbreaks. This knowledge gap provides a critical opportunity for further exploration.

Kennedy et al. (2005) found that domestic food handlers generally lack sufficient knowledge and demonstrate poor practices when it comes to food preparation and handling. According to Griffith et al. (2010), many people believe in the "hygiene hypothesis," which suggests that a small amount of exposure to dirt is beneficial. However, food handlers often fail to apply established food safety procedures during food preparation. Shakeel and Amal (2011) emphasized that having access to a clean water supply is one of the most critical factors in preventing food poisoning. The recurring issues identified in previous research point to persistent and multifaceted challenges in food safety. Kennedy et al. (2005) highlight a fundamental deficiency in food safety knowledge and poor food handling practices among domestic food handlers, suggesting a gap between awareness and application. Griffith et al. (2010) add a behavioural and cultural dimension, revealing that beliefs like the "hygiene hypothesis" may influence individuals to underestimate the importance of hygiene, despite the availability of guidelines. This indicates that attitudes and cultural norms can override formal training and regulations.

In parallel, Shakeel and Amal (2011) draw attention to the role of environmental infrastructure, particularly access to clean water, in maintaining safe food practices. Their findings underline that food safety cannot be ensured by knowledge and training alone; it also depends on the availability of basic resources and supportive infrastructure.

These converging issues, insufficient knowledge, cultural misconceptions, and environmental limitations create a critical gap in existing food safety research. Most prior studies treat these issues in isolation. However, a more holistic understanding is needed to explore how these factors interact in real-world food handling environments, particularly in high-risk settings such as schools, where vulnerable populations are affected.

The methods of food preparation and hygiene practices among Malaysia’s various ethnic groups are closely linked to their unique socio-cultural backgrounds, dietary habits, and culinary traditions (Ezat et al., 2013). However, there is limited information available on how sociocultural factors influence food safety behaviours within the population (Ehiri & Morris, 2013). It is essential to consider the community's food-related beliefs and practices when addressing food safety (Ehiri & Morris, 2013). Such insights are crucial for crafting effective disease prevention messages that can lead to behavioural change (Ehiri & Morris, 2013). Therefore, incorporating sociological or anthropological perspectives into future food safety training is necessary, as these approaches help identify the underlying cultural influences affecting food safety practices (Ehiri & Morris, 2013). The findings of Ezat et al (2013) and Ehiri & Morris (2013) point to an important but underexplored dimension of food safety: the influence of socio-cultural factors on food handling practices. In the Malaysian context, characterized by ethnic and cultural diversity, food preparation and hygiene are closely tied to cultural identity, traditions, and beliefs. However, existing food safety policies and training often adopt a universal or technical approach, overlooking the nuances of local practices and values.

Ehiri & Morris (2013) emphasize that to achieve meaningful behavioural change, public health strategies must be culturally sensitive and community-specific. This means moving beyond simple knowledge dissemination to understanding how people perceive food risk, how traditions shape food handling, and why certain unsafe behaviours persist despite training.

This gap in the literature and practice provide a compelling rationale for this study to explores how sociocultural beliefs and traditions influence food safety behaviours, particularly in school or community food settings, to investigates the effectiveness of current food safety training programs in multicultural context like Malaysia, to identifies cultural barriers to safe food handling across different ethnic groups and to develops a culturally-informed framework or a set of recommendations for improving food safety interventions and education.

It is against this background that the study investigates these issues, with the aim of narrowing the knowledge gaps and adding new insights.

1.3 Problem Statement

In 2018, a total of 13,686 food poisoning cases were reported in Malaysia, corresponding to an incidence rate of 42.25 per 100,000 people (Health Informatics Centre, Ministry of Health Malaysia) (Table 1.1). Sarawak reported a total of 1,089 food poisoning cases, resulting in an incidence rate of 39.04. The cases were notably more common in Betong, Sarawak, where Malay students experienced a higher incidence of food poisoning compared to their Iban counterparts (Table 1.2). According to data from the Betong District Health Office (2019), Malay students under the age of 18 accounted for 113 of the 183 reported cases in 2017 and 137 of the 148 cases in 2018 (Pejabat Kesihatan Daerah Betong, 2019).

There has been a recent increase in the number of food poisoning cases (Figure 1.1). In 2010, there were 3,822 reported cases of food poisoning, which rose to 3,959 in 2011 and 4,305 in 2012. The numbers continued to increase with 5,017 cases in 2013 and 5,265 in 2014. The peak occurred in 2015, with 8,000 cases reported. School students are particularly susceptible to food poisoning due to consuming contaminated food from school canteens.

The data outlined above have prompted the researcher to investigate the food preparation process and the practices of food handlers. Furthermore, this study seeks to assess the knowledge, attitudes, and behaviours regarding food hygiene among both food handlers and students. A key focus of the research is the physical cleanliness of kitchens and canteens, while also considering the sociocultural factors that influence hygiene practices. These aspects are investigated with the goal of preventing future occurrences of food poisoning.

Table 1.1: Food poisoning cases reported in all states in Malaysia in 2018

State	**Food Poisoning**	
	No. of Cases	**Incidence Rate**
Perlis	466	181.75
Kedah	810	37.24
Pulau Pinang	872	49.92
Perak	715	28.06
Selangor	2107	32.92
Kuala Lumpur	403	20.63
Labuan	105	106.06
Negeri Sembilan	1059	93.79
Melaka	897	97.34
Johor	1572	41.69
Pahang	508	30.25
Terengganu	578	47.32
Kelantan	768	41.57
Sabah	1737	45.07
Sarawak	1089	39.04
Malaysia	13686	42.25

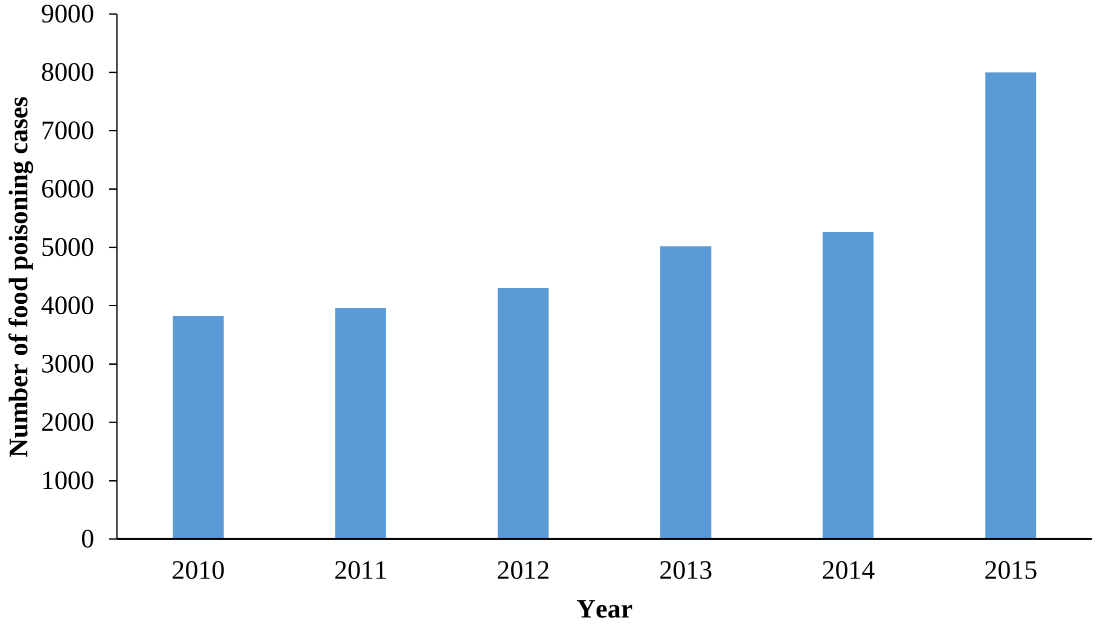
Source: Health Informatics Centre, Ministry of Health Malaysia 2018

Table 1.2: Number of food poisoning cases reported in Betong District, Sarawak from 2014 to 2018

Years	**Number of food poisoning cases reported**	**Age range under 18**	**Age Range above 18**	**Malay**	**Iban**	**Chinese**	**Other races**	**Male**	**Female**

2014	23	16	7	16	7	0	0	10	13
2015	89	76	13	61	28	0	0	50	39
2016	28	25	3	21	5	2	0	23	5
2017	183	146	37	113	69	0	1	74	109
2018	148	104	44	137	11	0	0	75	73

Source: Jabatan Kesihatan Daerah Betong, 2019



Source: Ministry of Health Malaysia (2016)

Figure 1.1: Number of food poisoning incidences reported in schools in Betong Sarawak, Malaysia from 2010 to 2015

The data outlined above inspired the researcher to examine the food preparation process and the practices of food handlers. In addition, the study seeks to assess the knowledge, attitudes, and behaviours related to food hygiene among both food handlers and students. One of the primary areas of concern is the physical cleanliness of kitchens and canteens. The study also considers the sociocultural factors that influence hygiene practices, aiming to support the prevention of food poisoning in the future.

1.4 Research Questions

Considering the background and the problem statements, the research questions for this study are:

i. What are the food preparation processes used by canteen food handlers in rural schools in Betong, Sarawak?
ii. How is the level of knowledge, attitudes and behaviours of canteen food handlers and students of Betong schools influence their daily food hygiene practices?
iii. What is the level of physical cleanliness of school kitchen, canteens and water supplies in rural schools Betong, Sarawak?
iv. How can guidelines be developed to reduce the incidence of food poisioning among food handlers and students in rural schools in Betong, Sarawak?

1.5 Research Objectives

The study objectives are:

i. To investigate the food preparation processes used by canteen food handlers in rural schools in Betong, Sarawak.

ii. To determine the level of knowledge, attitudes and behaviours regarding food hygiene among food handlers and students in rural schools in Betong, Sarawak.

iii. To assess the physical cleanliness of school kitchens, canteens and water supplies in the light of best practices.

iv. To develop guidelines for food handlers and students to reduce the incidence of food poisoning.

1.6 Operational Definitions of Primary Concepts

To ensure conceptual clarity and consistency, key variables examined in this study are operationally defined as follows. This includes concepts of foodborne diseases, food hygiene, lifestyle, and the KAP model.

Foodborne diseases refer to illnesses caused by the consumption of food contaminated with harmful microorganisms or toxic substances. In this study, they are measured using indicators such as incidence rates, reported symptoms, complaint rates and documented outbreak records.

Food hygiene refers to the conditions and practices required to ensure food safety throughout the processes of handling, preparation, and storage. It is operationalized through three core aspects: personal hygiene of food handlers, cleanliness of food preparation environments, and sanitation of equipment and utensils. Meanwhile, lifestyle is conceptualized as a set of behaviours, attitudes, and social norms that shape individuals' health related practices, including that linked to food hygiene.

The Knowledge, Attitudes and Practices (KAP) model is employed to assess food hygiene behavior. Knowledge (K) denotes the level of understanding of food safety principles and is measured using structured questionnaires. Attitude (A) refers to individuals' belief and perceptions towards food hygiene, assessed using Likert-scale technique. Practices (P) represent actual hygiene-related behaviours, such as handwashing and safe food handling, and that are measured through self-reported responses or observations.

1.7 Significance of the Study

This study is significant on multiple levels: practical, theoretical, and policy-related. At its core, the study seeks to address the persistent issue of food poisoning among school children by developing a set of culturally-informed and evidence-based food safety guidelines. These guidelines are intended to support various stakeholders, including education departments, school principals, canteen food handlers, teachers, and students, in ensuring safer food environments within schools.

Practically, the findings will serve to educate food handlers on hygienic food preparation methods, improve food storage and handling practices, and raise awareness of risk factors that contribute to foodborne illnesses. The study will also contribute to enhancing knowledge, attitudes, and behaviours related to food hygiene, not only among food handlers but also among students, who can be empowered as change agents within their school communities.

Importantly, the guidelines produced through this research can be institutionalized to enforce environmental cleanliness standards across school canteens. Education departments, particularly the Sarawak State Education Department and other regional authorities, can utilize the guidelines as a framework for training programs targeting school food handlers and food vendors. This has the potential to reduce the frequency of foodborne illness outbreaks and improve overall public health outcomes among school-aged children.

From a theoretical standpoint, the study addresses a major gap in current food safety research by incorporating sociological and anthropological perspectives. Food safety is often approached from a technical or biomedical angle; however, this research acknowledges that food practices are deeply embedded within cultural traditions, beliefs, and social norms. By investigating how these sociocultural dimensions influence food safety behaviours, the study contributes to a more holistic understanding of health behaviour in diverse community settings.

Moreover, the research provides valuable insights into how sociocultural factors contribute to the persistence of food poisoning cases, despite existing regulations and training. It highlights the limitations of "one-size-fits-all" interventions and underscores the need for culturally contextualized strategies in public health communication and policy enforcement.

Ultimately, this PhD study will offer actionable recommendations to policymakers, health educators, and school administrators. It will support the development of inclusive, culturally relevant, and sustainable food safety strategies that recognise the complexity of behavioural change. In doing so, the study not only contributes to academic knowledge but also has the potential to create long-term, positive health impacts for children and communities across Malaysia and beyond.

Guidelines aimed at preventing food poisoning among school children will be developed for use by education departments, school principals, canteen food handlers, teachers, and students. The findings of this study can help educate food handlers on safer and more hygienic food preparation methods, while also enhancing the knowledge, attitudes, and behaviours related to food hygiene among both food handlers and school students.

The guidelines can be used to enforce environmental cleanliness in all school canteens, and the Sarawak State Education Department and other departments can use them to train food handlers and food vendors. Last but not least, the findings of this research will provide information on how sociocultural aspects relate to the prevalence of food poisoning cases.

By integrating sociological and anthropological perspectives into food safety research, this PhD study will fill a critical gap by helping policymakers, educators, and health officials design more inclusive, relevant, and effective food safety strategies. It moves the field forward by showing that behavioural change requires cultural understanding, not just technical instruction.

1.8 Chapter Overview

The thesis comprises eight chapters. The first chapter introduces the research topic, outlines the aim, objectives and significance of the study. It provides a background to the research problem, states the research questions, and the scope of the study. The chapter concludes by outlining the structure of the thesis and its organization.

This is followed by Chapter 2, which presents a comprehensive review of existing literature relevant to the research topic. It includes discussion on the key concepts and past studies on food hygiene and preparation. This chapter also identifies gaps in the current body of knowledge and explains how this research can help to address those gaps.

Chapter 3 outlines the research design and methodology used in carrying out this study. It described in greater detail the research approach, sampling methods, data collection methods and data analysis. It also describes the ethical considerations and limitations of this research.

Meanwhile, Chapter 4 describes the demographic and population profiles of the sampled populations. This is followed by Chapter 5, which interprets and analyses the findings in the context of the study. It focuses on discussions on the knowledge, attitudes and practices of food hygiene among food handlers. Meanwhile, Chapter 6 discusses the knowledge, attitudes and practices of food hygiene among students in the case study area.

This is followed by Chapter 7 that focuses on discussing the physical cleanliness of school canteens and water supplies issues. The final chapter, Chapter 8, is the conclusion. This chapter summarises the key findings of the study and reflects on the research objectives.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to provide a review of related literature and studies that the researcher has perused to shed light on the topic under study. It covers the operational concepts used in the study, issues related to food preparation processes and hygiene, the Hygiene Knowledge, Attitudes and Behaviours (KAPs) in food preparation practices, issues on physical cleanliness, food hygiene, clean water, sanitation and environment. This chapter also covers the theoretical framework, including the Sustainable Livelihood Framework, the Theory of Access, and the concept of a resilient community.

This chapter presents an in-depth discussion on the operationalization of food hygiene concepts in the context of food safety and public health. It examines various dimensions of food hygiene, particularly within domestic and small-scale food preparation settings, as well as broader environmental and infrastructural factors influencing hygiene practices. The following sections outline key concepts such as food preparation processes, hygiene knowledge, attitudes and practices (KAPs), physical cleanliness, water and sanitation, and food poisoning prevention strategies. Furthermore, this chapter also explores issues related to accessibility to health facilities, clean water supplies, and sustainable livelihoods, which are crucial determinants of food hygiene compliance.

2.2 Operationalization Concepts

Foodborne diseases are typically measured using the incidence rate per 100,000 people (Disease Control Division MOH, 2018). According to the World Health

Organization (2004), the burden of disease refers to the impact of health problems as measured by mortality and the loss of healthy life due to diseases, injuries, and risk factors across different regions globally. This burden is calculated based on the years of life lost due to premature death and the years lived with a disability caused by the illness. One way to measure foodborne diseases is by tracking the number of related complaints received. The complaint rate per 100,000 people within a specific area can also serve as a useful indicator (Council to Improve Foodborne Outbreak Response, 2014). Foodborne disease is defined as an illness caused by harmful agents that enter the body through the consumption of contaminated food. These agents may include infectious organisms or toxic chemicals (Baraki et al., 2005).

Lifestyle encompasses a combination of behaviours, routines, attitudes, values, and norms that individuals adopt to gain benefits or advantages within a social setting. It can also serve as a reflection of social attitudes and the prevailing ideologies within a particular social environment (Dima-Cozma, 2014). In terms of the health indicators, the conceptual framework, and health status measurements. For instance, well-being, health behaviours, social and community factors, environmental factors and socio-economic factors. Health system performance measurement may be acceptability, efficiency and accessibility (International Standard Organization, 2003).

The World Health Organization (2006) defines food hygiene as the conditions and measures necessary to ensure the safety of food from production through to consumption. This includes all practices involved in handling, preparing, and storing food in ways that prevent contamination by harmful microorganisms. Food hygiene is essential for reducing the risk of foodborne diseases and is recognized as a foundational element of food safety

(Soon et al., 2012). In research and public health assessments, food hygiene is typically operationalized using a set of measurable indicators. These indicators are used to evaluate the hygiene practices of food handlers and the cleanliness of food environments. The three key dimensions for operationalization include: personal hygiene of food handlers, cleanliness of food preparation areas, and sanitation of equipment and utensils.

Personal hygiene is a critical factor in preventing contamination during food preparation. Indicators used to assess this dimension include Handwashing practices, with the frequency of handwashing before and after food handling being a primary indicator. Clayton et al. (2002) found that inadequate hand hygiene among food handlers significantly contributes to microbial contamination. Use of personal protective equipment (PPE), consistent use of gloves, hairnets, and aprons is associated with better hygiene outcomes (Soon et al., 2012). Observations can assess whether these items are used correctly and consistently. The health status of food handlers who work while ill or with open wounds poses a significant risk to food safety. WHO (2006) recommends that food handlers be excluded from work when symptomatic with gastrointestinal illnesses or skin infections.

The physical environment of food preparation plays a substantial role in maintaining hygiene. Key indicators include: Cleaning schedules and records, the presence of structured and documented cleaning routines is an indicator of good hygiene management (Ehiri & Morris, 1996). Absence of pests and insects is crucial because pests are common vectors of foodborne pathogens. Their presence signals poor sanitation. Regular pest control is recommended as a standard food hygiene measure (Food and Agriculture Organization [FAO] & World Health Organization [WHO], 2009). Waste disposal practices: Proper waste management, including the use of covered bins and regular waste removal, reduces contamination risks (Al-Shabib et al., 2016).

Regular cleaning and disinfection of equipment and utensils are essential to avoid cross-contamination. Operational indicators include: Cleaning frequency, the frequency with which food contact surfaces (e.g., cutting boards, knives, cooking utensils) are cleaned, is a standard hygiene metric (Sprenger, 2003). The use of sanitisers and disinfectants, and the correct use of food-safe cleaning agents, is critical. Bas et al. (2006) emphasize that training on chemical usage can significantly improve sanitation outcomes.

The prevention of foodborne diseases largely depends on the behaviour of food handlers and their compliance with food safety protocols. The Knowledge, Attitudes, and Practices (KAP) model is a widely adopted framework that facilitates the evaluation of individuals' understanding, beliefs, and behaviours regarding health-related topics, including food safety and hygiene (Launiala, 2009). In the context of food hygiene, the KAP framework is instrumental in identifying gaps between what food handlers know, how they perceive food safety, and how they act upon that knowledge in practice (Sharif & Al-Malki, 2010). This section provides the conceptual and operational definitions of each component in the KAP model, emphasising their relevance to food safety and hygiene.

Knowledge refers to the awareness and understanding of food safety and hygiene principles, including proper food handling, storage conditions, temperature control, and the transmission of foodborne pathogens (Al-Shabib et al., 2016). Food safety knowledge is assessed using structured questionnaires consisting of true/false or multiple-choice questions. Items typically address topics such as: safe refrigeration temperatures (below 5°C), the bacterial danger zone (5°C–60°C), personal hygiene practices (e.g., handwashing frequency), the risk of cross-contamination, and recognition of foodborne illness symptoms. Each correct response is assigned a point, with total scores indicating the overall knowledge level of respondents (Bas et al., 2006).

Attitude refers to the personal beliefs, values, and feelings that influence food handlers' willingness to adhere to hygiene protocols. These attitudes are shaped by perceived benefits and risks associated with food safety behaviours (Soon et al., 2012). Attitudes are measured using Likert-scale items (e.g., 1 = strongly disagree to 5 = strongly agree) that assess respondents' agreement with various statements about food safety, such as: "Maintaining food hygiene is essential for consumer safety.", "Using gloves and aprons can reduce contamination.", "I feel confident in my food safety skills.", "Cross-contamination is a serious concern in food handling." Total attitude scores are calculated by summing responses across items, with higher scores indicating more positive attitudes. Internal consistency of the scale is tested using Cronbach's alpha (Sharif & Al-Malki, 2010).

Practices refer to the actual behaviours or actions that food handlers perform when preparing, cooking, storing, and serving food. This includes compliance with hygiene protocols, use of protective equipment, and food safety procedures (Clayton et al., 2002). Food hygiene practices can be assessed via self-reported surveys or structured observational checklists. Measurable behaviours include: frequency of handwashing before and after handling food, use of personal protective equipment (PPE) such as gloves, aprons, and hairnets, cleaning and sanitising of utensils and food preparation surfaces, proper disposal of food waste and separation of raw and cooked food. Respondents rate the frequency of these actions (e.g., always, often, sometimes, never), and scores are computed to reflect adherence levels (Bas et al., 2006).

Food poisoning, also known as foodborne illness, is a health condition caused by consuming contaminated food or beverages. Contamination may result from pathogens such as bacteria (e.g., *Salmonella*, *E. coli*, *Listeria*), viruses (e.g., norovirus), parasites, or harmful chemicals (World Health Organization [WHO], 2022). Common symptoms include nausea, vomiting, diarrhea, abdominal pain, and fever. Food poisoning can range in severity from mild gastrointestinal distress to severe illness, hospitalisation, or even death, particularly among vulnerable populations such as children, the elderly, and immunocompromised individuals (Centres for Disease Control and Prevention [CDC], 2021).

In empirical research, food poisoning can be operationalised in several measurable ways: Reported Incidence of Symptoms: Participants may be asked to self-report symptoms (e.g., vomiting, diarrhoea, fever) occurring within a specific time frame after consuming food from a particular source (Bas et al., 2006). Clinical Diagnosis or Laboratory Confirmation: For more rigorous studies, laboratory tests confirming the presence of foodborne pathogens in stool samples or contaminated food can serve as direct indicators of food poisoning (CDC, 2021). Number of Reported Outbreaks: Secondary data, such as public health surveillance reports or food safety inspection databases, can provide outbreak statistics and trends over time (WHO, 2022).

Food poisoning prevention refers to a set of practices and conditions that reduce the risk of contamination and proliferation of foodborne pathogens. These include personal hygiene of food handlers, proper food storage and cooking temperatures, sanitation of equipment and surfaces, and safe food handling practices during preparation and service (Sharif & Al-Malki, 2010). Prevention strategies are based on the Hazard Analysis and Critical Control Points (HACCP) system and other food safety management standards (Soon et al., 2012). Preventive measures can be implemented at all stages of the food supply chain, from production and processing to preparation and consumption. Food poisoning prevention is operationalized using the following measurable indicators: Personal Hygiene Practices: frequency of handwashing before and after food handling, use of personal protective equipment (e.g., gloves, hairnets, aprons). Food Preparation and Storage: Cooking food to recommended internal temperatures, Storing perishable items below 5°C, Separating raw and cooked foods. Environmental Sanitation: Regular cleaning of kitchen equipment and surfaces, Absence of pests and vermin, Proper waste disposal systems, Training and Certification: food handlers' participation in certified food safety courses, display of valid food handling permits.

These variables can be measured using self-administered questionnaires, structured observational checklists, or institutional records. Data can be analysed to determine the relationship between preventive practices and the incidence of food poisoning in various settings (Bas et al., 2006; Soon et al., 2012).

The new concept invented by the researcher was food hygiene behavioural insights. The concept "Food Hygiene Behavioural Insights" refers to a novel approach introduced by the researcher to better understand and influence human behaviour about food hygiene practices. Food Hygiene Behavioural Insights is an interdisciplinary concept that combines principles from behavioural science, psychology, public health, and food safety to investigate how and why individuals (e.g., food handlers, consumers, vendors) behave in certain ways regarding food hygiene and how to use this understanding to improve hygiene practices effectively. Food hygiene behavioural insights focus on the underlying motivations, beliefs, habits, cultural norms, and environmental factors that drive individuals' food hygiene actions. For example, a food handler might skip washing hands due to time pressure, lack of facilities, or cultural perceptions.

In addition, the cognitive biases that examine mental shortcuts people use when making hygiene-related decisions (e.g., assuming food is safe if it smells fine). Looks at biases like optimism bias ("It will not happen to me") or social proof ("Others don't use gloves, so I don't need to"). Behavioural Interventions uses insights to design nudges, reminders, incentives, or changes in the environment that can encourage better food hygiene behaviour. For instance, placing visual cues near sinks to remind staff to wash their hands or changing kitchen layouts to reduce cross-contamination.

Traditional food hygiene education focuses on knowledge and compliance (e.g., food safety rules and guidelines). Food Hygiene Behavioural Insights concept goes beyond this by looking at real-world human behaviour and how it can be influenced more effectively through practical, context-sensitive strategies. It shifts the focus from "what people should do" to "what people actually do" and why studying how social roles (e.g., elders vs. younger food handlers) affect compliance with hygiene rules. Using behavioural nudges (e.g., posters showing clean practices) in hawker stalls to subtly encourage hygienic behaviour without enforcement.

2.3 Food Preparation Processes and Hygiene

According to Collins (1997), the increase in foodborne diseases is influenced by shifts in demographics and changes in consumer lifestyles, which impact how food is prepared and stored. Lifestyle factors affecting food-related behaviour include limited time for cooking and preparing meals too far in advance. Many reported cases of foodborne illness have been linked to incorrect storage temperatures and poor personal hygiene among food handlers. The primary sources of contamination include improper handling and inadequate refrigeration of food. Common contributing factors are cross-contamination between raw and cooked foods, the use of unclean utensils and plates, poor hygiene practices by food handlers, and improper management of food temperature and timing. Failing to wash hands before, during, and after food preparation also plays a significant role in food contamination (Collins, 1997). Additionally, Venter (2000) highlights that the absence of proper food preparation facilities contributes to the occurrence of foodborne diseases. Similarly, Collins (1997) and Venter (2000) strongly agreed that proper food preparation by the food handlers to prevent food cross-contamination led to food poisoning among students in rural schools.

Ehiri and Morris (2013) highlighted that information on sociocultural factors influencing food safety is often underutilised, emphasising the importance of considering a population's food-related habits and beliefs. This type of information is essential for effective disease control and can lead to changes in human behaviour. They advocate for incorporating anthropological and sociological approaches into future training programs. A sociological perspective is necessary to understand how various factors within a community affect food safety. Since safe food handling is closely linked to kitchen culture, food safety guidelines and practices should be developed with a deeper awareness of the cultural beliefs, practices, and values that shape food behaviours (Ehiri & Morris, 2013). It is apparent that there is a gap in knowledge of the sociocultural aspects of food poisoning prevention. These sociocultural aspects might include the Malay food handlers' cultural values, beliefs and practices regarding food preparation. The researcher found through reading that training does not take into consideration the cultural values in food handling of the food handlers. My research will address some of the gaps by creating new knowledge contributions and meeting my research objectives.

Ehiri & Morris (2013) consider that data obtained through sociological methods on cultural values in food preparation would probably be of better practical value for food safety training for food handlers. Through the end of this research, the researcher will create a framework which covers the cultural values and changes in behaviour in the food safety evaluation and guidelines in order to prevent food poisoning among vulnerable ethnic and school children.

The majority of food poisoning cases result from poor food handling, inadequate cleanliness during food preparation, and improper hygiene practices. Therefore, it is crucial to place significant emphasis on educating people about food safety and promoting positive attitudes towards hygiene and safe food handling (Soon, 2011).

Improper food handling practices were responsible for over 50% of reported food poisoning cases (Abdul-Mutalib et al., 2015). Contamination occurs when meat comes into contact with animal skin, fur, or intestines during food preparation in the kitchen, often due to mishandling, as food handlers overlook the proper procedures for preparing food (Abdul-Mutalib et al., 2015). Maintaining high kitchen hygiene is crucial for preventing food poisoning outbreaks, as well as ensuring the absence of unhygienic cooking utensils and kitchen counters (Abdul-Mutalib et al., 2015). Lack of awareness of the dangers of storing food at the wrong temperature in refrigerators could lead to food-borne disease (Johnson, Donkin, Morgan, et al., 1998). Most reported cases of food-borne disease are due to improper storage, inadequate cooking and cross-contamination (Kennedy et al., 2005). Another factor is that consumers prefer to buy cheap food, often without considering whether it is hygienic and safe to eat (Abdul-Mutalib et al., 2015).

Soon (2011) and Abdul-Mutalib et al. (2015) argued that proper food handling processes and high levels of hygiene practices are crucial to prevent food poisoning cases. However, Johnson, Donkin, Morgan, et al (1998) argued that the lack of awareness of the dangers of storing food at the wrong temperature in a refrigerator was the cause of food contamination. On the other hand, Kennedy et al (2005) stated that improper storage and inadequate cooking methods could be the cause of food-borne diseases.

Furthermore, this finding supports the idea that effective temperature control is essential to maintaining food freshness, and food stored at improper temperatures may become contaminated (Sharif, Obaidat & Al-Dalalah, 2013; Abdul-Mutalib et al., 2015). According to Abdul-Mutalib et al. (2015), prolonged exposure to incorrect temperatures can promote bacterial growth.

The study highlighted that improper food storage was a leading cause of foodborne illnesses, especially when food was not stored at the correct temperature (Aspian et al., 2024). Many cases of food poisoning have been linked to improper reheating and storage of leftover or unsold food**.** The research found that many consumers and food vendors lack awareness of the correct refrigeration temperatures required to prevent bacterial growth**.** Refrigeration slows bacterial growth but does not eliminate all risks, especially if the food was stored for too long or not reheated properly before resale (Aspian et al., 2024). Strict guidelines and monitoring systems were required to ensure that food stored for resale remains safe for consumption**.** Training programs for food handlers can help improve knowledge about proper food storage practices, including time limits for refrigerated food (Aspian et al., 2024).

In addition, in terms of temperature control of food. The research found that improper temperature control for food storage contributed to food contamination (Sharif, Obaidat & Al-Dalalah, 2013; Abdul-Mutalib et al., 2015). Abdul-Mutalip et al. (2015) also agreed that food storage at incorrect temperatures will lead to bacterial growth because of high temperatures. A similar finding by Aspian et al. (2024) argued that improper food storage, where the foods were stored at the wrong temperature, contributed to food poisoning. Besides, the scholar also argued that many food handlers ignored the correct refrigeration temperature to prevent bacterial growth (Aspian et al., 2024).

The findings are consistent with Abdul-Mutalib et al. (2015), who highlighted that contamination can occur when meat comes into contact with animal skin, fur, or intestines during food preparation due to improper handling, as food handlers neglect the correct food preparation methods. Nur Izyan et al. (2019) found that the majority of respondents (88.3%) ensured raw and cooked foods were kept separate to prevent cross-contamination. It is essential to separate raw and cooked foods, for example, by using different cutting boards for meats and vegetables (Dora-Liyana et al., 2018). Additionally, one-third (33.3%) of food handlers were unaware that using the same utensils for both raw and cooked foods could lead to foodborne illnesses (FDs) (Errico et al., 2022).

These findings are consistent with Abdul-Mutalib et al. (2015), who stated that contamination occurs when meat comes into contact with animal skin, fur, or intestines during food preparation due to mishandling, as food handlers neglect proper food preparation procedures. According to Nur Izyan et al. (2019), the majority of respondents

(88.3%) ensured that raw and cooked foods were kept separate to prevent cross-contamination. It is essential to keep raw and cooked foods apart, such as by using different cutting boards for meat and vegetables (Dora-Liyana et al., 2018).

Moreover, other studies found that food handlers with higher knowledge of food safety were significantly more likely to follow proper storage practices (Kwol et al., 2019). Kitchen hygiene practices, including separating raw and cooked foods, were linked to lower contamination rates and improved food safety. The study found a direct relationship between food safety knowledge and hygienic practices in food storage and preparation (Kwol et al., 2019). Food handlers with positive attitudes towards food safety were more likely to implement proper storage techniques, including keeping raw and cooked foods separated (Kwol et al., 2019).

Studies in Ghana have shown that separating uncooked and prepared meals before storage prevents contamination**.** There were 87.2% of food handlers agreed that storing raw and cooked foods separately stops infection, demonstrating a strong understanding of the risks of cross-contamination (Tuglo et al., 2021). Food safety knowledge was significantly associated with good hygiene practices**.** Food handlers who received food safety training were six times more likely to practice proper hygiene, including separating raw and cooked foods**.** 88.2% of respondents practised separating raw and cooked food before storage, showing a positive trend in compliance with food safety guidelines (Tuglo et al., 2021). Case studies in Iraq revealed that only 56.15% of food handlers consistently separated raw and cooked foods before storage, highlighting a gap between knowledge and practice. Despite this, 76.7% of food handlers agreed that separating raw and cooked foods is the best way to prevent the spread of germs (Kanaan et al., 2023). Additionally, 33.85% of food handlers were knowledgeable about proper refrigeration methods, indicating that the majority lacked awareness of correct food storage practices. Furthermore, 12.31% of participants were unaware that using the same knife for cutting both vegetables and meat increases the risk of foodborne illnesses, suggesting a potential for cross-contamination. About 57.15% of participants demonstrated low to intermediate competence in food safety procedures, such as preventing cross-contamination and ensuring proper food storage. The study concluded that education and training programs are essential to improving knowledge and compliance with food safety standards (Kanaan et al., 2023).

In terms of raw and cooked foods, Nur Izyan et al. (2019) urged the majority of the food handlers to ensure raw and cooked foods are separated to prevent cross-contamination. Similarly, Dora-Liyana et al. (2018) stated that using different chopping boards between meats and vegetables was the best way to cope with food contamination during food preparation. In contrast, Errico et al. (2022) argued that one-third (33.3%) of food handlers were unaware that using the same utensils for both raw and cooked foods could lead to foodborne illnesses (FDs). On the other hand, food handlers with positive attitudes towards food safety were more likely to implement proper storage techniques, including keeping raw and cooked foods separated (Kwol et al., 2019), therefore to reduce the prevalence of food poisoning among school students.

Tuglo et al. (2021) found there were 87.2% of Ghana food handlers agreed that storing raw and cooked foods separately stops infection, demonstrating a strong understanding of the risks of cross-contamination. Moreover, food handlers who received food safety training were six times more likely to practice proper hygiene, including separating raw and cooked foods. There were 88.2% of respondents practised separating raw and cooked food before storage, showing a positive trend in compliance with food safety guidelines. Kanaan et al. (2023) highlighted case studies in Iraq revealed that only 56.15% of food handlers consistently separated raw and cooked foods before storage, highlighting a gap between knowledge and practice among food handlers and students on food safety.

Despite the extensive research on food-borne diseases and food poisoning in schools, few studies have explored sociocultural factors that lead to food-borne diseases and the knowledge, attitude and behavioural (KAPs) factors among food handlers and students, particularly in Betong rural schools. Therefore, there was a need to establish the sociocultural and knowledge, attitude and behavioural (KAPs) data to reduce the prevalence of food-borne diseases in rural schools of Sarawak.

2.4 Hygiene Knowledge, Attitudes and Behaviours (KAPs) in Food Preparation Practices

Dietary practices, such as consuming raw or unsafe foods due to cultural rituals and beliefs, contribute to foodborne diseases (Venter, 2000). Research shows that food handlers often lack knowledge about proper food storage temperatures, preparation methods, and acceptable ways to thaw frozen foods. Effective temperature control is essential to maintain food freshness, as food stored at incorrect temperatures is vulnerable to contamination (Sharif, Obaidat & Al-Dalalah, 2013). To prevent bacterial growth, food should be kept between 2°C and 4°C.

Research has indicated that food poisoning incidents are more common in schools, primarily due to the limited time available for preparing large quantities of meals in a traditional kitchen. As a result, food handlers often prepare meals early in the morning or even the day before, which may increase the likelihood of bacterial growth in the food, ultimately leading to food poisoning (Dora-Liyana et al., 2018).

The majority of food poisoning cases were due to improper management of time and temperature, i.e., preparing food too early, improper thawing methods, improper food holding temperatures and malfunction of refrigeration equipment. The study by Dora-Liyana et al. (2018) revealed that basic food handling practices were lacking in schools, particularly in the routines of food handlers. These handlers exhibited poor personal hygiene, such as failing to keep their fingernails short or cover their hair with a cap, both essential practices for preventing cross-contamination. They also demonstrated inadequate handwashing habits, frequently failing to use antibacterial soap, and lacked knowledge of proper handwashing techniques. Additionally, food handlers distributed food without wearing gloves or masks and were observed talking while handling food (Dora-Liyana et al., 2018).

Food handlers were found to be unaware of proper equipment hygiene and reused dish towels to wipe plates, which is prohibited due to the risk of cross-contamination (Dora-Liyana et al., 2018). It is important to keep raw and cooked foods separate, such as by using different chopping boards for cutting meats and vegetables (Dora-Liyana et al., 2018).

Cowan (2019) observed that food handlers often neglected personal hygiene, while Sharifa Ezat, Netty, and Sangaran (2013) highlighted a general lack of education regarding basic hygienic food preparation practices. These findings may be influenced by genetic or sociocultural differences among ethnic groups, particularly in their dietary habits and cooking methods. For instance, Sharifa Ezat, Netty, and Sangaran (2013) noted that the

Hmong community in China has limited awareness of foodborne illnesses, and their cultural practices often involve inadequate food storage and preparation, increasing the likelihood of food poisoning. In contrast, the Chinese community records the lowest incidence of acute diarrhoea among various ethnic groups, likely because their food is typically cooked at high temperatures and served immediately, minimising the risk of contamination (Sharifa Ezat, Netty & Sangaran, 2013). Food handlers have poor knowledge of and practices regarding food handling (Kennedy et al., 2005).

In terms of knowledge, attitude and practice (KAPs) aspects among the food handlers and students. According to Dora-Liyana et al. (2018), food poisoning commonly happens in schools because the food handlers have to prepare a large amount of food in a short time period in a small kitchen, and the canteen food handlers tend to prepare food one day before, thus it will contribute to bacterial growth in the food. On the other hand, Cowan (2019) observed that food handlers often neglected personal hygiene, which might lead to food poisoning during food preparation processes. Whereas Sharifa Ezat, Netty, and Sangaran (2013) highlighted a general lack of education regarding basic hygienic food preparation practices. These findings may be influenced by genetic or sociocultural differences among ethnic groups, particularly in their dietary habits and cooking methods.

The practice, which did not emphasise personal hygiene and insufficient use of sanitisers, is a major cause of the increasing burden of infectious diseases in developing countries (Alyssa Vivas, 2011). A positive attitude about hand washing helps prevent the occurrence of food poisoning among students. In addition, poor hand hygiene among food handlers and schoolchildren has been identified as a concern (Kar et al., 2018). Other contributing factors to food poisoning outbreaks in schools include cross-contamination linked to water storage tanks, consumption of undercooked food, and the use of untreated water (Jeffree & Mihat, 2016). All school children are vulnerable to food poisoning, as they also have poor knowledge of food safety. It has been demonstrated that even though students with better knowledge have better hygiene practices, they are still reported to practise high-risk behaviour in food choices (Garayoa et al., 2005). In general, school children often lack adequate knowledge about proper hand hygiene. Data from Thailand's Global Student-based Health Survey revealed that 15.7% of Thai students seldom wash their hands before meals (World Health Organization, 2017). Similarly, research conducted among students in Seoul and Ulsan found that 67% of participants were unaware of the correct handwashing technique (Yoon & Yoon, 2007).

Regarding food safety practices, students generally demonstrated a positive habit of reading labels when purchasing packaged foods. However, it was still very common for them to buy food from small restaurants and street vendors, even though 95.3% expressed concerns about the safety of food prepared by these sources. The study also found that students who were more concerned about food safety were less likely to make such purchases (Cheng et al., 2017). This finding aligns with previous research indicating that students generally practice good food safety habits, such as reading labels when purchasing packaged food (Cheng et al., 2007).

A study conducted among food handlers at University Putra Malaysia revealed that they had moderate knowledge of temperature control, cross-contamination, food poisoning, and personal hygiene. In the assessment of knowledge on temperature control, most participants were aware that food should be cooked to a minimum temperature, but not all food handlers knew the correct temperature danger zone. Only 73% of them used thermometers to check the temperature of cooked food, while the others believed that the presence of bubbles indicated the food had reached its boiling point and was safe to eat (Nor-Khaizura et al., 2015).

Similar results were reported by Webb and Morancie (2015) and Faour-Klingbeil et al. (2015), where most respondents demonstrated limited knowledge about food temperature requirements. Additionally, having proper sewage systems and maintaining a well-organised canteen, free from congestion of food items and cooking utensils, are crucial factors. These elements help prevent an increase in kitchen temperatures, which can encourage bacterial growth. Proper upkeep of sewage and ventilation systems is vital, as neglect in these areas can create favourable conditions for harmful bacteria to thrive (Nordin et al., 2016). Studies have shown temperature as a primary factor in microbial growth; the study confirmed that temperature is a crucial factor affecting bacterial growth in food environments (De Silvestri et al., 2018). It directly influences the growth rate of bacteria such as *Aeromonas hydrophila*, *Listeria monocytogenes*, and *Yersinia enterocolitica*. Nonetheless, the study highlighted that foodborne outbreaks in canteens and catering services have been linked with improper temperature control (De Silvestri et al., 2018).

Jalani et al. (2021) said common issues included touching food with bare hands, refreezing defrosted foods, not separating raw and cooked food, and smoking in food preparation areas, which led to food poisoning in school canteens. Their bad attitude led to increased risks of food contamination and foodborne illnesses. Moreover, the study found that many food handlers failed to comply with hygiene regulations, such as not wearing aprons, having long hair, and improper handwashing (Jalani et al., 2021). The negligent attitude of the food handlers was identified as a major factor in foodborne illnesses (Jalani et al., 2021). Knowledge of the use of gloves is excellent, but in practice, food handlers rarely use them. This needs important attention for consumers, because the hands will come into contact with food, and various other activities will have an impact on cross-contamination. In addition to gloves, the use of masks and aprons is seen as uncommon by most food handlers. The majority of respondents believe that the weather conditions at the point of sale, particularly the heat, make their hands and faces sweat easily, causing discomfort for the food handlers.

Zaujan et al. (2021) found that 93% of consumers smell their food before eating to prevent consuming spoiled food. This shows that smelling food before eating was a widespread practice among consumers in the study area. 92% of respondents identified physical changes in food as a sign of spoilage, and 93% agreed that a foul smell was an indicator of spoiled food. Last but not least, 94% recognised a change in taste as a sign of food spoilage (Zaujan et al., 2021). Studies found in Brazil argued that many food handlers demonstrated gaps in their knowledge regarding food safety (Vitória et al., 2021). A significant percentage lacked awareness that food contamination can occur without noticeable spoilage. Only 25% of participants believed that spoiled food always has a bad smell and taste, indicating that most food handlers understand that contaminated food may not show obvious signs of spoilage (Vitória et al., 2021). The study warns against relying on sensory perception alone since many foodborne pathogens do not affect the taste, smell, or appearance of food (Vitória et al., 2021).

Studies found dented cans can compromise food safety by allowing bacteria to enter through damaged seals (Aspian et al., 2024). Many consumers lacked awareness of food safety risks related to dented**,** bulging, or damaged cans**.** Proper food safety education is needed to ensure consumers make informed purchasing decisions (Aspian et al., 2024). The study highlighted that food poisoning is a major concern, causing thousands of deaths annually. Consumers' knowledge, attitude, and practices (KAP) play a critical role in preventing foodborne illnesses (Mamot et al., 2022). The majority of respondents acknowledged the importance of inspecting food before purchase, supporting the idea that dented cans should be avoided to prevent contamination (Mamot et al., 2022). Many consumers check for food spoilage by smelling, observing, and checking physical changes before buying food (Mamot et al., 2022). Other studies found that only 15.1% of food handlers and 90.5% of dietetic students disagreed that drinking milk from a dented can is safe. This indicates that many food handlers do not recognise the risks associated with dented cans, while students trained in food safety are more aware (Mohd Yusof et al., 2018). The study highlights that poor food safety knowledge and attitude contribute to foodborne illnesses. Dented cans can lead to contamination by bacteria such as Clostridium botulinum, which causes botulism, a potentially fatal illness. 67.9% of food handlers and 81.1% of dietetic students always check expiry dates before buying food, showingg that proper food inspection was an essential practice (Mohd Yusof et al., 2018).

Studies found that storing food items near chemicals increases the risk of contamination, leading to potential health hazards. Consumers often lack knowledge about proper storage separation between food and hazardous substances**,** which can lead to poisoning incidents (Saadat et al., 2024). Unsafe food storage behaviours, including placing food near chemicals, were common in households lacking food safety education. Proper food storage is essential for maintaining food safety and hygiene (Saadat et al., 2024). The study found that many household consumers do not follow recommended food storage guidelines, increasing their vulnerability to contamination (Saadat et al., 2024). The study emphasizes that education on food safety can significantly improve knowledge and practices regarding food storage. Government regulations and consumer awareness programs should reinforce the importance of keeping food separate from hazardous substances like pesticides and cleaning agents (Saadat et al., 2024).

Studies in Ghana highlighted that inadequate knowledge and poor hygiene practices among food handlers contributed to food contamination. Specifically, improper cleaning of cooking utensils was identified as a significant factor in the spread of foodborne diseases (Tuglo et al., 2021). In addition, other studies in Iraq found that only 35.38% of food handlers had knowledge about the correct ways to clean and use cooking utensils (Kanaan et al., 2023). 83.85% of food handlers agreed that utensils used for food preparation can spread infections, indicating that improper cleaning leads to contamination (Kanaan et al., 2023). Food handlers' poor knowledge and practices were linked to an increased risk of foodborne diseases (FBDs). The study emphasized that proper utensil cleaning reduces the spread of foodborne pathogens, improving food safety (Kanaan et al., 2023). Whereas studies found in Negeri Sembilan, Malaysia, said 82.8% of chopping boards, 9.7% of knives, and 73.9% of dish plates were contaminated with *Staphylococcus aureus*, *Escherichia coli*, and total coliform. Poor hygiene practices among food handlers contributed to bacterial contamination (Saipullizan et al., 2018). 80.5% of food handlers had sufficient knowledge, but gaps in practice still led to contamination. Logistic regression analysis revealed that insufficient knowledge was linked to the presence of E. coli on dish plates and total coliform on knives, underscoring the importance of hygiene knowledge. The study highlighted the necessity for continuous training programs to enhance food handlers' knowledge, attitude, and practices (KAPs) related to utensil hygiene. Proper cleaning and sanitising of utensils were identified as essential measures for ensuring food safety (Saipullizan et al., 2018).

However, many food handlers lack awareness about the dangers of dented cans, suggesting the need for more training in food safety. The study found a significant association between knowledge and practice (p = 0.017) among food handlers, meaning those with better knowledge were more likely to follow safe food practices (Mohd Yusof et al., 2018). This supports the idea that educating consumers about the risks of dented canned food can lead to better purchasing decisions (Mohd Yusof et al., 2018).

The study found that good preventive practices—including handwashing with soap before eating help prevent foodborne illnesses (Mshelia et al., 2022). Many students reported that they "always wash their hands until they are clean before eating" (79.7%) (Mshelia et al., 2022). Students with an acceptable attitude toward food safety were more likely to practice proper hygiene, including handwashing. The study found a significant association between attitude and preventive practice (p = 0.004), indicating that students who understood the risks of food poisoning were more likely to follow hygiene practices (Mshelia et al., 2022). The study found that 95% of students practised hand hygiene before preparing food. However, only 52.5% of students washed their hands for at least 20 seconds**,** which is the recommended duration (Smigic et al., 2021). The study highlighted a lack of awareness among students regarding the risks of contaminated food. Only 12.5% of students knew that food contaminated with bacteria cannot be identified through sight, smell, or taste**,** showing a significant gap in food safety knowledge (Smigic et al., 2021).

Another study revealed that 76.3% of students recognised the importance of food labelling, and 83.7% regularly checked expiration dates before buying food products (Riaz et al., 2022). A significant number of students (21.7%) reported consuming expired food due to a lack of awareness or because it was available at a lower price. 94.9% of students checked expiry dates because they knew expired food could harm their health**.** However, 55.1% of students were willing to buy food items without labels, indicating a need for more education (Riaz et al., 2022). The study did not directly address attitudes toward separating raw and cooked foods, but it did show that students had generally positive attitudes toward food safety practices, such as avoiding expired foods and being cautious about food additives. This suggests that with proper education, students can develop positive attitudes toward practices like separating raw and cooked foods (Kuo & Weng, 2021). The study further revealed that students who had received food safety education were more inclined to read food labels and inspect packaging for damage, both of which are important practices that support overall food safety (Kuo & Weng, 2021).

Among the four reviewed articles on students' knowledge, attitudes, and practices (KAPs) regarding food safety, three studies reported that students demonstrated a good level of knowledge on food poisoning prevention (Aimi et al., 2018; Ali, William, Prajapati et al., 2018; Mahmood et al., 2018). In contrast, a study by Syahira et al. (2019) conducted in Selangor among form four students (4) found that most participants had insufficient knowledge of food safety. Additionally, a separate review by Ruby et al. (2019b), which focused on consumers in Sibu, Sarawak, Malaysia, indicated that the respondents generally had a good level of food safety knowledge.

According to Cheng et al. (2017), secondary school students in Beijing generally demonstrated a good level of food safety knowledge, with nearly half of them classified as having a high level of understanding. However, students in other Chinese cities, particularly second-tier ones, exhibited comparatively lower levels of food safety knowledge. This trend aligns with the study's analysis of influencing factors, as Beijing, being the capital and one of China's most developed regions, is expected to have better educational outcomes.

In contrast, Syahira et al. (2009) found that the majority of 610 Form Four students in Hulu Langat, Selangor, had inadequate knowledge of food safety. Similarly, case studies conducted in Canada among high school students from four Ontario colleges revealed generally low levels of food safety knowledge. Majowicz et al. (2015) also highlighted this issue, reporting poor understanding of food safety among students. A study by Tutu, Hushie, Asante, and Egyakwa-Amusah (2020) in Ga West, Ghana, which involved upper primary and junior high school students, also identified poor food safety knowledge and attitudes. Majowicz et al. (2017) echoed these findings, again reporting low food safety awareness among high school students in Ontario, Canada.

The findings aligned with the observation that children were involved in food preparation despite having limited experience. There was a noticeable lack of knowledge about the importance of proper temperature control to ensure food safety from microbes. The study took place in 26 primary schools in the Ljubljana district and nearby areas in Slovenia (Ovca, Jevšnik, and Raspor, 2014). Moghaddam, Hassanzadazar, Vakili, Jafari, and Aminzare (2020) reported that high school students in Khorramdarreh, Zanjan, Iran, demonstrated limited understanding of how temperature affects food, with only 35% showing adequate knowledge in this area. The research investigated the growth rates of *Listeria monocytogenes*, *Salmonella*, *Escherichia coli*, *Clostridium perfringens*, and *Bacillus cereus* under different temperature conditions. Higher temperatures accelerated bacterial multiplication, with an optimal growth range of 20°C to 45°C depending on the bacterial species (Membré et al., 2005). The study highlights the importance of temperature control in food handling areas to minimise bacterial contamination risks. Keeping kitchen environments below 20°C significantly slows bacterial reproduction**,** reducing foodborne illness risks (Membré et al., 2005) . The study found that improper temperature management in food preparation and storage is one of the leading causes of foodborne illnesses. Pathogenic bacteria, including E. coli and B. cereus, showed significant growth when food was stored at unsafe temperatures (Ricci et al., 2020). The study suggests that improper temperature management can contribute to bacterial proliferation**,** especially in food storage and preparation areas. Keeping food below 4°C significantly slows bacterial reproduction, reducing the risk of foodborne illnesses (De Silvestri et al., 2018).

The finding was supported by knowledge that utensils not washed with dishwashing soap can cause food pollution. According to Mohd Rizal (2010), kitchen utensils should be washed with clean water, soap, and appropriate washing materials, and then stored in a clean place to prevent contamination when they are next used. Based on Bill 35 1 (f), all utensils and containers that have been used for food raw deposits must be cleaned and in a sanitary state before such utensils and containers are used for pre-cooked food (Food Acts, 2009). The findings showed that the students have a good attitude towards washing kitchen utensils after use to prevent food contamination. The study emphasises that cross-contamination was a major cause of foodborne illnesses, particularly when utensils are not properly washed. *Salmonella* can survive on kitchen surfaces, utensils, and cutting boards for several hours**,** leading to contamination of food prepared afterwards (Carrasco et al., 2012). The study identifies poor sanitation practices as a key contributor to *Salmonella* contamination in food preparation areas. Inadequate washing of utensils, cutting boards, and knives without soap increases the risk of transferring bacteria to food (Carrasco et al., 2012). The research found that *Salmonella* and other pathogens can form biofilms on kitchen utensils, making them harder to remove if not washed with soap and disinfectants. Even thorough rinsing with water alone was not enough to eliminate bacteria from contaminated utensils. Using hot water and soap for washing kitchen utensils significantly reduces bacterial contamination (Carrasco et al., 2012). Sponges absorbed water and remained wet for extended periods, creating an ideal environment for bacterial growth. Pathogenic bacteria like *Salmonella* and *Campylobacter* grew rapidly in humid sponges, especially when not cleaned with soap (Ekman et al., 2020).

According to the Food Acts (2009), Bill 35 1(g), separate cutting boards should be used for raw and cooked foods to prevent cross-contamination. This practice is a key aspect that should be emphasized in school health promotion programs. Improper food handling, such as using the same cutting board for both raw and ready-to-eat foods, can significantly increase the risk of cross-contamination (Carrasco et al., 2012). Similar results were found in another study, where cross-contamination during food preparation was linked to the use of unwashed cooking utensils, sharing chopping boards for wet and dry ingredients, and poor maintenance of the school canteen (Osaili, Al-Nabulsi, & Taybeh, 2021). The study revealed that 58.1% of respondents were aware that using the same chopping board for vegetables after cutting raw meat could lead to cross-contamination (Osaili, Al-Nabulsi, & Taybeh, 2021). This indicates that just over half of the students understood the importance of using separate cutting boards for different types of food to avoid cross-contamination. However, the study also pointed out that students generally had limited knowledge about cross-contamination prevention and disinfection practices. This suggests that while some students may be aware of the correct procedures, overall adherence to these practices is likely low (Osaili, Al-Nabulsi, & Taybeh, 2021).

According to the Food Acts (2009), bill 35 1 (a), food should not be placed directly in contact with anything or substance that may contaminate the food. The students demonstrated a sufficient understanding that raw and cooked foods should be kept separate to prevent food contamination. However, the study found that about 20% of school children believed it was incorrect to store and handle raw food separately from cooked food to prevent food poisoning (Kuo & Weng, 2021). This highlights a knowledge gap among some students regarding the importance of separating raw and cooked foods to prevent cross-contamination.

The study also highlighted that Grade 6 students had significantly better knowledge about food safety compared to Grade 5 students, suggesting that food safety education in Grade 6 improved their understanding of practices like separating raw and cooked foods (Kuo & Weng, 2021). While the study did not specifically measure the practice of separating raw and cooked foods, it did find that handwashing before eating significantly improved among Grade 6 students after food safety education. This indicates that students are capable of adopting better food safety practices when educated (Kuo & Weng, 2021).

Generally, knowledge, attitude, and behavioural (KAP) factors among students and food handlers contribute to foodborne diseases. Based on Kuo & Weng's (2021) study, it was found that only 20% students believed it was incorrect to store and handle raw food separately from cooked food to prevent food poisoning. Therefore, there was a knowledge gap among the students on the importance of separating raw and cooked foods to prevent cross-contamination. In addition, Carrasco et al. (2012) argued that improper food handling, such as using the same cutting board for both raw and ready-to-eat foods, can significantly increase the risk of cross-contamination. A similar finding by Osaili, Al-Nabulsi, & Taybeh (2021) argued that cross-contamination during food preparation was linked to the use of unwashed cooking utensils, sharing chopping boards for wet and dry ingredients, and poor maintenance of the school canteen. The study revealed that 58.1% of respondents were aware that using the same chopping board for vegetables after cutting raw meat could lead to cross-contamination. This indicates that only half (50%) of the students have knowledge of the importance of using separate cutting boards for different types of food to avoid cross-contamination. However, the study found that the students have limited knowledge of food cross-contamination prevention. This suggests that while some students may be aware of the correct procedures, overall adherence to these practices is likely still low. In contrast, Cheng et al. (2017) found that in Beijing secondary schools, students generally demonstrated a good level of food safety knowledge, with nearly half of them classified as having a high level of understanding. In addition, Syahira et al. (2009) also found that the majority of 610 form four (4) students in Hulu Langat, Selangor, had inadequate knowledge of food safety. Similarly, case studies conducted in Canada among high school students from four Ontario colleges revealed generally low levels of food safety knowledge. Majowicz et al. (2015) also highlighted this issue, reporting poor understanding of food safety among students. A study by Tutu, Hushie, Asante, and Egyakwa-Amusah (2020) in Ga West, Ghana, which involved upper primary and junior high school students, also identified poor food safety knowledge and attitudes. Majowicz et al. (2017) echoed these findings, again reporting low food safety awareness among high school students in Ontario, Canada.

Although numerous scientific studies have examined the impact of water quality and food quality on food poisoning in schools, no studies were found on how knowledge, attitude, and behavioural factors influence the prevalence of food poisoning in schools at Betong, Sarawak.

2.5 Physical Cleanliness, Food Hygiene, Clean Water, Sanitation and Environment

Access to sufficient water, proper sanitation, and hygiene facilities in schools is essential for preventing diseases. Adams et al. (2009) discovered that disease rates are higher in many rural schools due to limited water availability, poor sanitation, and inadequate hygiene practices, especially the absence of regular handwashing.

The kitchen and its surrounding areas must be maintained in a clean state, free from dirt, flies, and harmful microorganisms. All cooking tools, including plates, cups, and other utensils, should be cleaned appropriately. Waste should be discarded in designated trash bins equipped with lids. Additional considerations include safeguarding the water supply, ensuring the proper disposal of solid waste and human waste, effective drainage of wastewater, limiting animal husbandry near food areas, and maintaining overall environmental cleanliness. An absence of clean water and poor hygiene can result in incidents of food poisoning. Unfortunately, many food handlers tend to overlook the critical role of safe food practices in the kitchen (Abdul-Mutalib et al., 2015).

Based on the Malaysia Food Act 2009, Bill 15 (1), the food premises shall remain in good condition, clean and neat at all times. Schools in urban areas are at a higher risk of food poisoning outbreaks. A study in India found that key factors contributing to food poisoning in schools include poor canteen design, insufficient sanitation facilities, and inadequate hand hygiene practices among both food handlers and students (Kar et al., 2018). All school children are at risk of food poisoning, as many lack adequate knowledge of food safety. Research shows that while students with better food safety knowledge tend to have improved hygiene habits, they still engage in high-risk food behaviours (Garayoa et al., 2005). In general, school children have a limited understanding of proper hand hygiene. For instance, a global health survey of students in Thailand revealed that 15.7% of students rarely wash their hands before meals (World Health Organization, 2017).

Using uncooked water for beverages can lead to waterborne diseases like cholera, typhoid, and dysentery. Proper treatment, for example, boiling, filtering, or using water purification tablets, was essential to make water safe for consumption (Bahagian Keselamatan dan Kualiti Makanan, 2023). Cross-contamination, including issues with water in tanks, undercooked food, and the use of untreated water, is an additional factor contributing to food poisoning outbreaks in schools (Jeffree & Mihat, 2016).

Hand towels accumulate bacteria, especially if they come into contact with body fluids or damp surfaces. Bacteria can thrive in the moist environment of a used towel. It's essential to maintain good hygiene by washing hands and towels regularly. Towels that have absorbed sweat, dirt, or any bodily fluids should be washed after each use (Bahagian Keselamatan dan Kualiti Makanan, 2023).

Over 80% of the respondents opposed using the same towel to clean multiple surfaces and disagreed with the idea of using an apron as a substitute for a towel to wipe hands (Nur Izyan et al., 2019). The findings from Dora-Liyana et al. (2018) also revealed that food handlers lacked knowledge about equipment hygiene and reused dish towels to wipe plates, which is prohibited due to the risk of cross-contamination. Furthermore, another study argued that using the same towel for wiping hands and dishware can spread bacteria, leading to cross-contamination.

This finding is supported by Dora-Liyana et al. (2018) and Abdul-Mutalib et al. (2012), who noted that food handlers exhibited poor personal hygiene, including improper handwashing, and lacked knowledge of the correct procedures for effective handwashing. This suggests that food handlers were unaware of the seven correct steps involved in proper handwashing. According to the Food Safety and Quality Department of the Ministry of Health Malaysia (2022), the 7-step handwashing technique recommended by the Ministry of Health Malaysia (MOH) is crucial to prevent food poisoning. This finding is also supported by Dora-Liyana et al. (2018) and Abdul-Mutalib et al. (2012), who reported that food handlers demonstrated poor personal hygiene, including improper handwashing, and lacked knowledge of the correct steps for effective handwashing. The Centres for Disease Control and Prevention (CDC) also identified cross-contamination between food and equipment as a key factor in outbreaks (de Oliveira et al., 2014). Food contamination from food handlers is related to workers with pathogens in their bodies and improper personal hygiene practices during food preparation. In our study, where the critical control point (CCP) of infected food handlers was suspected to contribute to food poisoning outbreaks, this was confirmed by positive microbiological results showing Staphylococcus aureus on the hands of food handlers. A study conducted in Kelantan found that hands were the primary source of cross-contamination. Food handlers were unaware of their hand movements and may have touched their face, nose, or other parts of their body. The study concluded that cross-contamination among food handlers during food handling processes is always a possibility (Zin et al., 2017). Therefore, hand hygiene is the most controllable factor in preventing food poisoning.

This finding aligns with the report by Well & Morancie (2015), who found that university employees in Trinidad and Tobago were unaware that jewellery should not be worn on the hands or arms while handling food. Bas et al. (2004) also have similar findings that food handlers do not wear jewellery during food preparation processes to prevent food contamination. According to the Food Act 2009, Personal hygiene of food handlers, bill 33 (1) (f), do not wear personal jewellery, clocks, pins or other accessories during food preparation. Moreover, the poor hygiene practices observed among 23% of Ghanaian kitchen staff in schools suggest that they are unlikely to remove their jewellery while preparing and serving food in school canteens (Ababio et al., 2016).

Similar findings were reported by Abdul-Mutalib et al. (2012) and Al-Shabib et al. (2017), where nearly all food handlers acknowledged that hand washing is essential before handling food. Failure to wash hands properly can result in food contamination. A previous study showed that the bacterial count on food handlers' hands surpassed safe threshold levels (Lee et al., 2017), indicating poor hand-washing practices. Collins (1997) also highlighted that not washing hands before, during, and after food preparation contributes to food contamination.

In addition, the study conducted in Indonesia confirmed that the canteen environment significantly affects food safety; poor hygiene and sanitation in canteens led to food contamination. In terms of storage and food handling issues, 60.4% of school canteens had inadequate kitchen facilities, 65.8% of canteens failed to meet hygiene standards for food processing equipment, and 95.1% of canteens lacked proper food display cases, thus increasing contamination risks (Ningsih et al., 2024). Furthermore, case studies found in Kuala Muda, Kedah highlighted 87% of food handlers did not practice good hygiene habits, for instance, hand washing after handling food and wearing proper protective clothing. Data shows that the food poisoning cases in school canteens have been increasing due to poor sanitation practices (Jalani et al., 2021). A study revealed gaps between knowledge and practice, despite food handlers having a high level of knowledge and a positive attitude towards food safety. However, their actual practices were poor, leading to food poisoning. They were aware of food safety rules but did not apply them correctly in daily food preparation (Jalani et al., 2021).

Besides, the study found that unsafe water leads to dehydration and health risks, dehydration can cause fatigue, impaired cognitive function, and physical decline (Mugalavai & Mokeira, 2019)**.** Waterborne diseases, including urinary infections, digestive issues, and chronic illnesses, are linked to unsafe water consumption. Many respondents lacked awareness of the health hazards of consuming untreated or contaminated water. Education on proper hydration and safe water consumption significantly influences positive water intake habits (Mugalavai & Mokeira, 2019). Another study stated drinking contaminated water can cause diarrhoea, dysentery, hepatitis, typhoid fever, and other serious diseases**.** Waterborne infections are one of the most common health risks globally and are responsible for significant mortality rates, especially among children (Swarnalatha, 2022). Unsafe drinking water and poor sanitation are the leading causes of enteric fever and dehydration in children. Each year, 1.5 million children die from diarrhoea, primarily as a result of unsafe water (Swarnalatha, 2022).

A study by Gerba et al. (2014) found that high bacterial contamination in hand towels, there were 89% of the towels contained coliform bacteria, which were indicators of faecal contamination. In addition, 25.6% of towels tested positive for Escherichia coli

(*E.coli*). Therefore, there was a direct relationship between washing frequency and bacterial presence. The towels that were washed more frequently had significantly lower levels of *E.coli* bacteria. Towels that were used repeatedly without washing accumulated high bacterial loads (Gerba et al., 2014). The other study said repeated use of hand towels without regular washing increases bacterial contamination, which was due to damp towels providing a breeding ground for bacteria, making them a source of cross-contamination (Duane et al., 2022). In conclusion, the hand towels should not be reused repeatedly without washing, as they accumulate bacteria and contribute to cross-contamination.

Furthermore, another study argued that using the same towel for wiping hands and dishware can spread bacteria, leading to cross-contamination. The findings showed 76.9% of food handlers acknowledged that dirty dish cloths increase the risk of food contamination (Saipullizan et al., 2018). Study found swabbing tests on kitchen utensils found Staphylococcus aureus (S. aureus), Escherichia coli (E. coli), and total coliform present on knives, chopping boards, and dish plates**.** The contaminated dish plates (69.4%) had S. aureus, indicating that poor hygiene practices contribute to the spread of bacteria through improper cleaning. The logistic regression analysis showed that food handlers with insufficient knowledge were 11.9 times more likely to have E. coli contamination on dish plates. This proved that a lack of awareness about cross-contamination contributes to bacterial presence on utensils and food surfaces (Saipullizan et al., 2018). Other studies found that cloth towels were the most contaminated contact surface, because they frequently transfer bacteria between hands and kitchen surfaces. The towels used to wipe hands after ineffective handwashing became contaminated and were later used to dry dishes and utensils, spreading bacteria (Sneed et al., 2015). The study also found that towels harboured high levels of bacterial contamination, bacteria from raw meat were transferred to towels, which then spread the contamination to hands, dishware, and other surfaces (Sneed et al., 2015). Last but not least, the food handlers frequently reused towels without washing them, increasing cross-contamination risks. Some food handlers used towels for multiple purposes, including wiping hands, drying dishes, and cleaning surfaces, all of which contributed to bacterial spread (Sneed et al., 2015). The study found that students strongly disagreed with the practice of using a single towel for multiple surfaces. Using the same towel to wipe hands, dishes, and other kitchen surfaces increases the risk of bacterial transfer, which can lead to foodborne illnesses (Adling & Malinao, 2022). The study supports the food safety guideline that different towels should be used for drying hands and for drying kitchen utensils and dishware. Proper storage and frequent laundering of towels were also highlighted as necessary preventive measures to avoid microbial contamination (Adling & Malinao, 2022). The study found that students generally demonstrated good food hygiene practices, but they lacked access to proper sanitation tools, such as separate towels for different purposes. Some students used the same towel for multiple tasks due to resource constraints, which posed potential health hazards (Adling & Malinao, 2022).

The finding was in line with the student's knowledge, which was also low, regarding that the towel used to wipe the hands can also be used to wipe the plate. Hand wiping towels and equipment used for food preparation are intermediaries that contribute to food contamination because dirty towels become breeding grounds for bacteria and fungi, which eventually become the cause of food poisoning events. Akabanda (2012) states that wiping towels, hands, and utensils can cause food pollution. These findings suggest that students still do not have precise knowledge of the basic principles of food safety.

Generally, in terms of physical cleanliness, food hygiene, clean water, sanitation, and environment did affect the prevalence of food-borne diseases in rural schools in Betong, Sarawak. Akabanda (2012) argued that wiping towels, hands, and utensils can cause food pollution. These findings suggest that students still do not have precise knowledge of the basic principles of food safety. Nevertheless, Saipullizan (2018) found that 76.9% of food handlers acknowledged that dirty dish cloths increase the risk of food contamination. Besides, food handlers with insufficient knowledge were 11.9 times more likely to have E. coli contamination on dish plates. This proved that a lack of awareness about cross-contamination contributes to bacterial presence on utensils and food surfaces (Saipullizan et al., 2018). In contrast, Sneed et al. (2015) urged that the towels used to wipe hands after ineffective handwashing became contaminated and were later used to dry dishes and utensils, spreading bacteria. The study also found that towels harbored high levels of bacterial contamination, bacteria from raw meat were transferred to towels, which then spread the contamination to hands, dishware, and other surfaces (Sneed et al., 2015).

In terms of hand towels for multiple uses, based on Sneed et al. (2015) findings highlighted that food handlers frequently reused towels without washing them, increasing cross-contamination risks. Some food handlers used towels for multiple purposes, including wiping hands, drying dishes, and cleaning surfaces, all of which contributed to bacterial spread (Sneed et al., 2015). In the same way, Adling & Malinao (2022) study found that students strongly disagreed with the practice of using a single towel for multiple surfaces. Using the same towel to wipe hands, dishes, and other kitchen surfaces increases the risk of bacterial transfer, which can lead to foodborne illnesses. The study found that students generally demonstrated good food hygiene practices, but they lacked access to proper sanitation tools, such as separate towels for different purposes. Some students used the same towel for multiple tasks due to resource constraints, which posed potential health hazards (Adling & Malinao, 2022).

According to Gerba et al. (2014), high bacterial contamination was found in hand towels, with 89% of the towels containing coliform bacteria, which are indicators of faecal contamination. Towels that were used repeatedly without washing accumulated high bacterial loads (Gerba et al., 2014). Correspondingly, the scholar Duane et al. (2022) urged that repeated use of hand towels without regular washing increases bacterial contamination, as damp towels provide a breeding ground for bacteria, making them a source of cross-contamination.

In addition, in terms of hand washing practices. Similar findings were reported by Abdul-Mutalib et al. (2012) and Al-Shabib et al. (2017), where nearly all food handlers acknowledged that hand washing is essential before handling food. Failure to wash hands properly can result in food contamination. A previous study showed that the bacterial count on food handlers' hands surpassed safe threshold levels (Lee et al., 2017), indicating poor hand-washing practices. Collins (1997) also highlighted that not washing hands before, during, and after food preparation contributes to food contamination.

2.6 Food Poisoning Prevention

Food-borne disease is preventable with proper food handling and a focus on good practices and hygiene (Ramful & Menon, 2017). There are five methods for safe food practices. The first one is to wash hands before handling food and always during food preparation. Next, separate raw and cooked foods, for instance, by the use of separate chopping boards and food handling utensils. Ensure food is cooked thoroughly at approximately 70 °C for at least 2 minutes to eliminate harmful microorganisms. Keep food stored in a refrigerator at a safe temperature, around 5 °C. Always use clean water and fresh, uncontaminated ingredients.

Furthermore, food handlers are expected to follow proper hygiene practices, such as maintaining appropriate refrigerator temperatures for food storage and cooling, wearing gloves and masks to ensure personal cleanliness, handling food only when they are in good health, and frequently washing their hands (Ramful & Menon, 2017).

2.7 Accessibility of Health, Facilities, Clean Water Supply, Employment and Education

Rahman (2014) stated that the health impact of water-borne diseases such as diarrhoea, cholera, jaundice and skin-related problems is most commonly seen. Particularly, children and elderly people are most commonly affected by these types of health issues. The lack of accessibility to basic health facilities led to the late treatment for the patients. In addition, he also argued that the difficulty in access to medicine facilities during the flood. The floodwater is contaminated by bacteria and poisonous substances. The contact with water could be harmful for human health, but then they are forced to use the polluted water for daily use due to a lack of safe water. Hence, the lack of access to health facilities led to WBDs.

Oranye, Utharas & Nora (2009) argued that water-borne diseases were caused by the socio-economic status of one community. The findings from the past study stated that the higher the education of the household heads, the prevalence of water-borne diseases would be decreased. By all means, the prevalence of water-borne diseases will reduce with the increased level of education of the community head. So, education is an important aspect for preventing the community from being infected by WBDs.

In addition, Oranye, Utharas & Nora (2009) also mentioned that the types of employment by the community also play an important role in the prevalence of water-borne diseases. For example, farmers and fishermen have a higher tendency to be infected by diseases compared to skilled workers and professionals. The source of water used is also one of the factors that contribute to WBDs. For example, the water from the river and the lake which were contaminated. Moreover, the water from the river and the lake is subject to contamination and is not safe for consumption. This is because the river and lake serve as household chores such as bathing, washing clothes and serve as sources of drinking water. As a result, it will lead to outbreaks of WBDs. Apart from that, there are inadequate health facilities. Furthermore, the widespread poverty in the rural area caused a high risk of WBDs because people could not afford a basic sanitation system. The findings prove that the community who did not have access to clean water has a high risk of WBDs as compared to the people who have access to safe water. Access to a clean water source is crucial for the sustainable livelihood of the community.

According to Patil, Somasundaram, and Goyal (2002), the health policies implemented in India so far have focused solely on economic growth, neglecting equity and equality. Consequently, they have widened the gap between urban and rural health development. Out of 70 per cent of deaths, about 92 per cent of deaths were from communicable diseases, which occurred among the poorest 20 per cent of the population.

Besides, to improve the current situation, the problem of rural health is to be mitigated both at the macro level (national and state) and micro level (district and regional), in a holistic way, with better efforts to bring the poorest of the population to the centre of fiscal policies. A fundamental change in approach from the current “biomedical model” to a “sociocultural model” is needed to meet the needs of the rural population. An intensive review of the National Health Policy addressing the existing inequalities and working towards creating a long-term perspective plan, particularly for rural health, is the current need.

Nicol (2000) said poor health caused by the poor water supply quality, insufficient sanitation and unsafe hygiene behaviour were considered as both a symptom and cause of poverty. In addition, if people do not have adequate and appropriate sanitation facilities and develop good hygiene practices, the diseases can be spread through the contamination of water.

2.8 Sustainable Livelihoods

A livelihood is sustainable, according to Chambers and Conway (1992), when it "can cope with and recover from the stress and shocks, maintain its capability and assets, and provide sustainable livelihood opportunities for the next generation...". Unfortunately, not all households are equal in their ability to cope with stress and repeated shocks. Poor people balance competing needs for asset preservation, income generation and present and future food supplies in complex ways (Maxwell & Smith, 1992).

2.8.1 Community Resilience

Community resilience can be defined as the capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change. Community resilience encompasses the community's adaptation, resistance, and acceptance of stress and shocks in their livelihoods (CARRI, 2013). The Kayan community in Sungai Asap, Belaga, faces issues with the contaminated water supply and the Bakun resettlement scheme. A lot of issues and problems faced by the

Kayan community when they first moved to the Bakun resettlement scheme, for instance, the clean water supply issues, the community's inaccessibility to clean water supply due to contaminated water in the Koyan river. Thus, the lack of a clean water supply led to water-borne diseases among the community. The Kayan community has endured significant challenges and shocks over the past 20 years. A clean water source is crucial to maintain sustainable and healthy livelihoods. The researcher aims to understand how the community has adapted to the current situation and overcome the associated stresses.

2.8.2 Health Lifestyles

According to Patil, Somasundaram, and Goyal (2002), Indian rural people's health practices and health status are attributed to their cultural beliefs and practices. Some of the rural natives still believed that the diseases were caused by taboos and hostile spirits. Thus, they used traditional medicine and spiritual practices to cure diseases and illnesses. As a result, the sociocultural context was important for the prevention of water-borne diseases.

In addition, Patil, Somasundaram & Goyal (2002) also argued that access to healthy and nutritious foods, clean water and healthy lifestyles were important for the prevention of water-borne diseases. The problem among rural people was a lack of health consciousness due to a low educational background. Therefore, high water-borne diseases are particularly prevalent in rural areas. Moreover, the study by Oranye, Utharas, and Nora (2009) also argued that in the context of Nigeria, individuals in the lower social structure tend to experience greater health issues compared to those in a higher social group. Both of these studies agreed that the education level was the determinant that contributed to the water-borne diseases. Oranye, Utharas and Nora (2009) also stated that the types of economic activities, such as farming and labour work by the rural people, are linked with health status. The labourers have a higher tendency to be infected by water-borne diseases as compared with other professions. This is because working in dirty environments, such as factories and agricultural sites, increases the risk of infection with diseases. Besides, the high rate of poverty among the rural poor made them vulnerable to water-borne diseases because they could not afford to buy healthy and nutritious foods and a proper sanitation system. Hence, these situations led to high cases of water-borne diseases.

According to Rahman (2014), the lack of accessibility to basic health facilities led to late treatment for the patients. Oranye, Utharas, and Nora (2009) also mentioned that the source of water used is also one of the important determinants contributing to water-borne diseases. For example, the water from lakes and rivers is subject to contamination. This was because the water from the river and the lake served for household cleaning purposes such as washing, drinking and bathing. Therefore, the water from the river was not safe to drink and tended to be at a higher risk of being infected by water-borne diseases.

Nicol (2000) also agreed that poverty among rural people has a strong relationship to poor water quality, inadequate sanitation, and poor hygiene practices.

2.9 Theory of Access

Access to technology and resources is a barrier to moving people away from the resources (Ribot & Peluso, 2003). Many resources cannot be extracted without equipment and technology. The people benefited from more advanced technology (Ribot & Peluso, 2003). For example, the rich people are more accessible to high-tech medical equipment and facilities as compared to the poor ones. In addition, access to capital is also one of the factors that determines who will benefit from the resources through controlling or maintaining access to them. The capital is generally in the form of finances and equipment.

As such, the rural poor have poor financial capacity and poor access to advanced medical facilities.

Besides, access to markets is also one of the determinants. The benefits gained from the resources depend on whether the owner has access to markets and the right to the resources (Ribot & Peluso, 2003). For example, the native or the rural poor have less access to health care facilities and thus deteriorate their health status. In other words, the rural poor lack access to labour and labour opportunities. The poor group has no right to bargain for employment chances and wages. Thus, only the rich people and big corporations are manipulating the poor.

Lack of access to knowledge by the rural poor (Ribot & Peluso, 2003). The education levels of the poor were very low, with a high rate of illiteracy among the rural poor due to various reasons. Low literacy leads the poor to a limitation in accessing technology and the market. For instance, the poor are unconscious about health care due to a lack of knowledge in health education. Access to authority also plays an important role in the community (Ribot & Peluso, 2003). The authority includes the government and private organisations. Those with the necessary funds or capital have the privilege of securing the project or obtaining the necessary funds. Whereas, the poor could not access authority because they lacked money.

Last but not least, access through social identity. Those who have the power or higher social status in the community or society have higher chances to access resources such as projects or contracts (Ribot & Peluso, 2003). Nevertheless, the rural poor have no access to resources because they have low social identity or status in society.

2.9.1 Health Accessibility Five Dimensions of Access

There are five dimensions of access, such as availability, accessibility, affordability, adequacy, and acceptability (Brigit, Nelly, & Christian, 2007). The availability of medicine and drugs in the health service is crucial for the patients. In addition, accessibility refers to the time and distance people need to travel between the villages and the healthcare centre (Brigit, Nelly, & Christian, 2007). The public transport, such as cars, buses and motorcycles, is the main access barrier. Besides, the affordability of health consultations and drug fees is also a concern. Not only that, the people also need to pay for the transport fee, petrol fee and sundry expenses for the trip (Brigit, Nelly, & Christian, 2007). Last but not least, the adequacy and acceptability in terms of people's judgment of the quality of service are also crucial for them. Five dimensions in access are availability, accessibility, affordability, adequacy, and acceptability. The availability of health care services, such as clinics and facilities, is crucial for the community, enabling them to access these facilities for disease prevention and treatment. For example, machinery, drugs, and medicine, as well as the availability of experts, such as doctors and specialists. In addition, the clinic is conveniently located in the area. In the case of Sungai Asap, the clinic is located in the centre of Sungai Asap's small town. The clinic can be accessible through a tar-sealed road. The current Sungai Asap clinic needs to be upgraded due to high patient demand. Some chronic diabetes and kidney failure patients have to travel for hours to Bintulu Hospital to get treatment. Moreover, in terms of affordability, the cost incurred by the patients to pay for the consultation fee and medicine fee. In addition, the transportation cost has to be incurred by the villagers if they travel from a far distance. In terms of the adequacy and acceptability of the medical consultation received by the patients.

2.9.2 Five Capitals in Sustainable Livelihood Assets and the Vulnerability Context

Human Capital consists of local knowledge, education, and skills (Brigit, Nelly, & Christian, 2007). Social capital is social networks and affiliations, natural capital such as land, water and livestock. Physical capital is infrastructure, equipment, means of transport and financial capital, for example, cash and credit. The land is the natural capital of the indigenous people, and it is the backbone of their livelihood. Earning cash from crops and farming activities constitutes financial capital (Brigit, Nelly, & Christian, 2007). The moral support from the family is their social capital in their livelihood. The road infrastructure and public transport are their physical capital that the government should provide. The medical officer and expert offer treatment to the people is human capital (Brigit, Nelly, & Christian, 2007). There are five (5) important capitals in sustainable livelihood, such as human capital, financial capital, physical capital, social capital and natural capital.

In the case of the Kayan community in Sungai Asap, their human capital is their education, skills and local knowledge. Their skills in cultivation activities such as paddy, pepper and rubber planting. They also possessed local knowledge, such as the making of traditional medicine from plants and the knowledge of making tobacco from dry banana leaves. In terms of financial capital, the cash held in their hand and the loan from the bank. The physical capital includes infrastructure such as roads, transport, and clinics. Besides, the social capital for the Kayan community is family bonding, church and social networking among the community. Last but not least, natural capital for the Kayan community is the land and crops. The land and crops are their livelihoods. The local Kayan people are heavily dependent on their land and crop cultivation.

2.9.3 Challenges Faced by the Community and Factors Affecting Water Borne Diseases (WBDs) on Housing and Basic Amenities

As the majority of the Orang Asli settlements are located in remote and rural areas, it is a challenging task to provide basic amenities such as piped water supply, electricity, toilet facilities and garbage disposal service to all these settlements (Geok & Zalilah, 2008). Only 12% of the housing units, mainly in the urban areas, are provided with garbage disposal service, while a majority, about 81% still use traditional disposal methods such as ground disposal and open burning (Geok & Zalilah, 2008).

Although there is an overall improvement in toilet facilities in the last decade, 36% of the housing units still do not have a proper toilet facility (Geok & Zalilah, 2008).

As we all know, physical infrastructures such as housing and basic amenities (proper toilet, water and electricity supplies and good roads) are crucial for the local Kayan community. All the physical infrastructures must be fulfilled in order to live a decent life for the Kayan community in Sungai Asap. Without proper basic infrastructures, the livelihood of the community will be affected, leading to diseases such as water-borne diseases in this study. The main causes of water-borne diseases are consuming dirty or contaminated water from the tap or the river. In addition, improper sanitation disposal and system also led to the water-borne diseases in the community. Therefore, physical determinants are significant for a decent life among the Kayan community.

2.9.4 Health Awareness, Water, Sanitation and Hygiene and Indigenous populations

There is no universal specification of dirt itself; rather, what are considered dirty are things out of place in that society’s classification system. Therefore, dirt is considered as “disorder” and exists only “in the eye of the beholder”. These values are crucial for how sanitation can be organised in society (Alejandro, Moa, & Marianne, 2014).

Studies on sanitation with special reference to indigenous culture are scarce. There was very little research regarding the connection between indigenous traditional beliefs and hygiene practices or household health care (Alejandro, Moa, & Marianne, 2014).

In the health literature, there were few studies that analysed the fact that certain diseases among the indigenous populations indicate their relationship with poor conditions of access to water and sanitation, and with poor hygiene conditions in households. It is worth noting that improvement of housing infrastructure is not sufficient to promise more hygienic living environments for the indigenous populations (Alejandro, Moa, & Marianne, 2014). Nevertheless, indigenous people’s hygiene practices are not consistently rated as poor. It is recorded that traditional hygiene habits in their native context were more efficient than those practised by teachers coming from outside to live in the indigenous villages (Alejandro, Moa, & Marianne, 2014).

Indigenous people face huge disparities in terms of access to and quality of education and health (United Nations, 2015). In Guatemala, for example, 53.5% of indigenous young people aged 15-19 have not completed primary education, as compared to 32.2% of non-indigenous youth. In Bolivia, the infant mortality rate among the indigenous population is close to 75/1000, as compared to 50/1000 for the non-indigenous population (United Nations, 2015).

2.9.5 Water & Health: The Poverty Connection

Poor health and illness are dreaded by almost everyone. Needy people often rely on their daily earnings and lack the cash reserves needed to cover a sudden illness. The loss of income and the inability to pay for the cost of treatment can push a family further into poverty and debt, thereby perpetuating the cycle of poverty (World Health Organisation, n.d.).

Poor communities are often forced to overexploit their natural resources in order to survive. Water sources are particularly vulnerable. In too many cases, they are abused to such an extent that they can no longer provide for a community's basic needs and end up posing serious health risks. However, opportunities for reversing this situation exist. What is required is that priority is given to water management and development, and that communities play a significant role in solving their problem. This will entail the full involvement of communities in the planning and development of their water systems (World Health Organisation, n.d.).

Actually, poverty among the Kayan community is caused by poor health and a lack of access to clean water. A clean water source is tremendously important to everyone's life, including the Kayan community in Sungai Asap. This is due to the fact that without a clean water supply for daily consumption and activities, the community will suffer from poor health conditions, such as the prevalence of water-borne diseases. As a result, the Kayan community has to pay more extra costs in health care, which has led to further poverty among the community. Most of the income earned from employment ends up paying for medical fees. Therefore, the community has no extra money to pay for daily necessities. Furthermore, purchasing a water filter machine and mineral water from the shop will place a financial burden on the community. The water filter machine cost a few thousand dollars for a machine, and not all people can afford to purchase one. Purchasing mineral water from the shop is a high cost in the long run.

2.10 Theories of Knowledge: Sociocultural Model in context

Figure 2.1: Theories of Knowledge: Sociocultural Model in context

The social-cultural model, the health status and infectious diseases among the rural community are related to their cultural beliefs, health lifestyles, habits, types of employment, educational levels, and religion. These social determinants are crucial for the state of health among rural people.

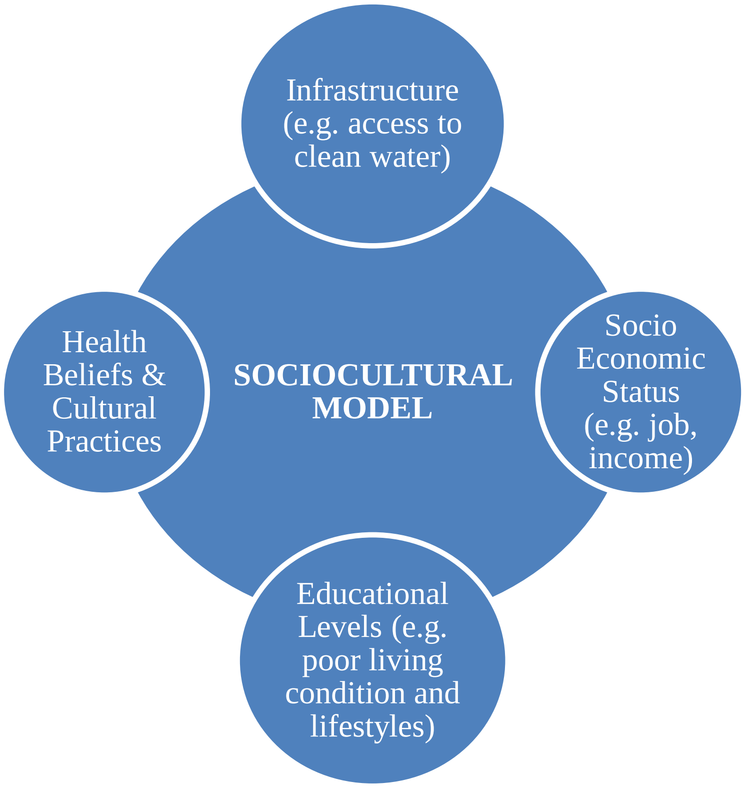


Figure 2.2: Sociocultural Model

Health and diseases are multi-factorial and defined by a person or group interacting with the whole environment. There are multiple simultaneous pathways that converge and interact to determine health outcomes (Armenakis & Kiefer, 2007).

Socio-cultural model seeks to learn how people understand their health situations. Meeting people within their cultural framework is more likely to be accepted by them, which increases chances of making an impact (Armenakis & Kiefer, 2007).

According to naturalism, the social-cultural model, the health status and infectious diseases among the rural community are related to their cultural beliefs, health lifestyles, habits, types of employment, educational levels, and religion. These social determinants are crucial for the state of health among rural people. For example, the water-borne diseases among the Kayan community in Sungai Asap.

The global burden of foodborne illnesses (Soon, 2011). Foodborne outbreak requires a multi-disciplinary approach for investigation. Most of the food poisoning cases were due to unhygienic food handling and lack of cleanliness in food preparation (Soon, 2011)—insanitary food handling procedures. The people have poor hygienic practices (Soon, 2011). Training and education are needed for food poisoning prevention (Soon, 2011). The knowledge and attitude towards food hygiene and safety are strongly emphasised (Soon, 2011).

Food poisoning cases have been linked with socioeconomic factors such as poverty, race, residence area and marital status (Song, 2009). Nevertheless, most of the investigations focused on mortality or incidence rate of the outcome, rather than on severity-based incidence related to socioeconomic status (SES) (Song, 2009). The socioeconomic factors could affect the overall incidence of poisoning. The mortality can also be sensitive to socioeconomic status (Song, 2009).

The fact that education level is an important socioeconomic status parameter when studying poisoning is acknowledged, but they lacked the information to adjust for these effects (Sockett, 1993). Morbidity linked with food-borne illness is an increasing issue. The socioeconomic burden of these diseases may be higher than previously thought (Sockett, 1993). To the long-term aspect of the education in hygiene of those engaged in the handling, storage, preparation and cooking of food (Cowan, 2019). Poor hygiene conditions are often due to a lack of attention to strict personal hygiene. The practice of a high standard of personal hygiene in food preparation. The education of the workers in the food industry (Cowan, 2019).

Education is one of the factors that could affect the occurrence of food-borne diseases, where a lack of education in the basic rules for hygienic food preparation (Sharifa Ezat, Netty, & Sangaran, 2013). Similar racial or cultural group differences in rates of acute diarrhoea (Sharifa Ezat, Netty, & Sangaran, 2013). Even though the reasons for such differences are not clear, the findings could be associated with genetic or socio-cultural differences between the ethnic groups, hence related to dietary and culinary practices (Sharifa Ezat, Netty, & Sangaran, 2013).

In other words, economic status and infrastructure (Sharifa Ezat, Netty, & Sangaran, 2013). A foodborne disease outbreak in Malaysia was due to an insanitary food handling procedure, which had more than 50 per cent of food poisoning episodes (Sharifa Ezat, Netty, & Sangaran, 2013). Unhygienic practices also contribute to outbreaks of food-borne diseases (Sharifa Ezat, Netty, & Sangaran, 2013). Poor knowledge and practices among food handlers (Kennedy et al., 2005). There have been few investigations that have examined consumer food safety knowledge and practices. To identify gaps in food safety knowledge among consumers and the hygiene errors (Kennedy et al., 2005). The findings found that adequate and appropriate food safety education can deliver significant reductions in the burden of foodborne illness among consumers (Kennedy et al., 2005).

Although low socioeconomic status SES is generally related to negative health outcomes (Newman et al., 2015), but then, its impact on food-borne illness is poorly understood (Newman et al., 2015). However, the relationship between SES and food-borne illness is less well understood (Newman et al., 2015). A better understanding of the relationship between SES and foodborne illness is important for efficient public health policy and intervention targeting (Newman et al., 2015). The knowledge, attitude and practices are the main determinants in reducing the incidence of food-borne diseases (Zyoud et al., 2019).

Poor hygienic practices, along with knowledge, attitude, and practices, are key factors in food-borne disease reduction (Zyoud et al., 2019). Access to a safe water supply is one of the most crucial determinants of health and socioeconomic development (Shakeel & Amal, 2011). Malaysia is one of the countries that has high cases of foodborne diseases. However, the immune systems and gut microbial communities depend on the human diet, which is indirectly influenced by socioeconomic status, culture, population growth and agriculture (Abdul-Mutalib et al., 2015). The main factor for foodborne illness in Malaysia is insanitary food handling procedures, which contribute to 50 per cent of the cases (Abdul-Mutalib et al., 2015).

2.10.1 Health Accessibility Rural Disparities in Health Care Access

The social class and socio-economic status are the causes of the epidemiology of infectious diseases in southeastern Nigeria. In addition, there is a lack of basic infrastructure and social amenities, for instance, water, roads, electricity and health facilities. The socio-economic and cultural environment led these communities to a higher risk of infectious diseases. The income per capita, education, housing, employment and lifestyles are the social determinants of health.

Moreover, ethnicity is also one variable of the prevalence of diseases. This was because ethnic background and culture influenced similar groups in terms of diet, hygiene, education, customs, and religion, all of which impact human health. Most of these determinants are related to human lifestyles and behaviour patterns. In Nigerian society, people with lower social strata tend to suffer more health issues.

The level of education among the community affects the prevalence of water-borne diseases. Poor living conditions and lifestyles led to a high prevalence of water-borne diseases. Poor road access and inadequate health care facilities (Oranye et al., 2009). Poverty is also one of the factors that exposes them to a high risk of disease because they cannot afford to install a sanitary system.

The socio-economic factors and social support play an important role in the prevalence of diseases and health. Income level is linked with health care accessibility. The studies found that an individual with a good socioeconomic background tends to enjoy a better quality of life, good healthcare service, and better health status (Yew & Noor Azlan, 2014). Studies in China have found that people living in provinces with significant income inequality gaps have poorer health compared to those in provinces with moderate income inequalities, particularly in modern cities like Guangzhou (Yew & Noor Azlan, 2014).

In addition, the level of education is a factor. The argument on the unskilled people was that they were more likely to have poorer health conditions than professionals (Yew & Noor Azlan, 2014). This is because professionals are more resourceful in obtaining better medical treatment, purchasing high-quality drugs, and accessing good health services (Yew & Noor Azlan, 2014). The professionals are highly educated and have secured well-paid jobs to afford expensive medical fees. The professionals can buy healthier and nutritious foods. Besides, the types of occupation and physical environment will also affect people's health. Social support is also crucial for better health. This is because good social support from family members can reduce psychological distress and recovery from illness (Yew & Noor Azlan, 2014).

Access to health care is considered a crucial indicator of health and thus contributes to health disparities (Cancel-Tirado et al., 2018). Rural poor face disparities in access to primary care physicians and specialists. The social determinants of health framework, such as social conditions, imbalances in power structures, and inadequate access to resources, influence health and are the root of health disparities (Cancel-Tirado et al., 2018). Rural-urban and racial-ethnic health disparities are commonly identified in the health literature (Cancel-Tirado et al., 2018). The challenges faced by the rural poor are a limited number of health care providers and specialists (Cancel-Tirado et al., 2018).

2.10.2 Health Beliefs, Cultural and Practices

Furthermore, people's beliefs and actions might affect their health status (Oranye et al., 2009). The cultural beliefs and practices impact the vulnerability of the people to water-borne diseases.

The lack of proper precautions may be attributed to cultural and religious beliefs at the very centre of popular conception of cleanliness and pollution (Liew & Lepesteur, 2006). Sanitary culture often reflects the belief that running water is clean for bathing, human consumption, and ritual purposes (Liew & Lepesteur, 2006).

As unfavourable conditions and difficulty in changing habits and customs favoured the continuous presence of communicable disease, health promotion and community education should become the main focus (Liew & Lepesteur, 2006).

There are important differences in cultural perspectives in understanding diseases, beliefs about health and illness (Liew & Lepesteur, 2006). The culture also gives meaning to the experience of health and illness. Every culture conceptualises disease and illness differently. Moreover, the type of treatment sought by the patient is usually affected by their beliefs and perceptions of what is causing their illness (Liew & Lepesteur, 2006).

Studies have shown that different cultures normally ascribe different cultural beliefs in tracing the causes of diseases (Yew & Noor Azlan, 2014). Such as possession, witchcraft, fate, luck, karma, spiritual and cultural habits, for instance, dietary habits and lifestyles (Yew & Noor Azlan, 2014).

Studies found that people living in rural areas are less likely to engage in preventive health behaviours (Thomlinson et al., 2004). They have also found evidence to support the idea that how one defines health will influence the type of health-promoting behaviours that are practised (Thomlinson et al., 2004).

The tribe has a belief that diseases stem from malevolent supernatural factors and the displeasure of ancestors (Rajkishor, 2007). In any disease or sickness, the majority turn to spirit worship, sorcery, and black magic (Rajkishor, 2007).

Levels of income and material poverty impact people's susceptibility to disease and their ability to pay for health services (Peters et al., 2008). There are a few social determinants of health, for instance, Geographic accessibility, which refers to the physical distance needed or travel time from the service delivery point to the user (Peters et al., 2008). For instance, good roads and infrastructure access. The availability of care, for example, includes having the correct type of care available to those who need it most, operating hours and waiting times that meet the demands of those who need it, and having appropriate types of service providers and materials (Peters et al., 2008). For example, the availability of drugs and medical assistants. Besides financial accessibility, the ability and willingness of the patient to pay the bill are also crucial. And the economic impacts on the patient due to health costs. As such, the transportation costs, daily expenses and lodging (Peters et al., 2008). The last is acceptability, whether the health providers are able to meet the social and cultural requirements of the patient (Peters et al., 2008).

The health of people is affected by many factors such as where we live, environment, income, education levels, and social relationships with society (Prince Osei-Wusu Adjei & Daniel Buor, 2012). Studies indicated that the level of a person's income, lifestyle and race are determinants of health (Prince Osei-Wusu Adjei & Daniel Buor, 2012). The illness comes after a social gradient. The lower the socioeconomic status, the worse the health. Poverty becomes the main determinant contributing to poor health. According to research, the real causes of many deaths are social determinants, for instance, illiteracy, fatalism and gender and racial inequalities, unemployment and poverty (Prince Osei-Wusu Adjei & Daniel Buor, 2012). Therefore, poverty becomes bad, the health outcome worsens. The poor are more exposed to bigger personal and environmental risks, poor housing conditions and have less access to information regarding health care access. Hence, the poor households are more prone to diseases due to poverty (Prince Osei-Wusu Adjei & Daniel Buor, 2012).

The rural households with lower socio-economic status, such as lower income and education levels, are burdened by poor health in rural Ghana. Most of the households with low education and income levels experienced a high prevalence of the diseases (Prince Osei-Wusu Adjei & Daniel Buor, 2012).

2.10.3 Health Awareness and Education

The low level of awareness and education on water-related health issues was accompanied by a high prevalence of water-borne diseases (Oranye et al., 2009).

The health care system is a social determinant by itself. The availability and access to health services have been proven to notably reduce people's mortality (Craig et al., 2015). The occupation, income and education are the centre of analyses on health disparities. The social gradient as a relative position in social hierarchy was considered to affect health. In addition, the distribution of social and cultural capital among people caused health disparities (Craig et al., 2015). Those people in lower economic strata tend to experience unfavourable health outcomes and higher rates of mortality and morbidity (Craig et al., 2015). The income inequality at the societal level has been proven to unequally influence the distribution of health outcomes and health care at the societal, behavioural, disease levels and environmental (Craig et al., 2015).

Unemployment and employment insecurity have been related to poor physical health and well-being, chronic disease, psychological distress, poor self-reported health, higher rates of medical visits and low medical coverage (Craig et al., 2015). Apart from that, lower educational levels have been associated with adverse health outcomes—shorter life expectancies. The relationship between education and health may be mediated through health behaviour, income, labour participation and literacy levels (Craig et al., 2015). Poor working conditions will also deteriorate health due to temporary employment, occupational status, work-related stress, longer working hours, high levels of work-life conflicts and lack of job control (Craig et al., 2015).

2.10.4 Health Challenges - Adaptation, Resistance and Resilience

Vector-borne diseases are influenced by the context of social, cultural and political change, which have major effects on the social determinants of health (Bardosh et al., 2017). The health care will be impacted by shifting patterns in access, treatment, provision and health-seeking behaviour, which will also be influenced by changing cultural norms and values (Bardosh et al., 2017).

The disease is causing a cycle of poverty. The low economic status tends to have limited political access as the key resources and opportunities are not accessible to the poor (Bardosh et al., 2017).

The causes of morbidity and mortality in Aboriginal Australia are low socioeconomic status and environmental factors as two main social determinants (Willis et al., 2004). The environmental factors are normally a lack of access to health services, for instance, clean water supply, sanitation and adequate housing (Willis et al., 2004).

The tribal populations in rural India have their own beliefs and practices on health (Patil et al., 2002). Some tribal groups still believe that a disease is always caused by hostile spirits or by breach of some taboo (Patil et al., 2002). Thus, they seek remedies through magico-religious practices (Patil et al., 2002). Apart from that, some rural people have continued to follow rich, undocumented, traditional medicine systems. The basic nature of rural health issues is related to a lack of health literature and health consciousness, and occupational hazards (Patil et al., 2002).

2.10.5 Significance of Research

A better understanding of the relationship between socioeconomic status and food poisoning is crucial for effective public health policy and intervention targeting. To identify the impact of low socioeconomic status (SES) on food poisoning cases.

The expected findings and contributions from this study are the provision of a more comprehensive and inclusive type of health policy that incorporates sociocultural aspects. This is because there is a lack of culture, health beliefs and practices in the current infectious diseases health policy.

The findings of this study will benefit society, given that health issues among communities significantly impact overall welfare. A healthy community and society are crucial for the development and welfare of the nation. In terms of research and development (R&D), the study will help the researcher uncover critical areas in the educational process that many researchers have been unable to explore. Thus, a new theory on health care awareness and education among the rural community may be arrived at. The national health policies and laws regarding control of the spread of infectious diseases, such as water-borne diseases, require notifying infectious diseases, declaring an infected local area, isolating infected persons and suspects (Prevention and control of infectious diseases Act, 2017). The prevention methods are through immunizations, alteration of the environment to eliminate sources or vectors of the etiological agent, elimination of opportunities for disease transmission and inactivation of the infectious agents (Arokiasamy, 1990).

The control of communicable diseases is due to the interaction between factors related to the host, the etiological agent and the environment. Major methods to control and prevent communicable diseases include reduction of host susceptibility, for instance, through immunisations, alteration of the environment to eliminate sources of the etiological agent, elimination of opportunities for disease transmission and inactivation of the infectious agent. Prevention and control measures include enforcing immunisation laws and continuously providing health education on disease prevention, as well as hygiene guidelines for students, families, and school personnel. Implementing good hand washing procedures. Implementing case isolation and effective treatment is crucial (Coordinated student health services, 2018).

The communicable diseases outbreak prevention strategies are outbreak management planning, organising training and simulation exercises, learning from previous crisis situations and setting up a rapid response team (RRT). The RRT is an expert and experienced group formed based on incident needs in order to provide a fast response in managing disease outbreaks effectively. The RRTs should be created at the district, state and national levels. The outbreak management planning, including regular observation or surveillance, will enable the organisation to predict possible outbreaks (early warning signs), so that the organisation can plan to prevent the outbreak from occurring (Ministry of Health Malaysia, 2018).

Training and simulation must be provided to the organisation's officers who are involved in outbreak investigation. The officer must have certain knowledge and skills to mitigate the issues when the outbreak occurs (Ministry of Health Malaysia, 2018).

2.10.6 Global burden on FBDs

The global burden of food-borne illnesses (Soon, 2011). Foodborne outbreak requires a multi-disciplinary approach for investigation. Most of the food poisoning cases were due to unhygienic food handling and lack of cleanliness in food preparation (Soon, 2011) insanitary food handling procedures. The people have poor hygienic practices (Soon, 2011). Training and education are needed for food poisoning prevention (Soon, 2011). The knowledge and attitude towards food hygiene and safety are strongly emphasised (Soon, 2011).

Food poisoning cases have been linked with socioeconomic factors such as poverty, race, residence area and marital status (Song, 2009). Nevertheless, most of the investigations focused on mortality or incidence rate of the outcome, rather than on severity-based incidence related to socioeconomic status (SES) (Song, 2009). The socioeconomic factors could affect the overall incidence of poisoning. The mortality can also be sensitive to socioeconomic status (Song, 2009).

The fact that the education level is an important socioeconomic status parameter when studying poisoning, but then they did not have information to enable them to adjust for these effects (Sockett, 1993). Morbidity linked with foodborne illness is an increasing issue. The socioeconomic burden of these diseases may be higher than previously thought (Sockett, 1993). To the long-term aspect of the education in hygiene of those engaged in the handling, storage, preparation and cooking of food (Cowan, 2019). Poor hygiene conditions, lack of attention to strict personal hygiene. The practice of a high standard of personal hygiene in food preparation. The education of the workers in the food industry (Cowan, 2019).

Education is one of the factors that could affect the occurrence of foodborne diseases, where a lack of education in the basic rules for hygienic food preparation (Sharifa Ezat, Netty, & Sangaran, 2013). Similar racial or cultural group differences in rates of acute diarrhoea (Sharifa Ezat, Netty, & Sangaran, 2013). Even though the reasons for such differences are not clear, the findings could be associated with genetic or socio-cultural differences between the ethnic groups, hence related to dietary and culinary practices (Sharifa Ezat, Netty, & Sangaran, 2013).

In other words, economic status and infrastructure (Sharifa Ezat, Netty, & Sangaran, 2013). A foodborne disease outbreak in Malaysia was due to an insanitary food handling procedure, which had more than 50 per cent of food poisoning episodes (Sharifa Ezat, Netty, & Sangaran, 2013). Unhygienic practices also contribute to outbreaks of food-borne diseases (Sharifa Ezat, Netty, & Sangaran, 2013). Poor knowledge and practices among food handlers (Kennedy et al., 2005). There have been few investigations that have examined consumer food safety knowledge and practices. To identify gaps in food safety knowledge among consumers and the hygiene errors (Kennedy et al., 2005). The findings found that adequate and appropriate food safety education can deliver significant reductions in the burden of foodborne illness among consumers (Kennedy et al., 2005).

Although low socioeconomic status SES is generally related to negative health outcomes (Newman et al., 2015), but then, its impact on food-borne illness is poorly understood (Newman et al., 2015). However, the relationship between SES and food-borne illness is less well understood (Newman et al., 2015). A better understanding of the relationship between SES and food-borne illness is important for efficient public health policy and intervention targeting (Newman et al., 2015). The knowledge, attitude and practices are the main determinants in reducing the incidence of food-borne diseases (Zyoud et al., 2019).

Poor hygienic practices, along with knowledge, attitude, and practices, are key factors in food-borne disease reduction (Zyoud et al., 2019). Access to a safe water supply is one of the most crucial determinants of health and socioeconomic development (Shakeel & Amal, 2011). Malaysia is one of the countries that has high cases of foodborne diseases. However, the immune systems and gut microbial communities depend on the human diet, which is indirectly influenced by socioeconomic status, culture, population growth and agriculture (Abdul-Mutalib et al., 2015). The main factor for foodborne illness in Malaysia is insanitary food handling procedures, which contribute to 50 per cent of the cases (Abdul-Mutalib et al., 2015).

2.11 Knowledge, Attitude, Practices (KAP) Framework

This study uses **KAPs Framework** in order to understand what people know, how they feel and what they actually do in relation to food handling, food hygiene and food preparation.

KNOWLEDGE (K)

Refers to what people know, including:

- Causes of food contamination, proper handwashing techniques, food storage, safe temperature, cross-contamination
- E.g. a food handler knows that raw meat and cooked meat cannot be stored in a same container.

ATTITUDES (A)

Refers to people's beliefs, perceptions and feelings, including:

- Perceived importance of cleanliness, beliefs about the risk of food poisoning, personal responsibility for customers' health, willingness to follow hygiene guideline
- A food handler believes in maintaining cleanliness to avoid food poisoning.

PRACTICES (P)

Refers to actual behaviours and actions, including:

- Frequency of handwashing before food preparation, use of clean utensils, proper food storage and reheating
- A food handler regularly washes hands with soap before preparing food.

Figure 2.3: Knowledge, Attitudes, and Practices (KAP) framework

This study adopts the Knowledge, Attitudes, and Practices (KAP) framework (summarised in the diagram above) to examine individuals' understanding and behaviors related to food handling, hygiene, and preparation. Within this framework, knowledge refers to what people know about safe food practices, attitudes capture their beliefs, perceptions, and level of concern toward food safety, while practices reflect their actual behaviors in everyday food-related activities. By analyzing the interrelationship between these three components, the study aims to identify gaps between awareness and behavior, and to better understand how knowledge and attitudes influence food safety practices.

2.12 Research Hypothesis

Below are the hypothesis that are used in this study:

(i) Gender differences among students:

H_0: There is no significant difference in hygiene knowledge, attitudes, and practices (KAPs) between male and female students.

H_1: There is a significant difference in hygiene knowledge, attitudes, and practices (KAPs) between male and female students.

(ii) Gender differences among food handlers:

H_0: There is no significant difference in hygiene knowledge, attitudes, and practices (KAPs) between male and female food handlers.

H_1: There is a significant difference in hygiene knowledge, attitudes, and practices (KAPs) between male and female food handlers.

(iii) Educational level among students:

H_0: Educational level has no significant influence on hygiene knowledge, attitudes, and practices (KAPs) among students.

H_1: Educational level has a significant influence on hygiene knowledge, attitudes, and practices (KAPs) among students.

(iv) Educational level among food handlers:

H_0: Educational level has no significant influence on hygiene knowledge, attitudes, and practices (KAPs) among food handlers.

H_1: Educational level has a significant influence on hygiene knowledge, attitudes, and practices (KAPs) among food handlers.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This study employed a mixed-methods research design, integrating both qualitative and quantitative approaches to comprehensively address the research questions. The selected design was an exploratory sequential approach, which involved two distinct phases: an initial qualitative phase followed by a subsequent quantitative phase. This design was particularly suitable for the research as it allowed for an in-depth exploration of the phenomenon in the first phase and a broader validation and generalization of findings in the second phase.

In the qualitative phase, data were collected through interviews, observations, and open-ended survey responses to capture detailed insights, experiences, and perceptions related to food hygiene and safety practices. This phase was crucial in exploring areas where existing knowledge was limited or insufficiently developed. The findings from this phase helped identify key themes, variables, and hypotheses that could be tested or measured more broadly in the next stage of the study. The qualitative data thus served as a foundation for developing a more structured and targeted quantitative instrument, such as a survey questionnaire.

Following the qualitative phase, the second phase of the research focused on quantitative data collection. This involved distributing the structured questionnaire to a larger sample in order to examine patterns, measure the prevalence of specific behaviours and attitudes, and assess the generalizability of the initial findings. The integration of quantitative data enabled the researcher to statistically validate the themes identified in the qualitative phase and determine whether those insights were consistent across a broader population.

The sequential nature of this design provided several advantages. First, it allowed the study to begin with a flexible, exploratory approach that was well-suited to understanding complex social behaviours. Second, it ensured that the quantitative tools were grounded in real-world data and perspectives, thereby increasing the relevance and accuracy of the measurement instruments. The combination of methods strengthened the overall research by addressing both depth and breadth, capturing nuanced, context-specific insights while also generating results that could be generalized to a wider context.

Additionally, the use of mixed methods enabled triangulation of data, enhancing the reliability and validity of the findings. The qualitative data provided a rich narrative that gave meaning and context to the numerical trends revealed in the quantitative phase. Conversely, the quantitative data helped validate and quantify the themes that emerged from the qualitative analysis, creating a more balanced and holistic understanding of the research problem.

While this design offered substantial benefits, it also required careful planning, adequate time allocation, and the availability of resources and expertise to manage both types of data effectively. Collecting and analysing two forms of data can be demanding, but the strength and depth of the resulting findings justified the effort. Overall, the mixed-methods exploratory sequential design was chosen to maximize the comprehensiveness, credibility, and practical impact of the study’s outcomes.

3.2 Research Design

This study adopted an exploratory research design, which is particularly suitable for investigating a relatively under-researched problem (Akhtar, 2016; Mittal, 2010), namely, the sociocultural factors contributing to food poisoning among Malay students in Betong. Exploratory research is essential when there is limited existing literature on a topic or when the researcher aims to gain new insights before proceeding to more structured investigations (Akhtar, 2016). It allows for a deeper understanding of emerging issues and is commonly employed in the early stages of research to clarify concepts, formulate hypotheses, and establish priorities for future studies (Zukauskas, Vveinhardt, & Andriukaitienė, 2018). Essentially, this research design helps researchers explore complex social phenomena that cannot be quantified easily, such as perceptions of hygiene, traditional cooking practices, and cultural taboos related to food preparation and consumption.

In line with this, the study employs a mixed methods approach, integrating both quantitative and qualitative data to provide a more comprehensive understanding of the issue. The quantitative component, guided by the KAP framework, enables the measurement of students' knowledge, attitudes, and practices related to food safety, while the qualitative component allows for an in-depth exploration of sociocultural meanings, beliefs, and everyday practices that shape these behaviours. This combination enhances the validity of the findings through triangulation and ensures that both measurable patterns and contextual insights are captured.

In the context of this study, exploratory research is necessary due to the limited availability of data on how sociocultural factors influence food hygiene behaviour in the

Malay student population. Ehiri and Morris (2013) had highlighted the lack of sociological inquiry in food safety research, particularly in marginalized or rural communities where cultural practices play a significant role in public health outcomes. They emphasised that understanding local beliefs and behaviours is essential for designing effective health interventions that are both culturally relevant and behaviourally sustainable.

Furthermore, sociological insights are key to uncovering hidden risk factors, such as reliance on traditional food preparation techniques, lack of awareness about cross-contamination, and communal food-sharing practices that may inadvertently increase exposure to foodborne pathogens. The inclusion of sociocultural perspectives ensures that food safety education does not merely impose external standards but rather adapts to the values, needs, and lived realities of the community (Ehiri & Morris, 2013).

In addition to identifying causative factors, exploratory research in this study assesses the reliability and relevance of the research tools, such as interview guides and observational checklists, for future large-scale studies (Zukauskas et al., 2018). This initial phase of research provides a foundation for hypothesis development and the design of culturally sensitive public health messages aimed at reducing food poisoning among students.

In general, the exploratory design, supported by a mixed methods approach, allows for an open-ended investigation of the sociocultural dimensions of food safety, facilitating a contextualised understanding that is critical for policy development and health education in multi-ethnic regions like Betong.

3.3 Study Location

The statistics provided by the Health Informatics Centre, Ministry of Health Malaysia, for 2018 show Sarawak had 1089 cases of food poisoning (a 39.4 incidence rate), and Malays were the ethnic group that suffered most, with 139 cases between 2014 and 2018 (Pejabat Kesihatan Daerah Betong, 2019). Most of the cases occurred in the Betong District (Pejabat Kesihatan Daerah Betong, 2019). This is the primary reason why the Betong area has been chosen for the study. The target populations are the students and school food handlers of SK Tambak Pusa, SK Maludam, SK Tuie, Asrama SK Paku Central, SMK Ulu Layar, MRSM Betong, SMK Beladin, SMK Pusa, Kolej Vokasional Betong, SK Ng. Lidong, SK Kalok and SK Semarang (Figure 3.1).

Figure 3.1: Maps of Sarawak (A) and Betong District (B) [Adapted from (Google Maps, 2024)]

3.4 Population and Sampling

As previously mentioned, the target groups for the study are students and school canteen food handlers. There were 12 schools in the rural stratum, the stratum can be defined as a subset or target population which is being sampled in statistics. The total population is 4442 students for 12 schools in the Betong area (Table 3.1). Every school has at least three (3) food handlers, so a total of 23 food handlers have been successfully interviewed during the data collection period.

Table 3.1: Total students population based on school

No.	Schools	Stratum	Number of students	Sample size (30%)
1	SK Maludam	Rural	347	104
2	SK Tambak	Rural	218	65

3	SK Tui	Rural	191	57
4	SK Paku Central	Rural	88	26
5	SK Semarang	Rural	145	44
6	SK Kalok	Rural	245	74
7	SK Ng. Lidong	Rural	57	17
8	SMK Pusa	Rural	990	297
9	SMK Ulu Layar	Rural	389	117
10	SMK Beladin	Rural	793	234
11	Kolej Vokasional Betong	Rural	732	220
12	MRSM Betong	Rural	247	74
	Total		**4442**	**1329**

These schools were selected because food poisoning cases are prevalent in them, as reported by Pejabat Kesihatan Daerah Betong (Pejabat Kesihatan Daerah Betong, 2019). The number of cases reported during 2018 in the respective schools was: SK Kalok, 39 cases; SK Tuie, 11 cases; MRSM Betong, 14 cases; and SK Semarang, 23 cases. In addition, during 2017, SMK Beladin reported 62 cases, SMK Pusa 29 cases, Kolej Vokasional Betong 59 cases, SK Ng Lidong 11 cases, and SK Kalok 4 cases (Pejabat Kesihatan Daerah Betong, 2019).

3.5 Sampling Technique

The study employed a non-probability sampling technique, specifically quota sampling. Quota sampling is deemed the most suitable method for this study due to its ability to ensure representation of key sub-groups based on specific characteristics such as age, gender, and ethnicity (Holmes, Illowsky, & Dean, 2005; Robinson, 2014). A fixed number of participants (quota) was determined for each category to ensure balanced representation. Participants were then selected within each quota, where respondents met the required characteristics were included until the quotas were fulfilled.

The justification for using quota sampling stems from both practical and methodological considerations. Unlike random sampling, which offers the highest degree of statistical accuracy but is often resource-intensive and time-consuming, quota sampling provides a cost-effective and time-efficient alternative. Random sampling, although ideal in theory, may not be feasible in studies like this due to constraints related to budget, fieldwork logistics, and participant accessibility (Moser, 1952; Singh & Masuku, 2014). Moreover, it may yield a sample that does not adequately reflect the specific sub-populations of interest, especially when studying rare or targeted phenomena such as foodborne illness incidents among specific ethnic groups.

Quota sampling also allows the researcher to replace non-respondents with other individuals who meet the same quota criteria, thereby maintaining the integrity of the sampling structure (Robinson, 2014). This flexibility is particularly advantageous when working with students or minors, who may be absent or unwilling to participate due to parental consent or institutional restrictions.

In quota sampling, the population is divided into mutually exclusive strata or quota controls, which reflect characteristics relevant to the research topic (Robinson, 2014). In this case, the researcher targeted Malay students under the age of 18 who had been affected by food poisoning between 2015 and 2018. These participants were grouped into various sub-groups based on educational level (primary or secondary school), gender, and age. The structured nature of quota sampling allows for stratified representation while maintaining flexibility in participant selection (Górny & Napierała, 2015).

Despite its advantages, quota sampling has notable limitations. It is generally considered less statistically rigorous than probabilistic methods and is more susceptible to selection bias, as the researcher exercises discretion in participant selection (Moser, 1952). However, if the population characteristics are well-understood and clearly defined, quota sampling can still yield highly reliable and valid results (Moser, 1952; Holmes et al., 2005).

A total of 23 food handlers and 487 students from rural schools in Betong, Sarawak were selected. They were chosen as they have direct experience with food preparation practices and the students from the reported food poisoning cases in rural schools Betong, Sarawak.

3.6 Sample Size

The sample size determination was based on the three (3) criteria, namely: the level of precision, the confidence level and the degree of variability (Singh & Masuku, 2014). The sampling error is the range of the actual value of the estimated population plus and minus 5 per cent (Singh & Masuku, 2014). For instance, if the researcher finds 30% of the students in the population, he can conclude that between 25% and 35% of the students in the population practice good food hygiene. The confidence level of this research, 95%, means that 95 out of 100 samples will have the actual population value (Singh & Masuku, 2014). The margin of error is between 0.01 to 0.05 (National Health & Morbidity Survey, 2011). If the population is homogeneous, then a smaller sample size is enough, whereas if it is heterogeneous, a bigger sample size is needed (Singh & Masuku, 2014). According to

Israel (1992), the population features such as age structure and population size were used to ensure consistency for a larger sample size. An adequate sample size is essential to ensure the sample is as representative as possible (Holmes et al., 2005).

The selected sample includes primary school students (from Primary 1 to Primary 6), secondary school students (from Form 1 to Form 5), and canteen food handlers from all 12 targeted schools. A coverage rate of 30% was used to ensure the reliability and validity of the findings. Specifically, a 20% coverage rate was applied to each primary and secondary grade level. For instance, 30% of the students were selected from Form 1, and another 30% from Form 2.

The sample size for each target population was determined based on the estimated prevalence of individuals demonstrating good food safety practices. A 5% margin of error and a 95% confidence level were applied. To estimate the sample size in prevalence studies, a single-proportion formula was used. Sample size calculations were conducted for each study objective and were finalised based on specific selection criteria.

$$n = \frac{z^2 \times p\,(1 - p)}{e^2}$$ **Equation 3.1**

The sampling error, also known as the margin of error, refers to the expected range within which the actual population parameter lies. In this study, a sampling error of ±5% was deemed acceptable. This means that if 30% of the sample is found to practice good food hygiene, we can be 95% confident that the actual proportion in the population lies between 25% and 35% (Singh & Masuku, 2014). The confidence level of 95% implies that if 100 different samples were drawn from the same population, 95 of them would yield results that accurately reflect the population parameters (Israel, 1992).

Furthermore, the margin of error in this study is considered within the range of 0.01 to 0.05, which aligns with the acceptable statistical standards set by previous national surveys (National Health and Morbidity Survey [NHMS], 2011). A smaller margin of error generally requires a larger sample size to ensure greater accuracy in estimates. The variability within the population also affects sample size. For instance, in a homogeneous population, where individuals share similar characteristics, a smaller sample may suffice. In contrast, a heterogeneous population, which includes individuals of varying backgrounds, age groups, and behaviours, demands a larger sample to capture the diversity adequately (Singh & Masuku, 2014).

3.7 Research Instruments

The research instruments consisted of validated questionnaires featuring both open-ended and closed-ended questions. These instruments were pre-tested and validated prior to data collection. Quantitative data analysis was conducted using SPSS (version 26, SPSS Inc., Chicago, IL), with a focus on primary and secondary school students, as well as all canteen food handlers. Data was gathered using Google Forms, with the questionnaire distributed via multiple channels, including Google Forms, WhatsApp, Computer-Assisted Telephone Interviews (CATI), and Computer-Assisted Personal Interviews (CAPI).

3.7.1 Questionnaire

Questionnaires are a widely recognised instrument for data collection in quantitative research, depending on how they are designed. For this study, questionnaires serve as a primary instrument for quantitative data collection, enabling the researcher to gather rich, relevant information directly from the respondents in the field (Dudovskiy, 2018). They are particularly effective in social research, allowing for targeted data collection from specific groups, such as school students and food handlers, as well as covering a broader population (Roopa & Rani, 2017).

The use of questionnaires is an effective method to collect a wide range of information from a large number of respondents (Roopa & Rani, 2017). The benefits of using self-completion questionnaires include their low cost and avoidance of biases due to clear and straightforward questions, as well as the elimination of disruptions from the interviewer (Phellas, Bloch & Seale, 2011).

This study employs group-administered questionnaires, a type that is a useful tool for data collection and which has the same purpose in the sample group (Wilkinson & Birmingham, 2003). Group-administered questionnaires are more effective than other types, such as mail surveys and household drop-off surveys, and have a higher response rate because the researcher can control the situation until completion (Bornman, 2009; Wilkinson & Birmingham, 2003). For convenience, respondents are brought together in groups to fill out the questionnaires. This kind of questionnaire is useful for collecting data on students and teachers in schools. Usually, the response rate in a group setting is high, and the researcher can clarify any questions that the respondent does not understand on the spot (Trochim, 2020).

Questions are carefully designed to reflect the research objectives, covering areas such as food hygiene knowledge, daily eating habits, perceptions of food safety, and any prior experiences with foodborne illness. The researcher adopts exhaustive response category variables in this study. Exhaustive response is a variable's attributes in which every case can be categorised as having one attribute. The exhaustive response categories provide respondents with all the possible answers (SAGE, 2017). The questions and choices of answers provided must be clear, either explicitly or implicitly (Lavrakas, 2008).

The limitation of the questionnaire method is that data are collected indirectly (Trigueros, 2017). The questionnaires cannot provide in-depth and detailed answers to questions (Pope, Boleman & Cummings, 2010). The questionnaire cannot guarantee that the right people answer the questions (Phellas, Bloch & Seale, 2011). There is no face-to-face contact between the researcher and the respondent; therefore, the researcher should possess some knowledge of the research topic (Trigueros, 2017). The respondent may be shy to write down the answer if his/her friends are around. The questionnaire method only yields written information (Trigueros, 2017).

The students answered the questionnaires distributed by the researcher in a dedicated multipurpose room, seated as for an examination. Thus, each student has the personal space to answer the questionnaire without influence from their friends, and so the answers will be more accurate.

The researcher gathers a group of students in one room, explains the study and how to answer the questionnaire. The students have to answer the questionnaire individually; the researcher will separate students as in an exam hall so that the answers will be more precise without influence from other students. The researcher notes which school students suffered from food poisoning. The food poisoning victims will be called back for an interview.

In this study, the researcher employs a mixed-format questionnaire, which combines open-ended and closed-ended questions. Open-ended questions allow respondents to express their views freely, which is essential for capturing insights into cultural practices, food beliefs, and personal hygiene behaviours. This format supports exploratory aims and helps uncover nuanced information that may not be captured through fixed choices (Dudovskiy, 2018). Closed-ended questions, on the other hand, provide structured, easily quantifiable data, making it easier to categorise and analyse responses (Wilkinson & Birmingham, 2003).

The questionnaire is group-administered, meaning that it is distributed to students in a controlled setting, typically a multipurpose room arranged like an examination hall. This method ensures that each respondent has adequate personal space, reducing peer influence and allowing for greater response accuracy. Group administration also helps maximise response rates, particularly in school settings, and enables the researcher to provide real-time clarification if students encounter difficulties (Trochim, 2020). It is a practical choice for research in educational institutions, especially where students are available during scheduled sessions.

By organising students in an exam-like setting, the researcher ensures that responses are individual and independent, preventing any collaboration or peer influence. The researcher begins by explaining the purpose of the study and providing clear instructions on how to complete the questionnaire. This setup not only enhances the validity of the data collected but also reflects ethical considerations, ensuring that participants understand their rights and responsibilities.

To ensure better comprehension among primary students, the original English version of the questionnaire was translated into Bahasa Malaysia. The questionnaire consisted of three modules: Module A, which focused on demography; Module B, covering hygiene, Physical Facilities, and Environment; and Module C, which examined students' awareness, knowledge, attitudes, and behaviours related to food hygiene. Responses were measured using a 5-point Likert scale, with options ranging from “Strongly agree” to “Strongly disagree.” The data obtained were processed and analyzed using the Statistical Package for Social Sciences (SPSS).

The questionnaire underwent a thorough review by a panel of healthcare professionals, which included a public health officer, a health education officer, and two lecturers from Universiti Malaysia Sarawak (UNIMAS). This content validation aimed to ensure that the questions were clear and the content was suitable. The same questionnaire was administered to both primary and secondary school students. Following the review, revisions were made based on the KAP (Knowledge, Attitude, and Practice) survey model, using the *Soal Selidik Kajian Faktor Yang Mempengaruhi Pencemaran Makanan di Kantin Sekolah di bawah KPM di Kelantan* by Zawaha et al. (2007) as a reference.

3.7 Data Collection

Data collection took place in Betong, Sarawak, targeting eight schools with the highest reported cases of food poisoning: Sekolah Kerajaan (SK) Maludam, SK Tambak, SK Tui, SK Semarang, SK Kalok, Sekolah Menengah Kerajaan (SMK) Pusa, SMK Ulu Layar, and SMK Beladin. Approvals for the data collection was granted by the Economic

Planning Unit (Reference No.: (16) JKM/SPU/608-8/2/1 Vol. 3) and the Ministry of Education Malaysia (KPM) (Bil. KPM. 600-3/2/3-ERAS (8886) and Reference No.: JPNSW.SKPP.LAT.600-1/1/1 Jld. 9(68)). In addition, ethical clearance was obtained from the university's research ethics committee, given that some participants were minors (UNIMAS/NC-17.04/04-01 Jld. 1(4)).

Data was collected using different methods, which include interview, focus group discussions (FGDs) and observation of the physical environment.

3.7.1 Interview

In this study, structured interview was one of the methods used for data collection. This method enables the researcher to ask each respondent the same questions in the same way (Mathers et al., 2002). The advantage of this method is that the researcher has control over the order of questions (Wilkinson & Birmingham, 2003). Basically, the questions are planned. The interview schedule is fixed, and the researcher predetermines the questions (Coughlan et al., 2009).

The researcher used exhaustive response categories as variables. For instance, a question such as "What kind of cleaning methods do you use before eating meals?" may offer the following options: (a) piped water, (b) soap, (c) hand sanitiser, (d) liquid hand wash, or (e) other. This helps ensure responses are exhaustive and systematically recorded (Wilkinson & Birmingham, 2003). This method offers more in-depth information on the subject matter. The advantages of the interview method are that the data are collected directly from the interview in a face-to-face meeting between the respondent and the researcher (Trigueros, 2017). The benefits of conducting interviews are that the interviewer can explain complex questions and more detailed answers will be given (Phellas, Bloch & Seale, 2011).

An interview is the best method to collect data if the respondents are school students or food handlers, because the interviewer can explain the questions if the students do not understand. Typically, the response rate will be high (Holmes et al., 2005). Valuable information can be obtained during a face-to-face interview between a researcher and food handlers or students. The disadvantage of the interview method is that it is time-consuming and expensive (Holmes et al., 2005). An interview may seem to be a very formal conversation (Hassan, 2008). The environment and human factors will affect the answers given by the informants.

In this study, structured interviews were used to assess food safety and hygiene practices. Respondents were asked the same set of questions in the same way, enhancing reliability and minimizing interviewer bias (Wilkinson & Birmingham, 2003).

In contrast, unstructured or in-depth interviews are more flexible and designed to uncover a respondent's personal views, cultural values, and subjective experiences. In such interviews, questions evolve based on the participant's responses, with no fixed sequence or format (Coughlan et al., 2009). These interviews are particularly valuable when exploring sensitive or complex topics, such as traditional food handling practices in specific cultural contexts.

According to Hassan (2008), in-depth open-ended interviews allow researchers to shift the focus from "what" people do to "how" and "why" they do it. This method facilitates a deeper understanding of informants' lived experiences and cultural backgrounds. It is especially effective in qualitative studies involving ethnographic or phenomenological perspectives.

In this study, structured interviews were employed to ensure consistency and control in questioning. However, some flexibility will be maintained to probe for deeper insights where necessary, ensuring the richness of the data is not compromised.

Face-to-face interviews were conducted in this study during the data collection period. The researcher conducted the interviews with all the food handlers and selected students. The interview transcripts had been prepared prior to the interview session. As part of the data collection process, face-to-face interviews were conducted to gather in-depth information relevant to the study objectives. This qualitative method was chosen to explore the perceptions, experiences, and practices of food handlers and selected students in relation to food hygiene and safety. The personal, direct nature of face-to-face interviews allowed the researcher to engage participants in a meaningful and interactive dialogue, fostering a more accurate and nuanced understanding of their knowledge, attitudes, and behaviours.

The interviews were carried out during the designated data collection period. All available food handlers within the study setting were approached, along with a purposeful sample of students who were selected based on specific criteria such as exposure to food handling environments or involvement in food-related activities. This sampling ensured that the participants had relevant experiences and insights to contribute to the study.

Prior to the interview sessions, an interview guide was developed based on the research questions and objectives. The guide included a series of semi-structured, open-ended questions designed to elicit detailed responses while allowing flexibility for follow-up questions and probing. The questions focused on areas such as food safety practices, personal hygiene routines, food storage and preparation habits, awareness of foodborne illness prevention, and challenges encountered in maintaining hygiene standards.

To ensure consistency and preparedness, interview transcripts and prompts were pre-prepared and reviewed. This allowed the researcher to maintain the flow of discussion and to record responses accurately and efficiently. Each interview session began with a brief introduction, during which the purpose of the study was explained, and informed consent was obtained from participants. Ethical considerations, including confidentiality, voluntary participation, and the right to withdraw, were clearly communicated.

The interviews were conducted in a quiet and private setting to encourage openness and reduce distractions. The duration of each session varied depending on the depth of the participants' responses, but typically ranged from 30 to 45 minutes. With participants' permission, interviews were audio-recorded to facilitate accurate transcription and analysis. Where necessary, field notes were also taken to capture non-verbal cues or additional contextual information.

Following the data collection, the audio recordings were transcribed verbatim. These transcripts were then subjected to thematic analysis to identify recurring patterns, concepts, and insights relevant to the study's aims. This process enabled the researcher to interpret and present the data in a coherent and meaningful way, contributing to the overall findings of the research.

The use of face-to-face interviews proved to be an effective method for obtaining detailed and context-rich data, allowing the voices of food handlers and students to be represented authentically in the study.

3.7.2 Focus Group Discussion (FGD)

As stated earlier, this study employed a mixed-method approach. One of the data collection methods used is the Focus Group Discussions (FGDs). FGDs play a vital role in this study as they enable the collection of rich, detailed insights from participants. It also facilitates a deeper understanding of individuals' experiences, beliefs, attitudes, and assumptions. During in-depth FGDs, participants build on each other's ideas, leading to a dynamic exchange of thoughts and perspectives (Bacon-Stone, 2015). The main objective is to explore a specific topic thoroughly in a relaxed setting, encouraging participants, who share a common background related to the research topic, to express a variety of opinions, emotions, and viewpoints. FGDs are particularly valuable for revealing how people respond in certain situations, offering a deeper level of understanding (Bacon-Stone, 2015).

For the FGD, a total of 4 to 5 food handlers was chosen for the discussion. They were purposefully selected based on their relevance to the research topic and their active involvement in daily food preparation activities. Participants were chosen to ensure they had first-hand experience with food hygiene practices and could meaningfully contribute to the discussion. The aim of the FGD was to gather in-depth information on food hygiene and safety practices.

The relatively small group size was intentional, allowing all participants sufficient time to express their views while maintaining manageability and focus within the session. This method was chosen to facilitate dynamic discussions among respondents and to uncover shared perceptions, beliefs, and experiences that may not emerge in individual interviews. FGDs are particularly effective in exploring group norms and social influences that shape behaviours, especially in occupational settings such as food handling (Krueger & Casey, 2015).

A semi-structured discussion guide was developed prior to the session. The guide contained open-ended questions and key themes aligned with the study objectives, covering topics such as knowledge of foodborne illnesses, attitudes towards hygiene protocols, use of protective clothing, personal hygiene, and challenges faced in maintaining food safety standards. The guide also included prompts and follow-up questions to encourage deeper discussion and clarification when necessary.

The discussion lasted approximately 60 minutes and was moderated by the researcher, who facilitated the flow of conversation while ensuring all participants had the opportunity to contribute. The moderator also probed for elaboration and clarification as needed, while maintaining neutrality to avoid influencing responses. An assistant moderator was present to take field notes and monitor the recording equipment. With participants' consent, the session was audio-recorded for accurate transcription and analysis. After the session, the audio recording was transcribed verbatim. A thematic analysis approach was employed to identify patterns, recurring themes, and meaningful insights from the discussion (Braun & Clarke, 2006). The FGD provided valuable contextual data and helped triangulate findings from other data sources, enhancing the reliability and richness of the study.

3.7.3 Observation

Observation is another method used in data collection for this study. By observing the environment and household surroundings, the researcher can obtain some important information without asking the informants. Through observation, the researcher can obtain information that the informants refuse to answer or deem unnecessary (Hassan, 2008). Observation of participants may create valuable data that cannot be obtained from interviews (Hassan, 2008). It serves as a complementary tool to interviews and focus group discussions, offering an additional layer of data that enhances understanding of participants' lived experiences (Creswell & Poth, 2018).

In this context, observation is a fundamental method in qualitative research, enabling the researcher to gain first-hand insights into a natural setting. Through observing behaviours, settings, and interactions, researchers can obtain detailed insights into social practices and cultural norms (Patton, 2015). For instance, subtle behaviours such as hygiene practices, body language, or reactions during food handling may go unnoticed in interviews but become evident through direct observation. The researcher has observed the physical environment of the school kitchen and canteen, and also the process whereby food handlers prepare food. The researcher also observed the food students buy and how they eat it. Moreover, the researcher observed whether the student brings home-packed foods to school for lunch break. This allows for the collection of contextual data that may not be accessible through verbal responses alone. This method is particularly valuable for uncovering tacit behaviours, routines, and environmental conditions that are often overlooked in interviews or surveys.

In this study, observation has also been used to examine the physical environment of the school kitchen and canteen. This includes cleanliness, organization, storage of ingredients, and the physical layout of the food preparation and dining areas. The researcher also observed the process by which food handlers prepare meals, including practices related to personal hygiene, food safety, and sanitation protocols. These observations are critical in identifying behaviours that either align with or deviate from recommended food safety practices (Spradley, 1980).

Additionally, the researcher observed the types of food purchased by students and how they are consumed. This includes analysing food choices, portion sizes, and hygienic practices during eating. The observation covered whether students bring home-packed meals and how these are stored or consumed during school hours. This component of observation is particularly significant in understanding broader food culture and hygiene habits among schoolchildren (Merriam & Tisdell, 2016). Furthermore, observation offers the opportunity to record these behaviours in real time, providing a more holistic and accurate account of the phenomena under study (DeWalt & DeWalt, 2011).

However, observation as a method also presents challenges. The presence of the researcher may influence participants' behaviour, a phenomenon known as the Hawthorne effect. Thus, researchers need to remain as unobtrusive as possible to ensure authentic data collection (Angrosino, 2007). Moreover, data analysis requires careful note-taking, reflexivity, and contextual understanding to accurately interpret observed behaviours and environments.

In summary, observation is a critical qualitative tool for capturing authentic, nuanced, and contextualized data. When integrated with other methods such as interviews and FGDs, it enriches the overall data set and contributes to a more comprehensive understanding of the research issue.

3.8 Data Analysis

Quantitative data were analysed using SPSS IBM version 26, while qualitative data were examined using ATLAS. ti version 26. Ethical considerations were addressed in line with the principles of the Nuremberg Code. To enhance the validity and reliability of the findings and to minimize bias, the triangulation method was applied, combining various techniques such as observation, structured and open-ended questions, and detailed exploration of the studied phenomenon.

Data analysis is performed using SPSS software (version 26). Descriptive statistics were used to measure the prevalence of the relevant changes in this study, and frequency distribution was used for this study. Inferential statistics (CI) are used to examine the relationship between knowledge levels, attitudes, and practices (KAP) and socio-demographics. Data analysis was carried out at a confidence interval of 95% and 5% significance level. In addition, the correlation coefficient is used to identify the strength and direction of a relationship between variables. Last but not least, the regression model is used to describe the relationship between variables. In terms of qualitative analysis using Atlas software, content analysis is used to describe the behavioural responses to the communication.

The analysis included coding responses into variables, resulting in 59 variables derived from food handlers' KAP questions and 45 variables from students' KAP questions, encompassing ordinal, nominal, and scale measurements. Descriptive statistics, frequency analysis, and ANOVA tests were conducted to interpret the data, offering valuable insights into the knowledge, attitudes, and practices related to food hygiene

The quantitative data was analysed using SPSS version 25. Descriptive statistics such as frequency and percentage were used to summarise demographic data and to test knowledge, attitude and practices (KAPs) towards food hygiene among food handlers and students. ANOVA tests were used to examine associations between hygiene practices and demographic variables. For quantitative data, there were 70 variables for food handlers that were analysed. For students, 50 variables were created and analysed using SPSS.

In terms of qualitative data, the interview transcripts were analysed using thematic analysis. Codes were assigned to recurring ideas, and themes were developed to represent the key findings related to food hygiene practices. There were direct quotations from the food handlers and students.

This study used SPSS or Atlas.ti software for data analysis. The researcher adopted an ethnographic approach in data analysis (Kawulich, 2004), i.e. on the culture, human life, and demographics such as education and family, as well as health care and environment (Kawulich, 2004). The independent variable is age group, here, students under 18 years old. The dependent variables are the students' level of hygiene knowledge and behaviour, the food preparation process and the physical cleanliness of the school canteen. The ordinal variable for this study is the educational status of students and food handlers (Brunette & Nelson, 2006).

This study employed both SPSS (Statistical Package for the Social Sciences) and ATLAS.ti software to conduct quantitative and qualitative data analysis, respectively. SPSS was used to analyse the statistical relationships among the variables, while ATLAS.ti will support the thematic coding and interpretation of qualitative data collected through interviews, field notes, and observations.

The independent variable is age group, focusing on students who are under 18 years old. This age group is critical because younger students may have less developed hygiene habits and are more susceptible to foodborne illnesses due to their developing immune systems. The dependent variables include: The students' level of hygiene knowledge**,** their hygiene-related behaviours, the food preparation processes in the school canteen, and the physical cleanliness of the canteen environment.

These variables were assessed using structured observation checklists, surveys, and interview data. SPSS facilitated descriptive and inferential analyses such as frequency distributions, t-test, ANOVA test and Pearson correlation test to identify relationships between gender and educational levels with hygiene-related outcomes. The hypothesis were tested, there is a significant difference in hygiene knowledge, attitudes and practices (KAPs) between male and female students, There is a significant difference in hygiene knowledge, attitudes and practices (KAPs) between male and female food handlers, Educational level significantly influences hygiene knowledge, attitudes and practices (KAPs) among students, and Educational level significantly influences hygiene knowledge, attitudes and practices (KAPs) among food handlers.

An ordinal variable in this study is the educational status of students and food handlers. Education levels will be categorized (e.g., primary, secondary, tertiary) to evaluate their influence on hygiene knowledge and food safety practices. As Brunette and Nelson (2006) emphasize, the level of education significantly affects an individual's understanding and implementation of food hygiene principles.

Qualitative data from interviews and observations were transcribed and analysed using ATLAS.ti. This software will help identify recurring themes related to cultural beliefs, environmental conditions, and institutional practices that influence food safety within schools. The integration of both quantitative and qualitative methods will ensure a rich, triangulated understanding of the issue, enhancing the validity and reliability of the study’s findings.

3.9 Data Presentation

The analysed data were presented using tables and figures. Quantitative findings were shown in frequency and percentage tables, while qualitative themes were described using direct quotes.

The use of direct quotations, narrative illustrations, and spoken words enhances the transparency and credibility of qualitative findings. As noted by Corden and Sainsbury (2006), quotations allow readers to see the link between the data and the researcher's interpretations, offering insight into participants’ thoughts, emotions, and motivations. This method also respects the voices of informants by presenting their experiences in their own words, thereby fostering empirical depth and interpretive trustworthiness.

The researcher used visual representation, i.e. tables and graphs or charts, to report quantitative data. In & Lee (2017) recommend that quantitative data be presented in graphical form. The researcher will use graphs to present data in the analysis phase. In & Lee (2017) discuss the use of bar graphs, histograms, and pie charts. These methods of analysis will result in clearer and more accurate findings.

The researcher adopted ethnographic data analysis of the qualitative data. The ethnographic analysis creates more detail and richer information, so the validity of the results will be more assured (Morrill et al., 2000). The researcher will use verbatim quotations to report qualitative findings. The use of quotations, illustrations and spoken words for explanations can help the researcher understand the informant’s thoughts (Corden & Sainsbury, 2006).

To ensure clarity and enhance the interpretability of findings, this study will present quantitative data using visual representations, including tables, charts, and graphs. These visual aids help convey complex statistical information in a format that is both accessible and analytically useful. According to In and Lee (2017), presenting quantitative data in graphical form, such as bar graphs, histograms, and pie charts, facilitates better understanding, pattern recognition, and comparison between variables. Tables will be used to summarise numerical data clearly. At the same time, graphs will provide visual emphasis on trends, distributions, and relationships relevant to the hygiene knowledge and behaviours of students and food handlers.

During the analysis phase, data related to the independent variable (age group) and dependent variables (hygiene knowledge, hygienic behaviour, food preparation practices, and canteen cleanliness) will be visualised to highlight key statistical relationships. For example, bar graphs may compare hygiene knowledge across different educational levels, while pie charts may illustrate the distribution of observed hygienic practices among food handlers. Such representations aid not only in the analysis but also in communicating results effectively to broader audiences, including school administrators and policymakers.

In reporting qualitative data, the researcher will adopt an ethnographic approach, which emphasises cultural context and the lived experiences of participants. Ethnographic data analysis focuses on narrative depth and contextual understanding, allowing for a nuanced interpretation of behaviours, values, and institutional practices that influence hygiene and food safety (Morrill et al., 2000). The results of this analysis will be presented through verbatim quotations from participants to preserve authenticity and illustrate the richness of the data.

In summary, the integration of graphical representations for quantitative data and narrative reporting for qualitative data will result in a comprehensive and multidimensional presentation of findings. This dual strategy strengthens the study's validity, reliability, and cultural relevance, allowing for more meaningful conclusions and informed recommendations regarding food hygiene practices in schools.

3.9.1 Video and Camera

The researcher used a tape recorder, video camera, and a smartphone as research tools during the interview session (Dudovskiy, 2018) and also prepared an interview schedule for the interviews. Before conducting an interview, the researcher consulted the informants, let them know that their conversation were to be recorded and ask their permission to take photos. The use of technology, such as smartphone recording, allows the researcher to obtain more precise data. A tape recording is necessary because researchers may occasionally overlook important information from informants, as they are preoccupied with taking notes during the interview (Dudovskiy, 2018).

In this study, the researcher used a tape recorder, a video camera, and a smartphone to document interview sessions and selected observational moments in the field. An interview schedule were prepared in advance to guide the data collection process and ensure consistency across sessions. Prior to any recording, the researcher obtained informed consent from all participants, explained the purpose of the recordings, how the data will be stored, and who will have access to it. Ethical considerations are paramount in this process to maintain trust and protect participants' privacy (BSA, 2017).

While recording technologies offer many benefits, researchers must be mindful of potential challenges. For example, the presence of a camera can sometimes influence participants' behaviour, leading to social desirability bias or reduced spontaneity. Therefore, researchers must balance the use of technology with efforts to create a comfortable, non-threatening environment (Silverman, 2021). Additionally, ethical concerns related to privacy, data security, and informed consent must be addressed in accordance with institutional and disciplinary guidelines.

In general, the use of recording devices such as tape recorders, video cameras, and smartphones greatly enhances the quality of qualitative research. When used responsibly and ethically, these tools provide a rich, multi-dimensional record of human experience that supports thorough analysis and trustworthy conclusions.

3.9.2 Data Saturation

The researcher keeps on asking the informant questions until he or she reaches the saturation point, which means the same answers are given and no new perspectives are obtained from the informants (Bacon-Stone, 2015). This method is particularly useful and relevant for qualitative studies. Once the answers given are repeated and no new answer arises, the researcher should stop the conversation (Bacon-Stone, 2015). The saturation point can also be used in participant selection. This method can also be used to sample, at the end of the interview, whether new information is available. If so, the interview should continue until saturation is reached, at which point the interview should stop (Fusch & Ness, 2015). The saturation point refers to the stage at which additional information provides minimal or no new insights to the study (Gentles et al., 2015).

Saturation is a fundamental concept in qualitative research, particularly in determining when data collection is sufficient. It refers to the point at which no new information, themes, or insights emerge from continued data collection. According to Bacon-Stone (2015), the researcher continues asking questions until responses become repetitive and no novel perspectives are offered. At this stage, known as the saturation point, further interviews or data collection are deemed unnecessary as they yield diminishing analytical value.

Saturation is especially important in studies that rely on in-depth interviews, focus group discussions, or open-ended observations. The goal is not to generalize findings statistically but to comprehensively understand the phenomenon being studied. Fusch and Ness (2015) highlight that saturation is essential for ensuring data adequacy, meaning that the collected data are rich and thick enough to support the study’s conclusions. When participants repeatedly share similar responses and no new categories or patterns emerge, the researcher can reasonably conclude that the study has achieved data saturation.

In summary, saturation ensures that qualitative research is both efficient and rigorous. It serves as a guiding principle for when to stop data collection and is key to ensuring that the findings are both rich in detail and sufficiently comprehensive to represent participants’ perspectives.

3.10 Pilot Testings

Before collecting the actual study data, the researcher conducted pilot testing to check the research questions and questionnaires, to ensure its accuracy. Pilot testings were conducted at a number of selected schools. The primary aim of this preliminary phase is to test the clarity, reliability, and relevance of the research instruments, particularly the questionnaires and observation checklists. Findings from the pilot testings were used to refine the research questions as needed. Essentially, pilot testing is a critical step in research design, as it allows researchers to detect potential issues related to instrument design, question wording, and logistical feasibility (van Teijlingen & Hundley, 2001).

In this context, pilot testings had involved the administration of questionnaires to a small, representative group of students and food handlers. This helped to determine whether the respondents understand the questions as intended, and to identify whether any items in the questionnaire are ambiguous or redundant, and whether the response options are adequate for capturing the desired information. Feedback from participants were collected to improve the structure and content of the instruments, ensuring content validity and respondent engagement (Presser et al., 2004).

In addition to questionnaire testing, the researcher also conducted field observations focused on: the physical cleanliness of school kitchens and canteens, the food preparation practices of canteen food handlers before, during, and after service, student hygiene behaviour, particularly whether students wash their hands before eating. These observations were guided by an ethnographic lens, allowing the researcher to immerse themselves in the natural setting and document real-life practices that may not be easily captured through surveys alone (Spradley, 1980). Particular attention were given to routine practices, environmental conditions, and interpersonal interactions related to food hygiene, as these factors may influence the final design of both qualitative and quantitative data collection tools.

3.10.1 Bias, Validity and Reliability

Reliability is a quality of measurement procedures, for instance, consistency, precision, trustworthiness of a study, and there should be no hidden bias or error (Mohajan & Haradhan, 2017). Bias cannot be avoided in any research. Reliability refers to the consistency of results over time and their accurate reflection of the population (Golafshani, 2003). The research instrument is considered reliable if using the same methodology will produce the same results. A stable measure indicates a high degree of reliability; hence, the results will always be the same (Golafshani, 2003).

Data validity is crucial in research. Using the correct tools to collect data is important to obtain accurate and precise results (Mohajan & Haradhan, 2017). Valid results are important for the genuineness or originality of the study. The triangulation technique can enhance the validity and reliability of data while minimising bias in research. This approach involves using various methods, such as observation, both open and structured interviews, and a detailed examination of the phenomenon under study (Turner, 2016).

Ensuring reliability, validity, and minimising bias are fundamental to conducting credible and trustworthy research. In this study, considerable attention was given to the methodological rigour of the data collection and analysis processes to enhance the quality and accuracy of the findings. Reliability refers to the consistency, precision, and stability of a research instrument over time and across different conditions (Mohajan, 2017). An instrument is considered reliable when it yields the same or highly similar results under consistent conditions. This concept also encompasses replicability, meaning the study can be repeated by other researchers using the same methodology and produce similar outcomes (Golafshani, 2003). A highly reliable instrument demonstrates a low level of measurement error and enhances the trustworthiness of the findings.

In this study, the reliability of both quantitative tools (e.g., questionnaires, checklists) and qualitative procedures (e.g., interview protocols) were assessed. For quantitative instruments, internal consistency reliability was evaluated using Cronbach's alpha, and for observational checklists, inter-rater reliability ensured through training and calibration of observers. For qualitative data, reliability was enhanced through coding consistency and cross-checking of themes among multiple researchers or coders.

Validity pertains to the extent to which a research instrument measures what it is intended to measure (Creswell & Creswell, 2018). Validity is critical for the accuracy, truthfulness, and applicability of study findings. A valid study ensures that conclusions drawn from the data accurately represent the phenomenon under investigation. In this research, content validity was established through expert review of instruments to ensure alignment with the study’s objectives. Furthermore, face validity was assessed through pilot testing to confirm that participants interpret the questions as intended (Mohajan, 2017).

To enhance construct validity, the items used to measure hygiene knowledge, behaviour, and environmental cleanliness were grounded in established frameworks and validated scales from prior studies, where available. The ecological validity of the study and its applicability to real-world settings was supported by conducting data collection in the natural school environment, where behaviours and practices naturally occur.

Bias refers to any systematic error that may distort findings and lead to invalid conclusions. While bias can never be eliminated, it can be minimized through careful research design and methodological transparency (Turner, 2016). Common sources of bias, such as observer bias, response bias, and sampling bias, were addressed through the use of standardized procedures, anonymous data collection, and purposive sampling strategies.

To strengthen the validity and reliability of the study while mitigating bias, a triangulation strategy was employed. Triangulation involves using multiple methods or data sources to examine a single phenomenon (Patton, 1999). In this research, triangulation was implemented through methodological triangulation (i.e. combining quantitative surveys with qualitative interviews and field observations), data triangulation (collecting data from different groups, e.g. students, food handlers, and school staff), investigator triangulation (involving multiple researchers in the coding and analysis of qualitative data to reduce individual bias).

Triangulation enhances the credibility, confirmability, and dependability of the findings, ensuring that the results are not an artefact of a single method, perspective, or researcher (Golafshani, 2003; Turner, 2016).

3.10.2 Reliability and Validity Test (Cronbach’s Alpha)

Reliability analysis was conducted using Cronbach’s Alpha in IBM SPSS Statistics to assess the internal consistency of the questionnaire items measuring food hygiene knowledge, attitude, and practices among food handlers and students. Listed below are the test results:

(i) Food Handlers: Knowledge on Food Hygiene

The reliability test for food handlers' knowledge on food hygiene consisted of 23 items, yielding a Cronbach's alpha value of 0.880. This value indicates good internal consistency, suggesting that the items used to measure knowledge are highly reliable and consistently reflect the same construct.

(ii) Food Handlers: Attitude on Food Hygiene

The reliability analysis for attitude included 6 items, with a Cronbach's alpha of 0.669. This value falls within the moderate/acceptable range, indicating that the items have a reasonable level of consistency, although some improvement could be made to strengthen the scale.

(iii) Food Handlers: Practices on Food Hygiene

The practice construct consisted of 2 items, with a Cronbach's alpha of 0.759. This indicates acceptable reliability. However, since the number of items is small, the alpha value may be affected. Generally, scales with fewer items tend to have lower reliability.

(iv) Students: Knowledge on Food Hygiene and Food Safety

For students' knowledge, 7 items were analyzed, producing a Cronbach's alpha value of 0.637. This value indicates moderate reliability. While acceptable for exploratory research, further refinement of items may improve consistency.

(v) Students: Attitude on Food Hygiene and Food Safety

The reliability test for students' attitude included 3 items, yielding a Cronbach's alpha of 0.652. This suggests moderate internal consistency, which is acceptable but could be improved by revising or adding more items.

(vi) **Students: Practices on Food Hygiene and Food Safety**

The practices construct among students consisted of 6 items, with a Cronbach's alpha value of 0.712. This indicates acceptable reliability, showing that the items consistently measure students' hygiene practices.

(vii) Overall Interpretation

In general, the Cronbach's alpha values obtained in this study ranged from 0.637 to 0.880, indicating that all constructs demonstrate acceptable to good internal consistency. According to commonly accepted guidelines:

- Values above 0.70 indicate acceptable reliability
- Values above 0.80 indicate good reliability
- Values between 0.60–0.70 are considered acceptable for exploratory studies

Therefore, the questionnaire used in this study is considered reliable and suitable for further statistical analysis.

The reliability analysis confirms that the measurement instruments for knowledge, attitude, and practices related to food hygiene and food safety are generally consistent and dependable. Although some constructs (particularly those with fewer items) show moderate reliability, the overall results support the use of the instrument for subsequent analyses such as mean score analysis, t-test, ANOVA, and correlation.

3.11 Ethical Considerations

Ethical issues in this study were resolved using the Nuremberg Code guidelines (Wurtzburg, Simmons & Souza, 2016; Shuster, 1997; Ghooi, 2011) as this study deals with participants 18 years and below. The Nuremberg Code outlines several key guidelines for protecting participants, including the absolute necessity of voluntary consent from the human subject. The study should aim to provide valuable results that benefit society, which cannot be achieved through other methods, and should not be random or unnecessary. It should be conducted in a way that minimizes any unnecessary physical or mental suffering or harm. No study should proceed if there is an apparent reason to believe it could result in death or serious injury, except in cases where the researchers are also subjects. The level of risk involved should never exceed the humanitarian significance of the problem being addressed by the study. Participants must voluntarily consent to take part, without coercion, and should not experience any emotional or physical harm as a result. The welfare of humanity should be the primary concern, and participants should never be exposed to unnecessary risks.

Given that this study involves human participants under the age of 18, ethical considerations are of paramount importance. Ethical safeguards were guided by the principles outlined in the Nuremberg Code, a foundational document in research ethics developed in response to unethical human experimentation during World War II (Shuster, 1997). The Nuremberg Code continues to serve as a benchmark for ethical research practice, particularly when working with vulnerable populations such as minors (Wurtzburg, Simmons, & Souza, 2016; Ghooi, 2011).

The research was designed and conducted to maximise benefit and minimise harm. According to the Nuremberg Code, research must offer socially and scientifically valuable results that cannot be obtained by other means (Ghooi, 2011). In this study, such value lies in improving hygiene practices and food safety standards in schools, which can positively impact student health and well-being. To achieve this, data collection was conducted in a non-invasive and respectful manner, ensuring that students are not subjected to any form of physical, emotional, or psychological distress.

Additionally, the study ensured that no participant is exposed to unnecessary risks. Observations and interviews were carried out in familiar, school-based environments, under the supervision of teachers and administrators. All procedures were approved by an institutional ethics committee prior to implementation. According to the Nuremberg Code, researchers must also be prepared to terminate the study if it is discovered that continuation would pose undue risk to participants (Shuster, 1997). This principle has been strictly upheld.

The ethical design of the study also incorporates the principles of beneficence, non-maleficence, and justice, as articulated in modern ethical frameworks such as the Belmont Report and CIOMS guidelines (CIOMS, 2016). Special attention was given to ensuring that participation is voluntary, confidential, and non-coercive, particularly given the hierarchical structures often present in school settings.

In summary, by aligning the study's ethical framework with the Nuremberg Code and contemporary bioethics standards, the research ensures that the rights, dignity, and well-being of all participants, especially children, were respected and protected throughout the study process.

3.11.1 Informed Consent

A letter of consent was issued by the authorities, such as UNIMAS and the State Planning Unit (SPU), consenting to the study being conducted. In addition, the researcher obtained approval from the student's parent before an interview was conducted. A formal letter requesting food-borne disease data from Jabatan Kesihatan Negeri Sarawak (JKN) was issued for this kind of study. However, it should be noted that participants have the right to decline participation in the study (Oslo, 2016).

Informed consent is a foundation of ethical research, particularly in studies involving human participants, and even more so when the study involves minors under the age of 18. To ensure full compliance with ethical research standards, this study implemented a multi-tiered consent process involving institutional, parental, and participant approvals.

Before beginning data collection, formal institutional approval was obtained from Universiti Malaysia Sarawak (UNIMAS) and the State Planning Unit (SPU), which serves as the governing body responsible for authorizing fieldwork within Sarawak schools. This ensures the research is aligned with national and regional educational and public health priorities.

In compliance with ethical standards for research with minors, parental consent were obtained through written consent forms distributed to parents or legal guardians of participating students. These forms had clearly explained the study's aim, procedures, potential risks and benefits, confidentiality measures, and the voluntary nature of participation. Additionally, child's permission were sought to ensure that students themselves agree to participate in a manner appropriate to their age and understanding (Council for International Organizations of Medical Sciences [CIOMS], 2016).

The researcher also seeked formal permission from Jabatan Kesihatan Negeri Sarawak (JKN), the Sarawak State Health Department, to access relevant data on foodborne illnesses. A letter requesting this data were drafted in accordance with government data request protocols and ethical guidelines to ensure compliance with data protection and privacy laws.

All participants, students, food handlers, and school personnel were informed of their right to withdraw from the study at any time without consequence. The study strictly adhered to the principle that participation must be voluntary, non-coercive, and fully informed, as established in global ethical research guidelines, including the Oslo Statement on Global Health Ethics (Oslo, 2016) and the Nuremberg Code (Shuster, 1997).

To ensure transparency and protect participants' autonomy, the consent forms include: a statement of purpose and procedures**,** a description of any foreseeable risks or discomforts, an outline of potential benefits**,** a note on confidentiality and data protection**,** information on who to contact for questions about the study, assurance of the right to decline or withdraw at any point.

By following this rigorous informed consent process, the study upholds the principles of respect for persons, beneficence, and justice, as recommended by the Belmont Report (National Commission for the Protection of Human Subjects of Biomedical and Behavioural Research, 1979).

3.11.2 Voluntary Participation

The researcher should not force anyone to participate in this study as participation is voluntary (Oslo, 2016). Participants have the right to be informed about the purpose of the research, any potential consequences for them, and to choose not to participate (Oslo, 2016).

Voluntary participation is a fundamental ethical principle in human subject research. Individuals must not be coerced, manipulated, or unduly influenced to take part in the study. According to the *Oslo Statement on Global Health Ethics*, participants have the right to make informed decisions about their involvement after being fully briefed on the study’s aims, procedures, potential risks, and benefits (Oslo, 2016). They were assured that choosing not to participate, or withdrawing later, will not result in any penalty or loss of benefits. Respecting autonomy is essential to ethical integrity and protects participants from exploitation or harm.

The food handlers and students withdraw from the study if felt uncomfortable during the data collection period. The selected food handlers and students were fully voluntary and agreed to participate in this study.

3.11.3 Risk of harm

The researcher is responsible for the safety of the participants (Oslo, 2016). The participants should not be exposed to physical harm or mental stress (Oslo, 2016). Risk of harm to the researcher cannot be neglected either, because the researcher will face risks due to unhygienic conditions and may expose themselves to diseases (Stewart-Withers, 2016).

Researchers are ethically obligated to protect participants from any form of harm, including physical injury, psychological distress, or emotional discomfort. As emphasised in the *Oslo Statement on Global Health Ethics* (2016), all necessary precautions must be taken to ensure participants are not exposed to unsafe or stressful conditions. Additionally, the researcher's safety must be considered, especially when conducting fieldwork in potentially hazardous environments. Stewart-Withers (2016) highlights that researchers working in settings with poor sanitation or unhygienic conditions may face health risks, including exposure to communicable diseases. Thus, appropriate safety protocols and risk assessments are essential for all involved.

3.11.4 Protection of Children

Children and adolescents should be protected (Oslo, 2016). This research involved primary and secondary school students who are 18 years old or younger. Children and adolescents are the main contributors to this study (Oslo, 2016), so their needs and interests must be protected by the rule of law (Oslo, 2016). Children are a vulnerable group which may be subject to abuse and ignorance. Therefore, the rights of the participants in the research process need to be protected. The researcher has a responsibility to fulfil a public duty to protect children (Randall, Anderson & Taylor, 2015).

Children and adolescents are a vulnerable population in research and must be granted special protections to ensure their safety, dignity, and well-being. As outlined in the *Oslo Statement on Global Health Ethics* (2016), researchers must uphold children's rights and act in their best interests at all times.

Children, due to their age and developmental stage, may not fully comprehend the risks involved or feel empowered to refuse participation, which puts them at risk of exploitation or coercion. Therefore, researchers have a legal and moral obligation to uphold national child protection laws and ethical guidelines that prioritise the child’s welfare (Randall, Anderson, & Taylor, 2015). Moreover, the researcher must remain vigilant against exposing children to any form of emotional stress, discomfort, or harm. This includes using age-appropriate language, creating a safe and respectful research environment, and being prepared to refer cases of suspected neglect or abuse to the relevant authorities. Protecting children is not optional; it is a public duty and ethical imperative.

The Sarawak Social Welfare Department (Jabatan Kebajikan Masyarakat Sarawak, JKMS) plays a pivotal role in implementing the National Child Protection Policy (Dasar Perlindungan Kanak-Kanak Negara) within the state. This policy, aligned with the Convention on the Rights of the Child (CRC) and the Child Act 2001, aims to safeguard children from neglect, abuse, violence, and exploitation, ensuring their holistic development in a safe and supportive environment. The National Child Protection Policy outlines seven primary objectives: protect every child from all forms of neglect, abuse, violence, and exploitation, and promote research and development to enhance child protection measures. In terms of research, for this study, the majority of school children were less than 18 years old. Their rights should be protected, and the teacher or guardian must provide consent.

3.11.5 Privacy and Confidentiality

The researcher must respect the respondents' integrity, freedom, autonomy and right of co-determination (Oslo, 2016). From a legal perspective, handling personal data is linked to safeguarding privacy (Oslo, 2016). Therefore, the research must adhere to fundamental legal principles to ensure better data protection (Oslo, 2016).

Confidentiality is to protect confidential data in research, such as private human subject data and classified research (Resnik, 2018). Adequate physical and administrative measures must be implemented to ensure the privacy of participants. The data and information will be stored in a locked cabinet (Research Ethics Board, 2017), and only authorised individuals will have access to the participants' information.

Respecting participants' privacy and maintaining confidentiality are fundamental ethical and legal obligations in research involving human subjects. Researchers must protect respondents’ integrity, autonomy, and right to make decisions about their personal data (Oslo, 2016). Collecting and handling sensitive information, particularly from minors, requires strict adherence to data protection laws and ethical standards. This includes securing informed consent, anonymising data where possible, and preventing unauthorised access. According to Resnik (2018), confidentiality involves protecting personal information such as identities, responses, and any other data that could compromise participant privacy. To achieve this, the researcher must implement physical safeguards, such as storing documents in locked cabinets, and administrative safeguards, such as restricting access to data only to authorised personnel (Research Ethics Board, 2017). Ensuring confidentiality not only builds trust but also upholds the dignity and safety of participants. These measures align with legal requirements and ethical standards to minimise the risk of data misuse.

3.11.6 Anonymity

The participants’ names should not be disclosed in public or on the internet (Walford, 2012). Information about the respondents should be kept secret (Walford, 2012). Anonymity is a fundamental ethical principle in research involving human participants. It refers to the practice of ensuring that the identities of participants are not revealed in any form, whether in published reports, presentations, or online platforms. As Walford (2012) emphasises, the names of participants must not be disclosed in public or on the internet to protect their privacy and maintain their trust. Ensuring anonymity helps to minimise the risk of harm, such as social stigma or legal consequences, especially when the research involves sensitive topics.

In practice, anonymity means that researchers should avoid collecting identifiable information unless absolutely necessary. When data collection requires identifiers for follow-up purposes, researchers must ensure that this information is stored securely and separated from the research data. According to Walford (2012), even indirect identifiers, such as job titles, locations, or unique personal experiences, should be carefully managed or disguised to prevent the potential identification of participants.

Maintaining anonymity also encourages participants to provide honest and accurate responses, knowing that their identity is protected. Ultimately, respecting participant anonymity not only upholds ethical research standards but also reinforces the integrity and credibility of the research process.

3.11.7 Plagiarism

The researcher should not plagiarise the work of others to uphold their integrity and professionalism as a researcher. Authors must be cited appropriately and acknowledged (Holmes et al., 2005). The turn-in software will be used in this research. Academic research requires originality of work, and the researcher must cite other scholars' work to ensure integrity in research (Oslo, 2016).

Plagiarism is a serious ethical violation in academic research, as it undermines the credibility and integrity of scholarly work. It involves using another person's ideas, words, or findings without proper acknowledgement, which can lead to academic misconduct and damage the researcher's reputation. To uphold integrity and professionalism, researchers must ensure that all sources are accurately cited and appropriately referenced (Holmes et al., 2005). Proper citation not only gives credit to the original authors but also allows readers to trace the development of ideas and verify sources.

Originality is a key expectation in academic research. According to Oslo (2016), researchers must contribute their analysis and insights while building upon the work of others through correct citation practices. This ensures that the research remains ethical and transparent, avoiding any misrepresentation of intellectual ownership.

To safeguard against plagiarism, this study used Turnitin software, a widely recognised tool for detecting similarities between the researcher's work and existing academic materials. This step helps maintain academic integrity by identifying potential issues before submission.

By adhering to these ethical practices, researchers not only respect the work of other scholars but also reinforce the authenticity and credibility of their contributions.

3.12 Chapter Summary

The researcher used both quantitative and qualitative methods. Data was collected via distributed questionnaires to collect data from the targeted respondents. The questionnaires contained open-ended and closed-ended questions. Other than that, interview transcripts were also used for the qualitative data collection method. The qualitative method include in-depth interviews and focus group discussions. The researcher kept asking questions until the saturation point is reached. Consent was acquired directly from the participants. Anonymity, autonomy, and confidentiality were maintained during the administration of the questionnaires and the report-writing process. Questionnaires were distributed to participants to ensure validity. The reliability and validity were further enhanced through pre-testing the questionnaire.

This chapter has described the research methodology, including the population, sample and data collection instruments, as well as strategies used to ensure ethical standards are kept and the results are reliable and valid.

CHAPTER 4

DEMOGRAPHY AND POPULATION

4.1 Introduction

Chapter 4 focuses on the demographics and population of the study. A total of 487 students from rural schools in Betong and 23 food handlers were interviewed. The study involved eight schools that had reported cases of food poisoning, including Sekolah Kerajaan (SK) Maludam, SK Tambak, SK Tui, SK Semarang, SK Kalok, Sekolah Menengah Kerajaan (SMK) Pusa, SMK Ulu Layar, and SMK Beladin. This Chapter 4 presents the student demographic profile of the study, students' demographic profile on physical facilities, water supplies, and physical environment, food handlers' demographic profile, and food handlers' demographic profile on physical facilities, water supplies, and physical environment.

This chapter is structured to provide a holistic view of the population involved in the study. Firstly, it outlines the demographic profile of the students, including age, gender, and grade level distribution. It then delves into the students' perceptions and experiences concerning physical facilities, water supply systems, and the overall physical environment of their respective schools, factors that can significantly affect food hygiene and health outcomes.

Subsequently, the chapter discusses the demographic background of the food handlers, including their age, educational background, training in food safety, and years of experience. This is followed by an analysis of the working conditions for food handlers, with specific attention given to the adequacy of physical facilities, access to clean water, and the sanitation of the school environment in which they operate.

By examining these aspects, this chapter aims to identify potential vulnerabilities and contributing factors to food poisoning incidents within school environments. The findings presented here will serve as a foundation for further analysis and discussion in the subsequent chapters. This research aims to foster behavioural changes and enhance the understanding of hygiene practices among both students and food handlers, encouraging the incorporation of hygiene knowledge and behaviours into their daily routines.

4.2 Students' Demographic Profile

This section describes the student demographic profile, including gender, age range, ethnic background, occupations and educational levels.

Table 4.1: Students' Demographic Profile

Gender	**Frequency**	**Percentages (%)**
Male	307	63.0%
Female	180	37.0%
Age range		
7 - 12 year old	320	64%
13 – 18 year old	33	6.6%
19 – 22 year old	119	23.8%
Ethnic Background		
Bidayuh	2	0.4%
Iban	110	22.6%
Others	10	2.1%

Malays	355	72.9%
Chinese	10	2.1%

Table 4.1 continued

Occupation		
Full-time student	487	100%
Educational Levels		
Children who are still schooling	293	60.2%
Others	20	4.1%
Primary 6	16	3.3%
Form 1	1	0.2%
Form 3	9	1.8%
Form 5	27	5.5%
Form 6	121	24.8%

Sources: Students' demographic profile (2024)

Table 4.1 shows the student demographic profile; there were 307 or 63.0% male students and 180 or 37.0% female students. Males generally have stronger gross motor skills at an older age, which may influence their ability to handle kitchen tools that require strength (e.g., lifting, chopping with force) (Ares et al., 2023). Females tend to develop fine motor skills earlier, which can contribute to better precision in handling food and kitchen tools, such as cutting, peeling, or arranging food in a sanitary manner. Females are more likely to be involved in food preparation at home, which provides them with greater exposure to food safety practices (Ares et al., 2023). Males may have less exposure to direct food handling and preparation activities, potentially leading to gaps in food safety literacy (Ares et al., 2023). In terms of age range, students between 7-12 years old have

320 students or 65.8%, while students between 13-22 years old have 167 students or 34.2%. Studies found that children in middle childhood (6-11 years old) develop basic knowledge of food categorisation and food preparation safety. They understand concepts like washing hands before eating and avoiding raw or expired food (Ares et al., 2023). School-based nutrition education programs help reinforce food safety literacy. Adolescents (12-18 years old), also known as teenagers, develop critical thinking abilities, enabling them to analyse food labels and identify foodborne risks. However, risk-taking behaviour (e.g., consuming undercooked food due to social influence) can reduce adherence to safe practices (Ares et al., 2023). Other research found that children from higher-income families had greater exposure to food safety education at home and school. Those from lower-income backgrounds showed gaps in food safety knowledge due to limited access to educational resources (O'Brien et al., 2024).

There was a majority of Malay students in this research because the majority of the school's students were Malays. Malay students comprised 355 students, or 72.9%, and Iban students made up 110, or 22.6%. There were only 2 Bidayuh students, or 0.4%. The other races were 10 students, or 2.2%, and 10 Chinese students, or 2.2%. Based on statistics, the majority population is Malay in the Betong district. All of the students were full-time students. There were 293 students, or 60.2% children, who were still schooling. 16 students (3.3%) were in Primary 6, 121 students (24.8%) were in Form 5, 27 students (5.5%) were in Form 3, 9 students (1.8%) were in other forms, and 20 students (4.1%) were in other classes. Data was collected from eight (8) schools in Betong, involving 487 students (comprising 329 primary school students and 158 secondary school students), as well as 23 food handlers

4.3 Students' Demographic Profile on Physical Facilities, Water Supplies and Physical Environment

This section discusses the students' demographic profile on physical facilities such as the type of houses they are staying in, the type of toilet facility, clean water supplies and the physical canteen environment.

Table 4.2: Students' Demographic Profile on Physical Facilities, Water Supplies and Physical Environment

Type of house	Frequency	Percentages (%)
Shop house	3	0.6%
Long house	70	14.4%
Detached house, bungalow, traditional house	405	83.2%
Squatters	9	1.8%
What kind of toilet facility do you and members of your household usually use?		
Container-based sanitation	2	0.4%
Pour flush toilet	116	23.8%
Borehole toilet with a closed lid	15	3.1%
Borehole toilet without a cover	3	0.6%
Flush toilet with septic tank	347	71.3%
No facility toilet/ bush/ field	4	0.8%

Table 4.2 continued

What kind of toilet facility do your school have?		
Container-based sanitation	1	0.2%
Bucket latrine	1	0.2%
Pour flush toilet	69	14.2%
Borehole toilet with a closed lid	18	3.7%
Borehole toilet without a cover	10	2.1%
Flush toilet with septic tank	387	79.5%
Hanging a toilet directly over the river	1	0.2%
Do you have soap or detergent in your school for washing hands?		
Yes	421	86.4%
No	66	13.5%
Do you have soap or detergent in your household for washing hands?		
Yes	471	96.7%
No	16	3.3%
Is there any rubbish bin provided in school canteen and kitchen?		

Table 4.2 continued

Yes	476	97.7%
No	11	2.3%
What is the main source of drinking water for members of your household?		
Surface water	3	0.6%
Rainfall collection	77	15.4%
Delivered water	4	0.8%
Water Kiosk	5	1.0%
Piped water	293	60.2%
Filtered water (Coway and Cuckoo)	6	1.2%
Drinking water (bottle)	85	17%
Water from the river and the lake	9	1.8%
Spring water	5	1.0%
What is the main source of drinking water in your school?		
Dispenser water	4	0.8%
Rainfall collection	38	7.8%
Water Kiosk	12	2.5%
Piped water	236	48.4%
Water from a spring	2	0.4%

Table 4.2 continued

Others	1	0.2%
Drinking water (bottle)	180	36%
Surface water	1	0.2%
Delivered water	13	2.7%

Table 4.2 shows that 405 students, or 83.2% are staying in traditional houses or detached houses. There were 70 students, or 14.4% staying in longhouses. Three students, or 0.6%, stayed in shop houses, and nine students, or 1.8%, stayed in squatter areas. Inadequate housing often lacks essential amenities such as clean water, proper sanitation, and safe food storage facilities. These deficiencies can lead to increased exposure to foodborne pathogens. The World Health Organisation (WHO) emphasises that poor housing is associated with a wide range of health conditions, including infectious diseases like diarrhoea, which are often linked to foodborne pathogens. WHO (2018) states that exposure to environmental hazards such as pests can lead to food contamination (World Health Organization [WHO], 2018). The WHO notes that poor housing conditions can create multiple health risks, including exposure to pests, which can contaminate food sources.

There were 347 students, or 71.3%, who used a flush toilet with a septic tank in their household, and 116 students, or 23.8%, who used a pour flush toilet. Borehole toilets with closed lids are used by 15 students, or 3.1%, and 2 students, or 0.4%, use container-based sanitation. No facility toilet/ bush/ field has four students, which is 0.8%. In terms of toilet facilities in school, there were 387 students or 79.5% who used flush toilets with septic tanks. There were 69 students, or 14.2% who used a pour flush toilet. The used borehole toilet with a closed lid has 18 students, or 3.7% and the borehole toilet without a cover has 10 students, or 2.1%. There was one (1) student, or 0.2% who used container-based sanitation and bucket latrine, respectively. Toilet facilities and a proper sanitation system are important aspects of safe and hygienic practices.

Gnanasekaran et al. (2024) found that toilets and proper sanitation are essential for health, dignity, and economic development. Without toilets, human waste contaminates water, soil, and food, spreading diseases like Cholera, Diarrhoea (kills over 1,000 children daily, WHO), Typhoid, Hepatitis A, and Dysentery. Proper sanitation reduces healthcare-associated infections (HAIs) in hospitals by over 50%. Improve public health and child mortality. Diarrheal diseases are a leading cause of death in children under 5. Safe sanitation could prevent 10% of global disease burden (WHO).

There were 421 students, or 86.4% who had soap or detergent in their school for washing hands, and 66 students, or 13.5% did not have soap or detergent in their school for washing hands. There were 471 or 96.7% had soap or detergent in their household for washing hands, and only 16 students or 3.3% did not have soap or detergent in their household for washing hands. Anti-bacterial soap or detergent is important for hand washing practices because this practice can reduce the prevalence of food-borne disease, such as food poisoning, among students in schools. The student said:

> “The school canteen failed to provide essential hygiene supplies, such as soap or antibacterial soap, for handwashing before and after meals. This negligence raises serious health concerns for both students and staff, increasing the risk of illness and spreading germs due to inadequate hand hygiene practices in the dining area”

(Student 1, 2024)

There were 476 students, or 97.7% who said there are rubbish bins provided in the school canteen and kitchen. There were only 11 students, or 2.3% who said the school canteen did not provide a rubbish bin. Proper solid waste disposal is crucial for maintaining a clean and safe environment, which helps prevent communicable diseases such as food poisoning. There were 293 students, or 60.2% who used piped water as drinking water in their household. In addition, there were 77 students or 15.4% who used rainfall collection using a water tank. There were 85 students, or 17% used drinking water (bottle) for their daily consumption in their house in Betong, this was because the pipe water is polluted and yellowish due to an old water pipeline. A proper water tank and water inspection are necessary to prevent food poisoning from contaminated water. Some villages or longhouses lacked a pipe water facility and a water supply due to geographical factors, such as rural location and inaccessibility constraints. Ravindra, Mor, and Pinnaka (2019) examine water usage, treatment, and sanitation practices in rural areas of Chandigarh, India. The study found that 68.6% of respondents did not treat their water before drinking. Among those who did, common methods included using domestic filters and boiling. While regular cleaning of rooftop water tanks was reported, contamination issues remained. Most households stored drinking water in plastic bottles or buckets. He said:

> "A rubbish bin is provided in my school canteen to promote cleanliness and proper waste disposal. It encourages students and staff to dispose of food wrappers, leftover food, and other trash responsibly, helping to maintain a hygienic environment and prevent littering in the dining area throughout the school day"
>
> (Student 2, 2024)

Whereas another student said:

> “My school canteen did not provide a rubbish bin, resulting in littering and improper waste disposal. This created an unhygienic environment that could attract pests such as rats and insects, posing serious health risks to students and staff, and potentially affecting the overall cleanliness and safety of the dining area”
>
> (Student 3, 2024)

There were 236 students, or 48.4% who used piped water as their drinking water in school. There were 180 students, or 36% said they drank water (bottle), which they bought from the shop. This is because the water was polluted or turned yellowish because of corrosion in the pipeline. One of the students said:

> “The water in the school appeared yellowish, likely due to an old and rusty piping system. This raised serious concerns about water quality and safety, posing potential health risks for students and staff who rely on the water for drinking, washing, and other daily activities within the school environment”
>
> (Respondent 4, 2024)

One of the respondents said:

> “Most of us resorted to buying bottled drinking water daily from a nearby grocery shop because the school’s water was unsafe for consumption. Concerns about contamination and poor water quality made the provided water unreliable, forcing students to spend extra money to ensure their health and hydration were protected”
>
> (Respondent 5, 2024)

And he said:

> “We don’t dare to drink the yellowish water from the pipes because we believe it is unsafe and could harm our health. The discoloured water raises fears of contamination, and many worry it could lead to stomach problems, infections, or other illnesses if consumed regularly by students and staff”
>
> (Respondent 6, 2024)

4.4 Food Handlers Demographic Profile

This part describes the school canteen food handlers demographic profile, such as age range, gender, occupations, ethnic background and educational levels.

Table 4.3: Food Handlers Demographic Profile

Age Range	Frequency	Percentages (%)
15 - 20 year old	16	68.8%
21 - 25 year old	1	4.3%
39-year-old	1	4.3%
41 – 45 year old	2	8.6%
46 – 50 year old	2	8.6%
51 – 55 year old	1	4.3%
Gender		
Male	18	78.3%
Female	5	21.7%
Ethnic Background		
Iban	15	65.2%
Others	3	13.0%
Malays	5	21.7%
Occupation		
Full time private worker (school canteen food handlers)	19	82.6%
Part timer	4	17.4%
Educational Levels		

Table 4.3 continued

Others	1	4.3%
Form 3	3	13.0%
Form 5	9	39.1%
Form 6 or diploma	9	39.1%
Finished Primary 6	1	4.3%

Sources: Food handlers demographic profile

Table 4.3 The demographic profile of food handlers showed a total of 23 canteen food handlers in eight (8) targeted schools. This study analysed demographic data from 8 school food handlers, a total of 23 food handlers interviewed by focusing on variables such as age, gender, education level, and work experience.

There were 14 food handlers (60.9%), and only one (4.3%) was aged 15, 20, 22, 39, 40, 44, 47, 48, or 54 years old, respectively. In terms of gender, there were 18 males and 5 females. Moreover, there were 15 Iban or 65.2% food handlers, 5 Malays or 21.7% and 3 others 13%. There were 19 full-time school canteen food handlers and 4 part-time in eight (8) targeted schools respectively. In terms of educational levels, 9 food handlers (39.1%) had completed Form 6, 9 (39.1%) had completed Form 5, and 3 (13%) had completed Form 3. There were 1 or 4.3% finished primary 6 and others, respectively.

4.5 Food Handlers Demographic Profile on Physical Facilities, Water Supplies and Physical Environment

This part is about the demographic profile for physical facilities, water supplies and physical environment among the food handlers.

Table 4.4: Food Handlers Demographic Profile on Physical Facilities, Water Supplies and Physical Environment

Do you have soap or detergent in your household for washing hands?	**Frequency**	**Percentages (%)**
Yes	21	91.3%
No	2	8.7%
Do you have soap or detergent in your school for washing hands?		
Yes	21	91.3%
No	2	8.7%
Type of house		
Townhouse, terrace, link house	1	4.3%
Long house	10	43.5%
Detached house, bungalow, traditional house	11	47.8%
Squatters	1	4.3%
What is the main source of drinking water for members of your household?		
Packaged water	1	4.3%

Table 4.4 continued

Surface water	1	4.3%
Piped water	19	82.6%
Rain water	1	4.3%
Others	1	4.3%
What is the main source of drinking water for members of your school?	**Frequency**	**Percentages (%)**
Packaged water	4	17.4%
Water kiosk	4	17.4%
Piped water	12	52.2%
Others	2	8.7%
Rain water	1	4.3%
What kind of toilet facility do you and members of your household usually use?		
Pour flush toilet	2	8.7%
Flush toilet and connected to the central sewerage system	5	21.7%
Flush toilet with septic tank	15	65.2%
No facility toilet/ bush/ field	1	4.3%

Table 4.4 continued

What kind of toilet facility do your school have?		
Pour flush toilet	1	4.3%
Borehole toilet with a closed lid	1	4.3%
Flush toilet and connected to the central sewerage system	12	52.2%
Flush toilet with septic tank	9	39.1%

Source: Demographic questions of food handlers

Table 4.4 as shown above, 21 food handlers, or 91.3% have soap or detergent in their household for washing hands. Whereas, there were 2 food handlers, or 8.7% who did not have soap or detergent in their household for washing hands. Todd et al. (2010) discuss how Hands quickly become contaminated during daily activities, especially in food handling. The most effective way to remove pathogens from hands is through proper hand washing with potable water and soap. Robinson et al. (2016) emphasised that washing hands for 20 seconds with soap significantly reduced bacterial transfer to tomatoes compared to no soap rubbing. Longer soap washing times reduced the presence of bacteria on hands and the outer surfaces of gloves. Various soap rubbing durations (0, 3, and 20 seconds) were tested.

Besides, 21 food handlers, or 91.3%, had soap or detergent in their school for washing their hands. But then there were 2 food handlers, or 8.7% who did not have soap or detergent in their school for washing hands. The availability of soap or detergent among school food handlers aligns with findings from various studies in Malaysia. For example, a study in the Hulu Langat district, Selangor, found that although food handlers were generally aware of the importance of hand hygiene, there were gaps in their knowledge regarding proper handwashing techniques and the presence of bacteria (Tan et al., 2013). This suggests that even when soap or detergent is available, proper handwashing practices may not be consistently followed, highlighting the need for comprehensive hygiene education (Tan et al., 2013).

This is because soap and detergent are important in preventing germs that may lead to food poisoning in schools. There were 10 food handlers (43.5%) staying in longhouses, 11 (47.8%) staying in traditional houses, one (4.3%) staying in a terrace house, and one (4.3%) staying in a squatter house. There were 19 food handlers, or 82.6% who used piped water as their main source of drinking water for members of their household. There was one (1) food handler, or 4.3% who used packaged water and surface water, respectively, as their main source of drinking water for members of their household. There were four food handlers, or 17.4% who used packaged water and water kiosks, respectively, as the main source of drinking water for members of their school. There were 12 food handlers, or 52.2% who used piped water, and 2 food handlers, or 8.7% who used other sources as their main source of drinking water for members of their school. The clean water supplies are crucial for the safe food preparation and handling processes in the daily school routine. He said:

> “The pipe water was yellowish and appeared polluted, giving off an unpleasant smell and a murky look. We felt it was not safe at all for cooking or drinking purposes, as it could pose serious health risks. As a result, many of us avoided using it entirely and relied on bottled water instead”

(Respondent 10, 2024)

There were 15 food handlers, or 65.2% who used a flush toilet with a septic tank for toilet facilities in their household. There were 2 food handlers (8.7%), who used a pour flush toilet. Five used a flush toilet connected to the main sewerage system, and one used a no-facility toilet/ bush/or field. In terms of school toilet facilities, 12 food handlers (52.2%) used flush toilets connected to the central sewerage system. There were 9 food handlers, or 39.1% who used a flush toilet with a septic tank. There was one (1) food handler used a pour flush toilet and a borehole toilet with a closed lid, respectively.

4.6 Conclusion

In conclusion, this chapter 4 summarises the demographic profiles of food handlers and students, providing insights into their age, gender, education, and work experience. These findings highlight important trends that influence hygiene practices. The next chapter will analyse how these demographics impact food safety awareness and compliance. This Chapter 4 has provided a comprehensive overview of the demographic profiles of both students and food handlers involved in the study. The analysis covered key variables such as age, gender, educational background, and work experience, offering valuable insights into the composition of the population under investigation. By examining these characteristics, the chapter sheds light on several demographic trends that may influence hygiene practices and food safety behaviors in school environments.

For students, factors such as age and educational level may affect their awareness and understanding of food safety issues, as well as their susceptibility to foodborne illnesses. The analysis of their experiences related to physical facilities, water supply, and the surrounding environment further underscores the significance of infrastructure in maintaining proper hygiene and preventing food poisoning outbreaks.

Similarly, the demographic information of food handlers, including their age, level of formal education, food safety training, and years of experience, provides an important context for understanding their practices and attitudes towards food hygiene. These factors are crucial in determining the level of compliance with established food safety standards and the overall effectiveness of food handling in school canteens.

The insights gathered in this chapter form a foundational basis for further analysis. In the next chapter, the focus will shift to examining how these demographic variables correlate with food safety awareness and compliance among both students and food handlers. By exploring these relationships, the study aims to identify key areas for intervention and policy improvement, with the ultimate goal of enhancing food safety standards in rural school settings.

CHAPTER 5

KNOWLEDGE, ATTITUDE AND PRACTICE OF FOOD HYGIENE AMONG FOOD HANDLERS

5.1 Introduction

This chapter 5 discusses the findings to answer the research question for knowledge, attitude and practice of food hygiene (KAP) among the food handlers in Betong schools. It also discusses the level of knowledge among the food handlers on food hygiene, the practices among the food handlers on food hygiene and the attitude of the food handlers towards food hygiene. In addition, this chapter discusses the tabulated data and make justifications of the findings using tables, frequency distribution, descriptive statistics analysis and ANOVA table by using the significance value.

Table 5.1 showed the result of food safety knowledge of food handlers towards microbial contamination, food storage and food safety certification. From the questionnaire survey, the respondents were asked to select their responses from a Likert scale of 1-5, where 1 = strongly agree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree, from the knowledge of food hygiene among the food handlers. Through this analysis, the study aims to assess how well-informed and compliant the food handlers are with established food safety standards and to identify potential gaps in food hygiene practices that may contribute to foodborne illnesses in school settings.

In addition, the findings from this chapter not only assess individual knowledge levels but also serve as a reflection of the food preparation processes practised in school canteens. For example, a food handler’s understanding of microbial contamination directly influences their approach to handling raw and cooked foods, cleaning kitchen equipment, and maintaining personal hygiene. Similarly, knowledge about proper food storage conditions affects how ingredients are preserved and prepared before serving to students.

By analysing the responses, this chapter provides insight into whether food handlers in these rural schools follow safe food preparation practices and where additional training or resources may be required. Ultimately, this analysis aims to inform policy recommendations and capacity-building strategies to enhance food safety practices in rural school settings in Sarawak.

Table 5.1: The Knowledge Related to Food Hygiene

Statement	1	2	3	4	5
Canteen environment affects food safety	11 (47.8%)	5 (21.7%)	5 (21.7%)	-	2 (8.7%)
Unboiled water should be used for beverages or drinks (Negative Statement)	3 (13.0%)	3 (13.0%)	1 (4.3%)	1 (4.3%)	15 (65.2%)
Food that has exceeded 4 hours may be allowed for consumption (Negative Statement)	1 (4.3%)	7 (30.4%)	1 (4.3%)	-	14 (60.9%)
Clean cooking utensils are allowed to produce clean and safe food	14 (60.9%)	5 (21.7%)	1 (4.3%)	1 (4.3%)	2 (8.7%)
A hand towel can be used Repeatedly without washing (Negative Statement)	2 (8.7%)	2 (8.7%)	2 (8.7%)	2 (8.7%)	15 (65.2%)
Food that is still hot can be kept in a fridge (Negative Statement)	3 (13.0%)	4 (17.4%)	2 (8.7%)	1 (4.3%)	13 (56.5%)

Table 5.1 continued

Food poisoning, such as stomach pain, squealing and vomiting can be avoided if eating with clean hands	15 (65.2%)	1 (4.3%)	4 (17.4%)	1 (4.3%)	2 (8.7%)
Dirty environments do not cause food pollution (Negative Statement)	6 (26.1%)	3 (13.0%)	1 (4.3%)	4 (17.4%)	9 (39.1%)
Expiration dates on food wrappers and drinks are important	17 (73.9%)	2 (8.7%)	1 (4.3%)	1 (4.3%)	2 (8.7%)
Food that has been damaged and smells unsafe to eat	17 (73.9%)	1 (4.3%)	1 (4.3%)	1 (4.3%)	3 (13.0%)
The ice cubes from unboiled water are safe to drink (Negative statement)	4 (17.4%)	8 (34.8%)	2 (8.7%)	-	9 (39.1%)
The newspaper's paper is unsafe to be used as food wrapping	13 (56.5%)	3 (13.0%)	4 (17.4%)	1 (4.3%)	2 (8.7%)
Stapler bullet on food wrappers are harmless (Negative Statement)	5 (21.7%)	1 (4.3%)	2 (8.7%)	1 (4.3%)	14 (60.9%)
Foods that contain hair will causes health problems if eaten	12 (52.2%)	3 (13.0%)	3 (13.0%)	2 (8.7%)	3 (13.0%)
Food that has been exposed to flies or cockroaches is safe to eat (Negative Statement)	4 (17.4%)	1 (4.3%)	1 (4.3%)	-	17 (73.9%)

Table 5.1 continued

Hot canteen environment temperature can increase germ breeding rates	9 (39.1%)	4 (17.4%)	7 (30.4%)	1 (4.3%)	2 (8.7%)
Germs in cooking utensils can be eradicated using hot water	10 (43.5%)	6 (26.1%)	5 (21.7%)	-	2 (8.7%)
Equipment that is not washed with dish soap or detergent can result in food pollution	13 (56.5%)	5 (21.7%)	3 (13.0%)	-	2 (8.7%)
Towel used to wipe hands can be used to wipe a dish and a bowl (Negative statement)	4 (17.4%)	1 (4.3%)	1 (4.3%)	1 (4.3%)	16 (69.6%)
Raw foods and cooked foods should not be stored in the same containers	11 (47.8%)	4 (17.4%)	3 (13.0%)	-	5 (21.7%)
The kitchen does not need to be protected from rats and lizards (Negative Statement)	5 (21.7%)	1 (4.3%)	2 (8.7%)	1 (4.3%)	14 (60.9%)
Repeated use of cooking oil is not good for health	8 (34.8%)	3 (13.0%)	5 (21.7%)	3 (13.0%)	4 (17.4%)
Chemicals such as rat poison and insect poison can be placed next to dried raw materials such as onions, rice and flour (Negative Statement)	7 (30.4%)	4 (17.4%)	1 (4.3%)	1 (4.3%)	10 (43.5%)

Source: Question Number 1

1 Strongly agree **2 Agree** **3 Neutral**
4 Disagree **5 Strongly disagree**

Table 5.2: Independent Samples T-Test (Food handlers' Knowledge)

Group Statistics					
	Apakah Jantina anda?	N	Mean	Std. Deviation	Std. Error Mean
Knowledge total mean score	Male	18	2.3258	0.97306	0.22935
	Female	5	1.4901	0.52651	0.23546

<table>
<tr><th colspan="11">Independent Samples Test</th></tr>
<tr><th colspan="2" rowspan="3"></th><th colspan="2">Levene's Test for Equality of Variances</th><th colspan="7">t-test for Equality of Means</th></tr>
<tr><th rowspan="2">F</th><th rowspan="2">Sig.</th><th rowspan="2">t</th><th rowspan="2">df</th><th rowspan="2">Sig. (2-tailed)</th><th rowspan="2">Mean Difference</th><th rowspan="2">Std. Error Difference</th><th colspan="2">95% Confidence Interval of the Difference</th></tr>
<tr><th>Lower</th><th>Upper</th></tr>
<tr><td rowspan="2">Knowledge total mean score</td><td>Equal variances assumed</td><td>2.857</td><td>0.106</td><td>1.826</td><td>21</td><td>0.082</td><td>0.83564</td><td>0.45758</td><td>-0.11594</td><td>1.78723</td></tr>
<tr><td>Equal variances not assumed</td><td></td><td></td><td>2.542</td><td>12.536</td><td>0.025</td><td>0.83564</td><td>0.32870</td><td>0.12284</td><td>1.54844</td></tr>
</table>

Table 5.2 shows an independent samples t-test was conducted to compare the total mean score between male and female respondents. The results indicated that there was no statistically significant difference between males (M = 2.33, SD = 0.97) and females (M = 1.49, SD = 0.53), $t(21) = 1.826$, $p = 0.082$.

Although male respondents had a higher average score than females, the difference was not statistically significant ($p > 0.05$), indicating that gender does not significantly influence the knowledge level.

Table 5.3: Post Hoc Test (Food handlers' Knowledge)

Multiple Comparisons							
Dependent Variable: knowledgetotalmeanscore							
	(I) Apakah tahap pendidikan tertinggi anda?	(J) Apakah tahap pendidikan tertinggi anda?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Form 3	Form 5	-0.14835	0.58733	0.966	-1.6343	1.3376
		Form 6 or Diploma	0.06678	0.59658	0.993	-1.4425	1.5761
	Form 5	Form 3	0.14835	0.58733	0.966	-1.3376	1.6343
		Form 6 or Diploma	0.21514	0.45614	0.885	-0.9389	1.3692
	Form 6 or Diploma	Form 3	-0.06678	0.59658	0.993	-1.5761	1.4425
		Form 5	-0.21514	0.45614	0.885	-1.3692	0.9389
Bonferroni	Form 3	Form 5	-0.14835	0.58733	1.000	-1.6828	1.3861
		Form 6 or Diploma	0.06678	0.59658	1.000	-1.4918	1.6254
	Form 5	Form 3	0.14835	0.58733	1.000	-1.3861	1.6828
		Form 6 or Diploma	0.21514	0.45614	1.000	-0.9766	1.4068
	Form 6 or Diploma	Form 3	-0.06678	0.59658	1.000	-1.6254	1.4918
		Form 5	-0.21514	0.45614	1.000	-1.4068	0.9766

totalmeanscore			
	Apakah tahap pendidikan tertinggi anda?	N	Subset for alpha = 0.05
			1
Tukey HSD[a,b]	Form 6 or Diploma	9	2.0389
	Form 3	4	2.1057
	Form 5	10	2.2541
	Sig.		0.920
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 6.506.			
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.			

Table 5.3 shows Post hoc test and Homogeneous Subsets. The educational level had no significant impact on the total mean score. Mathematically, the differences between the means (e.g., 2.03 vs 2.25) are so small that they are likely just due to random chance or the small sample size (N=23), rather than a real effect of education.

Table 5.4: ANOVA Test on educational levels (Food handlers' Knowledge)

Descriptives								
totalmeanscore								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Form 3	4	2.1057	0.87363	0.43682	0.7156	3.4959	1.36	3.36
Form 5	10	2.2541	1.14401	0.36177	1.4357	3.0725	1.00	4.83
Form 6 or Diploma	9	2.0389	0.83987	0.27996	1.3934	2.6845	1.09	3.52
Total	23	2.1441	0.95198	0.19850	1.7324	2.5558	1.00	4.83

ANOVA					
totalmeanscore					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.226	2	0.113	0.115	0.892
Within Groups	19.711	20	0.986		
Total	19.938	22			

Table 5.4 shows a one-way ANOVA was conducted to examine whether there were differences in total mean scores across different education levels (Form 3, Form 5, and Form 6/Diploma). The descriptive statistics indicated that Form 5 students (M = 2.2541, SD = 1.14401) had a slightly higher mean score compared to Form 3 (M = 2.1057, SD = 0.87363) and Form 6/Diploma students (M = 2.0389, SD = 0.83987).

However, the ANOVA results revealed that the differences were not statistically significant, $F(2, 20) = 0.115$, $p = 0.892$. Since the p-value is greater than the significance level of 0.05, the null hypothesis is not rejected. This indicates that there is no significant difference in knowledge among the different education levels.

Table 5.5: ANOVA Test on Level of Education

Variables	P – value Significance (Sig.)	F	Significance
I do not need to wash my hands using seven correct hygiene steps if I am busy serving customers	0.859	0.323	Not significance
Canteen environment affects food safety	0.718	0.526	Not significance

Table 5.6: ANOVA on Significance between Genders (Male and Female)

Variables	P-value Significance (Sig.)	F	Significance
I do not need to wash my hands using seven correct hygiene steps if I am busy serving customers	0.044	4.576	Significance

Table 5.6 continued

Canteen environment affects food safety	0.039	4.859	Significance
I do not need to strip off watches, rings, bracelets before preparing food	0.035	5.066	Significance
Food that is still hot can be kept in a fridge	0.044	4.609	Significance
Foods that contain hair will causes health problems if eaten	0.045	4.565	Significance
Germs in cooking utensils can be eradicated using hot water	0.027	5.619	Significance

5.2 The Knowledge of Food Hygiene among Food Handlers

According to Table 5.1, findings show that most food handlers have a very good knowledge of specific concerns**.** Among those is the environment of the canteen. There were 16 or 69.5% food handlers who had pretty good knowledge of the effect of a clean environment on food hygiene. Next, *"Canteen environment affects food safety", the mean was 2.000 and the* SD was 1.2432. This indicated the food handlers had adequate knowledge of a clean kitchen to ensure food safety. In addition, based on Table 5.6, the variable "*Canteen environment affects food safety", the P-value was 0.039, and the* F-value was 4.859. Thus, the ANOVA test showed that gender significantly impacts the hygienic knowledge among the food handlers. The findings proved that there was a difference in knowledge between male and female food handlers. Based on the Malaysia Food Act 2009, Bill 15 (1), the food premises shall remain in good condition, clean and neat at all times. Schools in urban areas are at a higher risk of food poisoning outbreaks. A study in India found that key factors contributing to food poisoning in schools include poor canteen design, insufficient sanitation facilities, and inadequate hand hygiene practices among both food handlers and students (Kar et al., 2018). All school children are at risk of food poisoning, as many lack adequate knowledge of food safety. Research shows that while students with better food safety knowledge tend to have improved hygiene habits, they still engage in high-risk food behaviours (Garayoa et al., 2005). In general, schoolchildren have a limited understanding of proper hand hygiene. For instance, a global health survey of students in Thailand revealed that 15.7% of students rarely wash their hands before meals (World Health Organization, 2017). In addition, the study conducted in Indonesia confirmed that the canteen environment significantly affects food safety; poor hygiene and sanitation in canteens led to food contamination. In terms of storage and food handling issues, 60.4% of school canteens had inadequate kitchen facilities, 65.8% of canteens failed to meet hygiene standards for food processing equipment, and 95.1% of canteens lacked proper food display cases, thus increasing contamination risks (Ningsih et al., 2024). Furthermore, case studies found in Kuala Muda, Kedah highlighted 87% of food handlers did not practice good hygiene habits, for instance, hand washing after handling food and wearing proper protective clothing. Data shows that the food poisoning cases in school canteens have been increasing due to poor sanitation practices (Jalani et al., 2021). A study revealed gaps between knowledge and practice, despite food handlers having a high level of knowledge and a positive attitude towards food safety. However, their actual practices were poor, leading to food poisoning. They were aware of food safety rules but did not apply them correctly in daily food preparation (Jalani et al., 2021).

According to Table 5.1 Findings revealed that most food handlers demonstrated a strong level of knowledge in specific aspects of food safety, particularly concerning the canteen environment. Notably, 16 food handlers, representing 69.5%, exhibited good knowledge regarding the importance of maintaining a clean canteen environment and its effect on food hygiene. This is supported by the recorded mean score of 2.00 (SD = 1.24) for the variable *"Canteen environment affects food safety"*, indicating an adequate level of understanding among food handlers about the importance of a clean kitchen to ensure food safety.

Further analysis is presented in Table 5.6 indicated that the variable yielded a p-value of 0.039 and an F-value of 4.859, based on the ANOVA test. This result signifies a statistically significant difference in hygienic knowledge between male and female food handlers, suggesting that gender influences food safety awareness among canteen workers.

According to the Malaysia Food Act 1983 (as amended in 2009), Section 15(1) stipulates that food premises must be maintained in good condition, clean, and neat at all times (Laws of Malaysia, 2009). This regulation underscores the importance of environmental cleanliness, particularly in school canteens, which serve a vulnerable population, schoolchildren.

Schools in urban areas are especially at risk for foodborne illness outbreaks due to overcrowding and limited sanitation infrastructure. A study by Kar et al. (2018) in India found that poor canteen design, inadequate sanitation, and insufficient hand hygiene among food handlers and students were key contributors to food poisoning incidents. These findings are aligned with global concerns regarding food safety in educational institutions.

Research has shown that children are particularly vulnerable to foodborne illnesses due to limited food safety knowledge. Although students with greater food safety knowledge tend to practice better hygiene, they still often engage in risky behaviours (Garayoa et al., 2005). For example, a global survey conducted by the World Health Organisation (2017) in Thailand revealed that 15.7% of students rarely washed their hands before meals, a behaviour known to increase the risk of foodborne disease.

In the Southeast Asian context, a recent study by Ningsih et al. (2024) in Indonesia confirmed the significant impact of the canteen environment on food safety. The study found that 60.4% of school canteens had inadequate kitchen facilities, 65.8% failed to meet food processing hygiene standards, and 95.1% lacked appropriate food display cases, conditions which significantly elevated contamination risks.

Locally, a case study in Kuala Muda, Kedah, revealed that 87% of food handlers did not adhere to essential hygiene practices, such as proper handwashing and wearing protective clothing (Jalani et al., 2021). Alarmingly, the number of food poisoning incidents in school canteens has been rising due to poor sanitation practices. Despite food handlers demonstrating high levels of knowledge and positive attitudes toward food safety, their actual practices often did not reflect this understanding. Jalani et al. (2021) emphasised a critical gap between knowledge and practice, as food handlers were aware of safety protocols but failed to implement them consistently in daily food preparation.

In conclusion, while food handlers generally possess adequate knowledge regarding the importance of maintaining a clean canteen environment, there remains a substantial discrepancy between knowledge and actual behaviour. This inconsistency poses a serious public health concern and highlights the need for targeted training, monitoring, and reinforcement of food safety practices in school canteens.

Food handlers said:

> "Food handlers find the hot weather around the place of sale uncomfortable, as it causes excessive sweating on their hands and face. This not only affects their comfort and concentration while working but may also raise hygiene concerns, especially when handling food in such a warm and unventilated environment"
>
> (Respondent 1, 2024)

In addition, other food handlers think:

> "Raw materials such as chicken, fish, and vegetables are usually defrosted in large plastic basins at room temperature. This practice raises concerns about hygiene and food safety, as prolonged exposure to warm conditions can lead to bacterial growth and potential contamination, putting consumers at risk of foodborne illnesses"
>
> (Respondent 5, 2024)

In addition, the findings showed that the majority of the food handlers have a very good knowledge of "*Unboiled water should be used for beverages or drinks".* There were 16 people, or 69.5% who had good knowledge that uncooked water should not be used for beverages to prevent food poisoning. The Mean value was 3.957, and the standard deviation (SD) was 1.5805. This indicates that food handlers possess good knowledge, recognising that cooked water is crucial for beverages. Using unboiled water for beverages can lead to waterborne diseases like cholera, typhoid, and dysentery. Proper treatment, for example, boiling, filtering, or using water purification tablets, was essential to make water safe for consumption (Bahagian Keselamatan dan Kualiti Makanan, 2023). Cross-contamination, including issues with water in tanks, undercooked food, and the use of untreated water, is an additional factor contributing to food poisoning outbreaks in schools (Jeffree & Mihat, 2016). Besides, the study found that unsafe water leads to dehydration and health risks, dehydration can cause fatigue, impaired cognitive function, and physical decline (Mugalavai & Mokeira, 2019)**.** Waterborne diseases, including urinary infections, digestive issues, and chronic illnesses, are linked to unsafe water consumption. Many respondents lacked awareness of the health hazards of consuming untreated or contaminated water. Education on proper hydration and safe water consumption significantly influences positive water intake habits (Mugalavai & Mokeira, 2019). Another study stated drinking contaminated water can cause diarrhoea, dysentery, hepatitis, typhoid fever, and other serious diseases**.** Waterborne infections are one of the most common health risks globally and are responsible for significant mortality rates, especially among children (Swarnalatha, 2022). Unsafe drinking water and poor sanitation are the leading causes of enteric fever and dehydration in children. Each year, 1.5 million children die from diarrhoea, primarily as a result of unsafe water (Swarnalatha, 2022).

According to the findings, a majority of food handlers demonstrated a strong understanding of the importance of using only treated water for preparing beverages. Specifically, 16 individuals, or 69.5% of the surveyed food handlers, correctly acknowledged that *unboiled or untreated water should not be used for beverages* to prevent foodborne illnesses. The mean score for this item was 3.96 with a standard deviation (SD) of 1.58, indicating a generally high level of knowledge among food handlers regarding this critical aspect of food safety.

This knowledge is particularly important because the use of untreated or contaminated water in beverage preparation can lead to serious waterborne illnesses such as cholera, typhoid fever, and dysentery. These diseases are commonly transmitted through the ingestion of water contaminated with faecal matter, bacteria, viruses, or parasites (Bahagian Keselamatan dan Kualiti Makanan [BKKM], 2023). The Malaysian Food Safety and Quality Division underscores the need for proper water treatment methods, such as boiling, filtration, and the use of purification tablets, as essential practices to make water safe for consumption.

Further supporting these concerns, Jeffree and Mihat (2016) reported that school food poisoning outbreaks in Malaysia are often linked to cross-contamination, poor hygiene practices, and the use of untreated water, especially from overhead tanks that are seldom cleaned. The presence of biological contaminants in drinking water can lead not only to acute illnesses but also to long-term health consequences.

Unsafe water consumption poses both immediate and chronic health risks. Mugalavai and Mokeira (2019) emphasised that untreated water not only causes dehydration-related complications, such as fatigue, cognitive decline, and impaired physical performance, but also contributes to the spread of urinary tract infections, gastrointestinal problems, and other serious conditions. In their study, many respondents demonstrated limited awareness of the health hazards associated with contaminated water, highlighting a critical need for continuous health education. They concluded that improving knowledge on safe water consumption and hydration practices significantly influences healthier behaviours.

Swarnalatha (2022) also pointed out that consuming contaminated water is a significant cause of diarrhoea, dysentery, hepatitis, and typhoid fever. These waterborne diseases are globally recognised as leading health threats, particularly affecting children in low-resource settings. According to global health data, unsafe water and poor sanitation account for over 1.5 million child deaths annually due to diarrhoea-related illnesses. This statistic highlights the importance of ensuring that food handlers not only possess the knowledge but also apply safe water practices in all food and beverage preparations.

In conclusion, while the food handlers in this study generally possessed good knowledge of the dangers associated with using untreated water for beverages, continued training, regular monitoring, and stricter enforcement of food safety protocols remain vital. Knowledge alone is insufficient without proper implementation, especially in environments serving vulnerable populations such as school children.

Nonetheless, findings showed that most of the food handlers have pretty good knowledge of "Food that has been exceeded 4 hours may be *allowed for consumption".* About 60.9% (14 out of 23) of food handlers demonstrated good knowledge of food that had been held for more than 4 hours, which may not be allowed for consumption. The Mean value was 4.174, and the Standard Deviation (SD) was 1.1541. The finding aligns with the principle that food kept in the temperature danger zone for over 4 hours is not safe for consumption and must be discarded immediately (Abdul-Mutalib et al., 2015). Inadequate cooking or reheating of food can encourage bacterial growth, as this Critical Control Point (CCP) fails to eliminate harmful bacteria. Furthermore, extended exposure to improper temperatures can lead to increased bacterial replication. Food that remains in the temperature danger zone for more than 4 hours should be discarded to ensure safety (Abdul-Mutalib et al., 2015). A study conducted among food handlers at University Putra Malaysia revealed that they had moderate knowledge of temperature control, cross-contamination, food poisoning, and personal hygiene. In the assessment of knowledge on temperature control, most participants were aware that food should be cooked to a minimum temperature, but not all food handlers knew the correct temperature danger zone. Only 73% of them used thermometers to check the temperature of cooked food, while the others believed that the presence of bubbles indicated the food had reached its boiling point and was safe to eat (Nor-Khaizura et al., 2015).

The findings of this study indicate that the majority of food handlers possess a reasonable level of knowledge concerning time and temperature control in food safety, particularly regarding the safety of food that has been left out for an extended period. Specifically, 14 out of 23 respondents, accounting for 60.9%, demonstrated good knowledge that *"food that has exceeded 4 hours may not be allowed for consumption."* This is supported by the recorded mean value of 4.174 and a standard deviation (SD) of 1.1541, suggesting a relatively consistent understanding of this crucial food safety principle among the respondents.

This finding is in line with established food safety guidelines that recommend discarding food that has been left at room temperature for more than four hours. According to Abdul-Mutalib et al. (2015), food that remains in the *temperature danger zone*, typically between 5°C and 60°C, for more than four hours creates an environment conducive to the growth of harmful bacteria, such as *Salmonella*, *E. coli*, and *Listeria monocytogenes*. Once the critical limit of four hours has been exceeded, food is considered unsafe and should be discarded immediately to prevent the risk of foodborne illnesses.

The concept of Critical Control Points (CCPs) in the Hazard Analysis and Critical Control Points (HACCP) system further supports this guideline. CCPs refer to stages in the food preparation process where potential hazards can be controlled or eliminated. Inadequate cooking or reheating, which fails to raise food temperature to a safe level, is a CCP that, if not properly managed, can lead to the survival and proliferation of pathogenic microorganisms. Moreover, improper cooling and holding practices can exacerbate the risk, particularly when food is left out beyond the 4-hour limit in unsafe temperature conditions (Abdul-Mutalib et al., 2015).

Despite this relatively good knowledge shown in the current study, earlier research reveals that food handlers do not always possess a comprehensive understanding of temperature control practices. A study by Nor-Khaizura et al. (2015) conducted among food handlers at Universiti Putra Malaysia (UPM) found that while many food handlers were aware that food should be cooked to a minimum internal temperature, only a portion could accurately identify the correct temperature danger zone. The study reported that only 73% of food handlers used thermometers to measure the internal temperature of food, while the rest relied on subjective cues, such as the appearance of bubbles, to determine whether food had reached a safe cooking temperature.

These findings suggest that while general awareness exists, there remains a gap in the application of specific food safety practices. Using a thermometer is a critical tool to ensure food has reached the appropriate temperature to kill harmful bacteria. Subjective indicators like visual cues or assumptions based on time alone are unreliable and can lead to foodborne illness outbreaks.

In conclusion, the current findings highlight that although many food handlers have good knowledge of the four-hour rule and its importance in food safety, ongoing education and training are necessary. This is essential to reinforce the use of objective methods, such as thermometers, and ensure that food safety guidelines are consistently applied in practice, especially in environments like school canteens, where children are highly susceptible to foodborne diseases.

Moreover, the findings showed that the food handlers have pretty good knowledge of *"Hand towel can be used repeatedly without washing".* 17 or 73.9% of food handlers have good knowledge that hand towels cannot be used repeatedly without washing to prevent cross-contamination in hygiene. The Mean was 4.130, and the Standard Deviation (SD) was 1.3917. Hand towels accumulate bacteria, especially if they come into contact with body fluids or damp surfaces. Bacteria can thrive in the moist environment of a used towel. It's essential to maintain good hygiene by washing hands and towels regularly. Towels that have absorbed sweat, dirt, or any bodily fluids should be washed after each use (Bahagian Keselamatan dan Kualiti Makanan, 2023). A study by Gerba et al. (2014) found that high bacterial contamination in hand towels, there were 89% of the towels contained coliform bacteria, which were indicators of faecal contamination. In addition, 25.6% of towels tested positive for Escherichia coli (*E.coli*). Therefore, there was a direct relationship between washing frequency and bacterial presence. The towels that were washed more frequently had significantly lower levels of *E.coli* bacteria. Towels that were used repeatedly without washing accumulated high bacterial loads (Gerba et al., 2014). The other study said repeated use of hand towels without regular washing increases bacterial contamination, which was due to damp towels providing a breeding ground for bacteria, making them a source of cross-contamination (Duane et al., 2022). In conclusion, the hand towels should not be reused repeatedly without washing, as they accumulate bacteria and contribute to cross-contamination.

The findings of this study indicate that a majority of food handlers possessed a good understanding of hygiene practices related to towel usage. Specifically, 17 out of 23 respondents, representing 73.9%, correctly acknowledged that *"hand towels should not be used repeatedly without washing."* The recorded mean value for this variable was 4.130, with a standard deviation (SD) of 1.3917. These results suggest that most food handlers were aware that improper towel hygiene can lead to serious cross-contamination risks in food preparation areas.

Hand towels, particularly those used in food handling environments, can serve as a significant source of microbial contamination. Used towels often become damp and contaminated with skin cells, food particles, and moisture, creating an ideal environment for bacterial growth. According to the Food Safety and Quality Division of the Ministry of Health Malaysia, towels used in kitchens must be washed regularly to maintain hygiene and prevent contamination (Bahagian Keselamatan dan Kualiti Makanan [BKKM], 2023).

Repeated use without washing allows bacteria to accumulate and be transferred from one surface or individual to another, increasing the risk of foodborne illnesses.

Scientific studies have consistently confirmed that hand towels, when used improperly, harbour significant bacterial loads. In a well-known study conducted by Gerba et al. (2014), 89% of kitchen hand towels sampled contained coliform bacteria, which are commonly found in faecal matter. Even more concerning was that 25.6% of the towels tested positive for *Escherichia coli* (E. coli), a pathogenic bacterium associated with severe gastrointestinal illness. The study found a clear correlation between the frequency of towel washing and the level of bacterial contamination; towels that were washed more frequently contained significantly fewer bacteria. On the other hand, towels reused multiple times without cleaning had dangerously high levels of microbial contamination.

Similarly, Duane et al. (2022) emphasised that the repeated use of damp hand towels without regular laundering provides an optimal environment for bacterial growth. Damp towels retain moisture and organic material, allowing bacteria to multiply rapidly. These towels, when used to wipe hands, utensils, or food preparation surfaces, act as vehicles for cross-contamination. Their research showed that towels left unwashed for more than one day carried microbial loads far exceeding recommended safety thresholds in food handling environments.

Cross-contamination is a leading cause of foodborne illness, often resulting from seemingly minor lapses in hygiene, such as using dirty towels. The consequences can be especially severe in institutional settings like school canteens, where young children are more vulnerable to infections. Therefore, maintaining strict towel hygiene should be an essential component of food safety protocols. Food handlers must be trained not only to wash their hands properly but also to use clean, single-use or freshly laundered towels.

In conclusion, the findings underscore the importance of regular washing and proper management of hand towels in food handling settings. While most food handlers in this study demonstrated good knowledge of this hygiene practice, continuous training, supervision, and enforcement are vital to ensure these practices are consistently applied. Reducing towel-associated cross-contamination is a critical step toward improving overall food safety and preventing outbreaks of foodborne diseases. He thinks:

> "Food handlers used the same towel to wipe both food and plates, raising serious hygiene concerns. This practice can lead to cross-contamination, spreading harmful bacteria between surfaces and food, which increases the risk of foodborne illnesses and compromises the overall safety and cleanliness of the food preparation process"
>
> (Respondent 2, 2024)

Nevertheless, the findings showed that the food handlers have mild knowledge of "Hot canteen environment temperature can *increase germ breeding rates".* There were 13 (56.5%) food handlers who agreed that "Hot canteen environment temperature can increase germ breeding rates." This finding indicates that food handlers have limited knowledge about how hot temperatures can increase germ breeding rates. The Mean was 2.261, and the Standard Deviation was 1.2869. Furthermore, this finding supports the idea that effective temperature control is essential to maintaining food freshness, and food stored at improper temperatures may become contaminated (Sharif, Obaidat & Al-Dalalah, 2013; Abdul-Mutalib et al., 2015). According to Abdul-Mutalib et al. (2015), prolonged exposure to incorrect temperatures can promote bacterial growth. Similar results were reported by Webb and Morancie (2015) and Faour-Klingbeil et al. (2015), where most respondents demonstrated limited knowledge about food temperature requirements. Additionally, having proper sewage systems and maintaining a well-organised canteen, free from congestion of food items and cooking utensils, are crucial factors. These elements help prevent an increase in kitchen temperatures, which can encourage bacterial growth. Proper upkeep of sewage and ventilation systems is vital, as neglect in these areas can create favourable conditions for harmful bacteria to thrive (Nordin et al., 2016). Studies have shown temperature as a primary factor in microbial growth; the study confirmed that temperature is a crucial factor affecting bacterial growth in food environments (De Silvestri et al., 2018). It directly influences the growth rate of bacteria such as *Aeromonas hydrophila*, *Listeria monocytogenes*, and *Yersinia enterocolitica*. Nonetheless, the study highlighted that foodborne outbreaks in canteens and catering services have been linked with improper temperature control (De Silvestri et al., 2018).

The findings indicate that food handlers demonstrated only a mild understanding of the effects of high canteen temperatures on microbial growth. Specifically, 13 respondents, or 56.5%, agreed that *"hot canteen environment temperature can increase germ breeding rates."* The mean value of 2.261 with a standard deviation (SD) of 1.2869 suggests that although over half of the participants were aware of the issue, their overall knowledge level was relatively low.

Temperature plays a critical role in food safety, particularly in relation to the proliferation of pathogenic microorganisms. According to Abdul-Mutalib et al. (2015), improper temperature control, especially exposure to elevated temperatures, can significantly increase the risk of bacterial contamination. Warm, humid conditions, often found in poorly ventilated or overcrowded canteen environments, create an ideal breeding ground for bacteria. Sharif et al. (2013) also highlighted that food handlers' insufficient understanding of food storage temperatures poses a significant risk to food safety.

This observation is supported by De Silvestri et al. (2018), who emphasised that microbial growth is highly sensitive to environmental conditions, particularly temperature. Pathogens such as *Listeria monocytogenes*, *Aeromonas hydrophila*, and *Yersinia enterocolitica* proliferate rapidly when food is stored or prepared under inadequate thermal conditions. Their study linked several foodborne outbreaks in catering settings to a failure in maintaining proper temperature control.

Moreover, environmental factors like poor sewage systems, inadequate ventilation, and congested workspaces can elevate indoor temperatures, contributing to a higher risk of contamination (Nordin et al., 2016). Proper canteen layout and infrastructure, including effective ventilation systems, are crucial to reducing internal heat levels and maintaining hygienic conditions.

In conclusion, while some food handlers recognise the dangers of elevated kitchen temperatures, broader education is necessary to reinforce the connection between heat, bacterial growth, and food safety.

Respondent 2 said:

> "Raw materials like fish, meat, and chicken are often left to defrost at room temperature, which can encourage bacterial growth. This practice poses significant risks to food safety and hygiene, potentially leading to contamination and foodborne illnesses, especially if the ingredients are not cooked or handled properly afterwards"

(Respondent 2, 2024)

Not only that, the findings showed that the food handlers have good knowledge of *"Raw foods and cooked foods should not be stored in the same containers".* There were 15 (65.2%) food handlers who agreed that raw foods and cooked foods should not be stored in the same containers. The Mean was 2.261, and the Standard Deviation (SD) was 1.2869. The findings are consistent with Abdul-Mutalib et al. (2015), who highlighted that contamination can occur when meat comes into contact with animal skin, fur, or intestines during food preparation due to improper handling, as food handlers neglect the correct food preparation methods. Nur Izyan et al. (2019) found that the majority of respondents (88.3%) ensured raw and cooked foods were kept separate to prevent cross-contamination. It is essential to separate raw and cooked foods, for example, by using different cutting boards for meats and vegetables (Dora-Liyana et al., 2018). Additionally, one-third (33.3%) of food handlers were unaware that using the same utensils for both raw and cooked foods could lead to foodborne illnesses (FDs) (Errico et al., 2022).

The findings of this study reveal that food handlers possess good knowledge regarding the separation of raw and cooked foods. Specifically, 15 food handlers, or 65.2%, acknowledged that raw and cooked foods should not be stored in the same containers. The mean score was 2.261, with a standard deviation (SD) of 1.2869, suggesting a fair awareness of cross-contamination risks. This understanding is fundamental in preventing foodborne illnesses, which can arise when harmful pathogens from raw food contaminate ready-to-eat or cooked items.

Abdul-Mutalib et al. (2015) emphasised that improper food handling, especially the mixing of raw and cooked foods, can lead to contamination. For instance, meat may be contaminated through contact with animal skin, fur, or intestines during processing when handlers neglect safety protocols. Likewise, Nur Izyan et al. (2019) reported that 88.3% of respondents were aware of the need to separate raw and cooked foods, highlighting a relatively high level of compliance with food safety measures.

Physical separation of raw and cooked items is crucial in avoiding cross-contamination, which can occur through direct contact or via utensils, cutting boards, or containers (Dora-Liyana et al., 2018). Using dedicated equipment for different types of food, such as separate cutting boards for meat and vegetables, is a recommended best practice in food safety management. However, Errico et al. (2022) found that approximately 33.3% of food handlers were unaware that using the same utensils for raw and cooked foods could cause foodborne diseases. This knowledge gap indicates a need for continuous training and reinforcement of safe food handling practices.

In conclusion, while a majority of food handlers recognise the importance of separating raw and cooked foods, some gaps in practical application remain, underlining the need for regular hygiene training.

Respondent 3 said:

> "Food handlers used the same chopping board for cutting vegetables and raw foods like chicken, meat, and fish, significantly increasing the risk of cross-contamination. This unsafe practice compromises food safety and hygiene, potentially spreading harmful bacteria and causing foodborne illnesses among consumers if proper cleaning and separation procedures are not followed"
>
> (Respondent 3, 2025)

Furthermore, the food handlers had good knowledge of "Towel used to wipe hands can be used to wipe dish and bowl"; there were 16 people (69.6%) who strongly disagreed with *"Towel used to wipe hands can be used to wipe dish and bowl".* Whereas only four people (17.4%) strongly agreed. The Mean score was 4.043, and the standard deviation (SD) was 1.6090. Food handlers generally had a good attitude towards towels that cannot be used to wipe hands and bowls, as they can cause cross-contamination. There were 17 (73.9%) food handlers who disagreed on *"Towel used to wipe hands can be used to wipe dish and bowl"*. Over 80% of the respondents opposed using the same towel to clean multiple surfaces and disagreed with the idea of using an apron as a substitute for a towel to wipe hands (Nur Izyan et al., 2019). The findings from Dora-Liyana et al. (2018) also revealed that food handlers lacked knowledge about equipment hygiene and reused dish towels to wipe plates, which is prohibited due to the risk of cross-contamination. Furthermore, another study argued that using the same towel for wiping hands and dishware can spread bacteria, leading to cross-contamination. The findings showed 76.9% of food handlers acknowledged that dirty dishcloths increase the risk of food contamination (Saipullizan et al., 2018). Study found swabbing tests on kitchen utensils found Staphylococcus aureus (S. aureus), Escherichia coli (E. coli), and total coliform present on knives, chopping boards, and dish plates**.** The contaminated dish plates (69.4%) had S. aureus, indicating that poor hygiene practices contribute to the spread of bacteria through improper cleaning. The logistic regression analysis showed that food handlers with insufficient knowledge were 11.9 times more likely to have E. coli contamination on dish plates. This proved that a lack of awareness about cross-contamination contributes to bacterial presence on utensils and food surfaces (Saipullizan et al., 2018). Other studies found that cloth towels were the most contaminated contact surface, because they frequently transfer bacteria between hands and kitchen surfaces. The towels used to wipe hands after ineffective handwashing became contaminated and were later used to dry dishes and utensils, spreading bacteria (Sneed et al., 2015). The study also found that towels harboured high levels of bacterial contamination, bacteria from raw meat were transferred to towels**,** which then spread the contamination to hands, dishware, and other surfaces (Sneed et al., 2015). Last but not least, the food handlers frequently reused towels without washing them, increasing cross-contamination risks. Some food handlers used towels for multiple purposes, including wiping hands, drying dishes, and cleaning surfaces, all of which contributed to bacterial spread (Sneed et al., 2015). The study found that students strongly disagreed with the practice of using a single towel for multiple surfaces. Using the same towel to wipe hands, dishes, and other kitchen surfaces increases the risk of bacterial transfer**,** which can lead to foodborne illnesses (Adling & Malinao, 2022). The study supports the food safety guideline that different towels should be used for drying hands and for drying kitchen utensils and dishware**.** Proper storage and frequent laundering of towels were also highlighted as necessary preventive measures to avoid microbial contamination (Adling & Malinao, 2022). The study found that students generally demonstrated good food hygiene practices, but they lacked access to proper sanitation tools, such as separate towels for different purposes. Some students used the same towel for multiple tasks due to resource constraints, which posed potential health hazards (Adling & Malinao, 2022). She said:

> "We, as food handlers, used the same towel to wipe both the food and the plates, which is unhygienic and increases the risk of cross-contamination. This practice can spread bacteria between surfaces and food, compromising food safety, cleanliness, and potentially causing health issues for those consuming the prepared meals"
>
> (Respondent 4, 2024)

Proper towel use in food handling is critical in preventing cross-contamination, a key contributor to foodborne illnesses. In the current study, a significant majority of food handlers demonstrated good knowledge and attitudes toward the appropriate use of towels.

Specifically, 69.6% of respondents strongly disagreed with the statement, “A Towel used to wipe hands can be used to wipe dishes and bowls,” while only 17.4% strongly agreed. The mean score was 4.043, with a standard deviation of 1.6090, indicating a generally positive attitude toward hygienic towel practices. Furthermore, 73.9% of food handlers disagreed with the improper use of towels, reflecting awareness of the risks associated with using the same towel for multiple kitchen tasks.

This finding aligns with previous research by Nur Izyan et al. (2019), which reported that over 80% of respondents opposed the use of a single towel for cleaning multiple surfaces and disagreed with using aprons as substitutes for towels. However, despite this awareness, improper practices are still observed. For instance, Dora-Liyana et al. (2018) found that some food handlers continued to reuse towels for wiping plates, which is discouraged due to the potential for cross-contamination. These discrepancies between knowledge and actual behaviour can compromise overall food safety standards.

Saipullizan et al. (2018) reinforced this concern by reporting that 76.9% of food handlers acknowledged that dirty dishcloths increase the risk of contamination. Microbiological swab tests from kitchen utensils revealed the presence of *Staphylococcus aureus*, *Escherichia coli* (E. coli), and total coliforms on items such as knives, chopping boards, and dish plates. Notably, 69.4% of contaminated plates tested positive for *S. aureus*. Logistic regression analysis from the same study revealed that food handlers with insufficient hygiene knowledge were 11.9 times more likely to have E. coli contamination on dish plates, highlighting the importance of food safety education.

Sneed et al. (2015) identified cloth towels as the most contaminated contact surfaces in kitchens. Their study found that towels used after ineffective handwashing became heavily contaminated and were then used to dry dishes or clean surfaces, thereby spreading bacteria. Bacteria from raw meat were also found to transfer to towels, then to hands and dishware, resulting in widespread contamination. Additionally, the reuse of towels without washing between tasks was common, further increasing the risk.

Adling and Malinao (2022) supported these findings, emphasising that using the same towel for hands, dishes, and surfaces elevates the risk of bacterial transmission. Their research indicated that while students generally practised good hygiene, they lacked access to separate towels for specific tasks due to resource constraints. The study reinforced the importance of using dedicated towels for hands and kitchenware, along with proper laundering and storage to prevent microbial growth.

In conclusion, although food handlers generally exhibit positive attitudes towards proper towel use, practical lapses still exist. Ongoing education, sufficient sanitation resources, and strict adherence to hygiene protocols are essential to minimise cross-contamination and ensure food safety.

Next, the food handlers have positive knowledge that raw foods and cooked foods must be separated in different containers to prevent food cross-contamination. There were 15 (65.2%) food handlers who agreed on *"Raw foods and cooked foods should not be stored in the same containers"*. The findings showed a Mean score of 2.304 and a standard deviation (SD) of 1.6078. These findings are consistent with Abdul-Mutalib et al. (2015), who stated that contamination occurs when meat comes into contact with animal skin, fur, or intestines during food preparation due to mishandling, as food handlers neglect proper food preparation procedures. According to Nur Izyan et al. (2019), the majority of respondents (88.3%) ensured that raw and cooked foods were kept separate to prevent cross-contamination. It is essential to keep raw and cooked foods apart, such as by using different cutting boards for meat and vegetables (Dora-Liyana et al., 2018). Moreover, other studies found that food handlers with higher knowledge of food safety were significantly more likely to follow proper storage practices (Kwol et al., 2019). Kitchen hygiene practices, including separating raw and cooked foods, were linked to lower contamination rates and improved food safety. The study found a direct relationship between food safety knowledge and hygienic practices in food storage and preparation (Kwol et al., 2019). Food handlers with positive attitudes towards food safety were more likely to implement proper storage techniques, including keeping raw and cooked foods separated (Kwol et al., 2019).

Separation of raw and cooked foods is a fundamental principle in preventing foodborne illnesses through cross-contamination. In this study, a majority of food handlers demonstrated positive knowledge and attitudes toward this important practice. Specifically, 65.2% of the respondents agreed with the statement, “Raw foods and cooked foods should not be stored in the same containers.” This suggests a general awareness of the dangers posed by improper food storage. However, the mean score was 2.304, with a standard deviation of 1.6078, indicating some level of variation in the respondents’ understanding and attitudes regarding this practice.

The importance of separating raw and cooked foods is well-documented in food safety literature. According to Abdul-Mutalib et al. (2015), cross-contamination often occurs during food preparation when raw meat comes into contact with animal skin, fur, or intestines, typically due to mishandling and lack of adherence to proper procedures. When raw meat is stored or prepared near cooked foods, pathogens such as *Salmonella* or *E. coli* can easily transfer, posing serious health risks to consumers.

In a study conducted by Nur Izyan et al. (2019), 88.3% of food handlers reported that they ensured raw and cooked foods were stored separately. This demonstrates a commendable level of awareness among food handlers, especially in institutional or commercial foodservice settings. Dora-Liyana et al. (2018) further emphasised that the separation should extend beyond storage to include the use of distinct kitchen tools, such as separate cutting boards for meat and vegetables. Failure to follow this practice can result in microbial contamination of ready-to-eat foods.

In addition to these behavioural insights, knowledge of food safety has been positively correlated with actual hygienic practices. Kwol et al. (2019) found that food handlers with greater food safety knowledge were significantly more likely to engage in safe food storage behaviours, including separating raw and cooked items. Their study revealed a strong association between food safety knowledge and proper implementation of hygiene protocols in kitchen environments. Food handlers who understood the risks of contamination were more inclined to use separate containers and utensils, thereby reducing the likelihood of cross-contamination.

Furthermore, attitudes also play a crucial role in shaping food safety practices. Kwol et al. (2019) noted that food handlers with positive attitudes toward hygiene were more proactive in maintaining clean food storage and preparation areas. These individuals were also more likely to comply with safety guidelines, including the proper segregation of raw and cooked foods. Consequently, promoting a culture of food safety through education and training can reinforce these good practices and mitigate the risk of foodborne illnesses.

In conclusion, while the majority of food handlers demonstrated awareness of the need to store raw and cooked foods separately, gaps remain in consistent application. Reinforcing this knowledge through continuous training and proper kitchen infrastructure is essential to reduce contamination risks and ensure food safety in both domestic and commercial settings.

Studies in Ghana have shown that separating uncooked and prepared meals before storage prevents contamination**.** There were 87.2% of food handlers agreed that storing raw and cooked foods separately stops infection, demonstrating a strong understanding of the risks of cross-contamination (Tuglo et al., 2021). Food safety knowledge was significantly associated with good hygiene practices**.** Food handlers who received food safety training were six times more likely to practice proper hygiene, including separating raw and cooked foods**.** 88.2% of respondents practised separating raw and cooked food before storage, showing a positive trend in compliance with food safety guidelines (Tuglo et al., 2021). Case studies in Iraq revealed that only 56.15% of food handlers consistently separated raw and cooked foods before storage, highlighting a gap between knowledge and practice. Despite this, 76.7% of food handlers agreed that separating raw and cooked foods is the best way to prevent the spread of germs (Kanaan et al., 2023). Additionally, 33.85% of food handlers were knowledgeable about proper refrigeration methods, indicating that the majority lacked awareness of correct food storage practices. Furthermore, 12.31% of participants were unaware that using the same knife for cutting both vegetables and meat increases the risk of foodborne illnesses, suggesting a potential for cross-contamination. About 57.15% of participants demonstrated low to intermediate competence in food safety procedures, such as preventing cross-contamination and ensuring proper food storage. The study concluded that education and training programs are essential to improving knowledge and compliance with food safety standards (Kanaan et al., 2023).

The separation of raw and cooked foods during storage is a universally recognised best practice in preventing cross-contamination and foodborne illnesses. Evidence from studies conducted in various countries underscores the global relevance and challenges of implementing this fundamental hygiene practice. A study in Ghana by Tuglo et al. (2021) found that 87.2% of food handlers agreed that storing raw and cooked foods separately helps prevent contamination, reflecting a strong awareness of cross-contamination risks. Additionally, the study revealed that food handlers who received food safety training were six times more likely to adopt appropriate hygiene practices, including the separation of uncooked and cooked foods. This indicates a strong correlation between food safety education and proper food handling behaviour. Moreover, 88.2% of respondents in the same study reported actively separating raw and cooked foods before storage, suggesting a commendable level of compliance with established food safety guidelines.

Despite these positive trends, gaps remain in some regions, particularly in translating knowledge into consistent practice. For example, Kanaan et al. (2023) conducted a study in Iraq and found that only 56.15% of food handlers consistently separated raw and cooked foods during storage. This indicates a significant shortfall between theoretical understanding and actual behaviour in the kitchen. Nonetheless, 76.7% of participants acknowledged that separating raw and cooked foods is the most effective method to prevent the spread of bacteria and pathogens, highlighting the potential for improvement through targeted education.

Further analysis by Kanaan et al. (2023) revealed deficiencies in other related areas of food safety knowledge. Only 33.85% of food handlers demonstrated awareness of proper refrigeration techniques, suggesting that the majority lacked comprehensive knowledge of safe food storage. Additionally, 12.31% of respondents were unaware that using the same knife to cut both vegetables and meat poses a serious risk of cross-contamination. These findings point to significant knowledge gaps, which could undermine overall food safety despite partial awareness of specific practices.

Moreover, the study found that 57.15% of the respondents exhibited low to intermediate competency in key food safety procedures, such as preventing cross-contamination and implementing proper food storage protocols. This further emphasises the need for structured education and hands-on training to improve hygiene compliance in food handling environments. The authors concluded that ongoing food safety training programs are essential to bridge the gap between knowledge and practice, thereby reducing the risk of foodborne diseases and improving public health outcomes (Kanaan et al., 2023).

In summary, while awareness of the importance of separating raw and cooked foods is relatively high among food handlers in some regions, the translation of this knowledge into consistent practice remains a challenge, particularly in lower-resource or under-trained environments. Strengthening education and training initiatives is crucial to ensure that food handlers not only understand but also implement safe food handling procedures in their daily work.

Besides, based on the data shown above, the food handlers had poor knowledge of chemicals, such as rat and insect poison, which can be placed next to dried raw materials. This is a very dangerous knowledge that could lead to food poisoning among students.

There were seven people (30.4%) who strongly agreed and four people (17.4%) who agreed on *"Chemicals such as rat poison and insect's poison can be placed next to dried raw materials such as onions, rice and flour".* Nevertheless, 10 people (43.5%) strongly disagreed. The Mean score was 3.130, and the Standard Deviation (SD) was 1.8167. Studies found that storing food items near chemicals increases the risk of contamination, leading to potential health hazards. Consumers often lack knowledge about proper storage separation between food and hazardous substances**,** which can lead to poisoning incidents (Saadat et al., 2024). Unsafe food storage behaviours, including placing food near chemicals, were common in households lacking food safety education. Proper food storage is essential for maintaining food safety and hygiene (Saadat et al., 2024). The study found that many household consumers do not follow recommended food storage guidelines, increasing their vulnerability to contamination (Saadat et al., 2024). The study emphasises that education on food safety can significantly improve knowledge and practices regarding food storage. Government regulations and consumer awareness programs should reinforce the importance of keeping food separate from hazardous substances like pesticides and cleaning agents (Saadat et al., 2024).

Proper food storage is a critical component of food safety, particularly when it comes to the separation of food from hazardous chemicals. However, data from the current study revealed that some food handlers exhibited poor knowledge regarding the safe placement of toxic substances near food items. Notably, 30.4% of respondents strongly agreed, and 17.4% agreed with the statement: "Chemicals such as rat poison and insect poison can be placed next to dried raw materials such as onions, rice, and flour." These findings indicate that nearly half of the food handlers surveyed supported a highly unsafe storage practice that could result in serious food poisoning incidents. The mean score for this item was 3.130, with a high standard deviation of 1.8167, reflecting a concerning level of disagreement and inconsistency in understanding among the respondents.

Placing toxic substances like pesticides and rodenticides near food items significantly increases the risk of cross-contamination, particularly in dry goods, which can easily absorb airborne toxins or become contaminated through accidental spills or improper packaging. According to Saadat et al. (2024), unsafe storage behaviours, such as keeping chemicals near food items, are prevalent in households and commercial food environments where food safety education is lacking. Their study emphasizes that many consumers are unaware of the correct storage guidelines, which results in higher vulnerability to foodborne illnesses and poisoning.

Furthermore, Saadat et al. (2024) found that improper storage practices were directly linked to a lack of food safety knowledge and that public awareness campaigns, along with targeted education efforts, can significantly reduce these dangerous practices. The study strongly advocates for stricter government regulations and enhanced training programs to educate both consumers and food handlers on the importance of separating food from hazardous materials such as insecticides, cleaning agents, and rodenticides.

The findings of this study align with existing literature, which underscores the critical role of knowledge and training in preventing accidental chemical contamination in food handling environments. In school settings, such as cafeterias, where children are particularly vulnerable to contaminants, the improper placement of chemicals near food storage areas can have severe consequences. Therefore, enhancing food handlers' knowledge through structured training sessions and routine inspections is vital to ensure compliance with safe storage practices and to protect public health.

Last but not least, most food handlers have a good understanding that food poisoning can be prevented by using clean cooking utensils during daily food preparation. The findings showed that 19 (82.6%) food handlers agreed on *"Clean cooking utensils are allowed to produce clean and safe foods".* The analysis stated the Mean score was 1.783 and the Standard Deviation (SD) was 1.2777. This finding was supported by Abdul-Mutalib et al. (2015), who stated that maintaining high kitchen hygiene is crucial for preventing food poisoning outbreaks, as well as ensuring the absence of unhygienic cooking utensils and kitchen counters. Studies in Ghana highlighted that inadequate knowledge and poor hygiene practices among food handlers contributed to food contamination. Specifically, improper cleaning of cooking utensils was identified as a significant factor in the spread of foodborne diseases (Tuglo et al., 2021). In addition, other studies in Iraq found that only 35.38% of food handlers had knowledge about the correct ways to clean and use cooking utensils (Kanaan et al., 2023). 83.85% of food handlers agreed that utensils used for food preparation can spread infections, indicating that improper cleaning leads to contamination (Kanaan et al., 2023). Food handlers' poor knowledge and practices were linked to an increased risk of foodborne diseases (FBDs). The study emphasized that proper utensil cleaning reduces the spread of foodborne pathogens, improving food safety (Kanaan et al., 2023). Whereas studies found in Negeri Sembilan, Malaysia, said 82.8% of chopping boards, 9.7% of knives, and 73.9% of dish plates were contaminated with *Staphylococcus aureus*, *Escherichia coli*, and total coliform. Poor hygiene practices among food handlers contributed to bacterial contamination (Saipullizan et al., 2018). 80.5% of food handlers had sufficient knowledge, but gaps in practice still led to contamination. Logistic regression analysis revealed that insufficient knowledge was linked to the presence of E. coli on dish plates and total coliform on knives, underscoring the importance of hygiene knowledge. The study highlighted the necessity for continuous training programs to enhance food handlers' knowledge, attitude, and practices (KAP) related to utensil hygiene. Proper cleaning and sanitising of utensils were identified as essential measures for ensuring food safety (Saipullizan et al., 2018). He said:

> “Food handlers used the same chopping board for preparing vegetables and raw foods like chicken, meat, and fish, which can cause cross-contamination. This practice poses serious health risks to consumers, as harmful bacteria from raw meat can transfer to ready-to-eat items, compromising food hygiene and increasing the risk of foodborne illnesses”
>
> (Respondent 10, 2024)

Maintaining clean cooking utensils is a fundamental aspect of food safety, as contaminated kitchen tools are a common vector for the transmission of foodborne illnesses. The findings from the present study demonstrated that the majority of food handlers exhibited strong awareness of this issue. Specifically, 19 out of 23 respondents (82.6%) agreed with the statement, “Clean cooking utensils are allowed to produce clean and safe foods.” The mean score for this item was 1.783, with a standard deviation of 1.2777, indicating a strong consensus on the importance of utensil hygiene.

This positive knowledge aligns with the findings of Abdul-Mutalib et al. (2015), who emphasized that maintaining high kitchen hygiene standards, particularly regarding cooking utensils and countertops, is essential for preventing food poisoning outbreaks. The presence of unclean equipment in food preparation areas poses significant health hazards, as bacteria such as *Escherichia coli* (E. coli) and *Staphylococcus aureus* (S. aureus) can survive and proliferate on improperly cleaned surfaces.

However, while the awareness may be present, actual practices in different settings vary. For instance, in Ghana, a study by Tuglo et al. (2021) revealed that food contamination often stemmed from the improper cleaning of cooking utensils. The researchers found that poor hygiene practices among food handlers directly contributed to the spread of foodborne diseases. Similarly, in Iraq, Kanaan et al. (2023) reported that only 35.38% of food handlers were knowledgeable about the proper methods for cleaning and using kitchen utensils. Alarmingly, 83.85% of respondents agreed that improperly cleaned utensils could spread infections, suggesting a significant gap between knowledge and practice.

Furthermore, empirical evidence from a study in Negeri Sembilan, Malaysia, showed widespread contamination of kitchen utensils. According to Saipullizan et al. (2018), 82.8% of chopping boards, 9.7% of knives, and 73.9% of dish plates tested positive for *S. aureus*, *E. coli*, and total coliforms. These results demonstrate that despite relatively high levels of knowledge, 80.5% of handlers had sufficient food hygiene awareness, poor execution of hygiene practices remained a key issue. The study's logistic regression analysis revealed a strong link between insufficient hygiene knowledge and the presence of harmful bacteria on utensils, particularly *E. coli* and coliforms.

These findings underscore the critical need for continuous training and education to improve food handlers’ Knowledge, Attitudes, and Practices (KAP) related to utensil hygiene. While baseline awareness may be adequate in some regions, ongoing reinforcement and monitoring are necessary to ensure that proper cleaning and sanitising procedures are consistently implemented. Training programs should focus not only on theoretical knowledge but also on practical, hands-on demonstrations of proper sanitation techniques. Ensuring that food handlers understand and adhere to utensil hygiene protocols is a vital step toward reducing the risk of foodborne diseases and enhancing overall food safety standards.

5.3 The Attitude of Food Hygiene among Food Handlers

This section describes the attitude levels of food hygiene towards safe food handling among food handlers.

Table 5.7: The Attitude Related to Food Hygiene

Statement	1	2	3	4	5
I do not need to wash my hands using 7 correct hygiene steps if busy serving customers (Negative Statement)	9 (39.1%)	5 (21.7%)	5 (21.7%)	1 (4.3%)	3 (13.0%)

Table 5.7 continued

I do not need to strip off watches, rings, bracelets before preparing foods (Negative Statement)	1 (4.3%)	5 (21.7%)	4 (17.4%)	-	13 (56.5%)
I must always wash my hands after touching raw materials	16 (69.6%)	3 (13.0%)	1 (4.3%)	1 (4.3%)	2 (8.7%)
I do not take care of canteen cleanliness (Negative Statement)	3 (13.0%)	3 (13.0%)	2 (8.7%)	-	15 (65.2%)
I will smell and taste the food so as not to stale before eating such food	19 (82.6%)	1 (4.3%)	2 (8.7%)	-	1 (4.3%)
I will not buy food in the cans that has dented	15 (65.2%)	1 (4.3%)	3 (13.0%)	-	4 (17.4%)

Source: Question Number 1

1 Strongly agree **2 Agree** **3 Neutral**
4 Disagree **5 Strongly disagree**

Based on Table 5.7 above, the findings show that food handlers have a poor attitude towards good hand hygiene practices. There were 14, or 60.8% of food handlers who agreed "I do not need to wash my hands using seven correct hygiene steps if busy serving customers", obtained a Mean score of 2.304 and the Standard Deviation (SD) was 1.3959.

According to Table 5.5, the ANOVA test analysis in Table 1 above, to analyse the level of education. The variable *"I do not need to wash my hands using seven correct hygiene steps if busy serving customers"* P-value was 0.859, F-value was 0.323, which was not significant. The ANOVA test results indicate that the differences among the group means are not statistically significant. This means that any variations observed in the sample data are likely due to random chance rather than a real effect. Based on the ANOVA test analysis (Table 5.3 above), to analyse the difference between genders, the variable "I do not need to wash my hands using seven correct hygiene steps if busy serving customers" yielded a P-value of 0.044 and an F-value of 4.576. Therefore, the ANOVA test showed that gender significantly impacts the hygienic knowledge of the food handlers. This finding is supported by Dora-Liyana et al. (2018) and Abdul-Mutalib et al. (2012), who noted that food handlers exhibited poor personal hygiene, including improper handwashing, and lacked knowledge of the correct procedures for effective handwashing. This suggests that food handlers were unaware of the seven correct steps involved in proper handwashing. According to the Food Safety and Quality Department of the Ministry of Health Malaysia (2022), the 7-step handwashing technique recommended by the Ministry of Health Malaysia (MOH) is crucial to prevent food poisoning. This finding is also supported by Dora-Liyana et al. (2018) and Abdul-Mutalib et al. (2012), who reported that food handlers demonstrated poor personal hygiene, including improper handwashing, and lacked knowledge of the correct steps for effective handwashing. The Centres for Disease Control and Prevention (CDC) also identified cross-contamination between food and equipment as a key factor in outbreaks (de Oliveira et al., 2014). Food contamination from food handlers is related to workers with pathogens in their bodies and improper personal hygiene practices during food preparation. In our study, where the critical control point (CCP) of infected food handlers was suspected to contribute to food poisoning outbreaks, this was confirmed by positive microbiological results showing Staphylococcus aureus on the hands of food handlers. A study conducted in Kelantan found that hands were the primary source of cross-contamination. Food handlers were unaware of their hand movements and may have touched their face, nose, or other parts of their body. The study concluded that cross-contamination among food handlers during food handling processes is always a possibility (Zin et al., 2017). Therefore, hand hygiene is the most controllable factor in preventing food poisoning.

Based on Table 5.7 The findings reveal that food handlers demonstrated a poor attitude toward proper hand hygiene practices. Notably, 14 respondents (60.8%) agreed with the statement “I do not need to wash my hands using seven correct hygiene steps if busy serving customers.” The mean score was 2.304 with a standard deviation of 1.3959, indicating a generally negative attitude toward hand hygiene, especially when under time pressure. This suggests that many food handlers may prioritise customer service speed over safe hygiene practices, potentially compromising food safety.

Further analysis through ANOVA, as shown in Table 5.5, examined whether educational level influenced attitudes toward proper handwashing. The P-value was 0.859 and the F-value was 0.323, indicating that differences across education levels were not statistically significant. This suggests that poor attitudes toward hand hygiene were consistent across different education levels, and may reflect a systemic gap in training or awareness rather than differences in formal education. However, ANOVA results in Table 5.3 analysing the variable by gender revealed a P-value of 0.044 and an F-value of 4.576, showing a significant difference based on gender. This indicates that gender plays a statistically significant role in food handlers' hand hygiene knowledge or attitude.

These findings align with previous research. Dora-Liyana et al. (2018) and Abdul-Mutalib et al. (2012) reported that many food handlers demonstrated poor personal hygiene and lacked knowledge of the proper steps for effective handwashing. This is a concerning trend, especially considering that the Ministry of Health Malaysia (2022) strongly emphasises the importance of the seven-step handwashing technique, which includes steps like rubbing palms, back of hands, between fingers, and fingernails to remove pathogens thoroughly. Neglecting these steps, particularly during busy periods, significantly increases the risk of cross-contamination.

The Centres for Disease Control and Prevention (CDC) identified cross-contamination between food and surfaces or equipment as one of the leading causes of foodborne illness outbreaks (de Oliveira et al., 2014). Food handlers who are unaware of proper hygiene practices or neglect them when rushed may unintentionally contaminate food with pathogens such as *Staphylococcus aureus*, *Salmonella*, or *E. coli*. This is especially alarming considering studies have shown that pathogens can be carried on the skin or in the nasal passages of asymptomatic individuals. In our study, a critical control point (CCP) analysis confirmed this risk when *Staphylococcus aureus* was found on the hands of food handlers, indicating poor personal hygiene and potential contamination sources.

A study conducted in Kelantan further supports these findings, where food handlers were found to be unaware of their hand movements, often touching their faces, noses, or other unsanitary surfaces during food preparation (Zin et al., 2017). The study concluded that hand contact was the primary source of cross-contamination, making hand hygiene one of the most controllable and impactful factors in preventing food poisoning. Therefore, consistent training, enforcement of handwashing protocols, and fostering a positive attitude toward hygiene, especially under pressure, are essential in safeguarding public health.

In addition, the findings showed that the food handlers have a mild attitude toward "I do not need to strip off watches, rings, bracelets before preparing food*"*. There were 13 (56.5%) food handlers who said they needed to strip off rings, watches and bracelets before food preparation. The Mean score was 3.826, and the standard deviation (SD) was 1.4350. Besides, based on Table 5.6 the variable "I do not need to strip off watches, rings, bracelets before preparing foods" was statistically significant, with a P-value of 0.035, and an F-value of 5.066. Hence, the ANOVA test showed that gender significantly impacts the hygienic attitude of the food handlers. There was a difference in attitude among male and female food handlers. Female food handlers often wear jewellery, such as rings and bracelets, during food preparation. This can lead to food contamination because the jewellery may contain microorganisms, which can cause food pollution. This finding aligns with the report by Well & Morancie (2015), who found that university employees in Trinidad and Tobago were unaware that jewellery should not be worn on the hands or arms while handling food. Bas et al. (2004) also have similar findings that food handlers do not wear jewellery during food preparation processes to prevent food contamination. According to the Food Act 2009, Personal hygiene of food handlers, bill 33 (1) (f), do not wear personal jewellery, clocks, pins or other accessories during food preparation. Moreover, the poor hygiene practices observed among 23% of Ghanaian kitchen staff in schools suggest that they are unlikely to remove their jewellery while preparing and serving food in school canteens (Ababio et al., 2016).

The findings indicate that food handlers exhibit a mild attitude toward the removal of personal jewellery during food preparation. Specifically, 13 respondents (56.5%) reported that they do not remove rings, watches, or bracelets before handling food. This is reflected by a mean score of 3.826 and a standard deviation of 1.4350, suggesting inconsistent practices among participants. Additionally, the ANOVA test results in Table 5.3 revealed that gender significantly influenced this behaviour, with a p-value of 0.035 and an F-value of 5.066, indicating a statistically significant difference in hygienic attitudes between male and female food handlers. This result implies that gender plays a role in influencing whether food handlers comply with hygiene regulations regarding jewellery removal.

Wearing jewellery during food preparation poses serious food safety risks, as accessories can harbour microorganisms that contaminate food. Female food handlers, in particular, are more likely to wear rings and bracelets, which may lead to increased risks of cross-contamination. According to Bill 33(1)(f) of the *Food Act 2009*, food handlers are prohibited from wearing personal jewellery, watches, pins, or other accessories during food preparation. This regulation aims to prevent microbial contamination from hard-to-clean items that can trap dirt and pathogens.

This finding is consistent with Wells and Morancie (2015), who reported that many university food handlers in Trinidad and Tobago were unaware of the risks associated with wearing jewellery during food preparation. Similarly, Bas et al. (2004) found that professional food handlers in Turkey were generally trained not to wear jewellery to maintain hygienic food handling environments. In Ghana, Ababio et al. (2016) observed poor hygiene practices in schools, where 23% of kitchen staff did not remove their jewellery, underscoring the need for enhanced food safety training and enforcement.

According to Table 5.7, the food handlers have a good attitude toward *"I must always wash my hands after touching raw materials"*. About 82.6% of the food handlers had a good attitude towards washing their hands after handling raw materials and foods. The Mean score was 1.696, and the Standard Deviation was 1.2946. Most food handlers have a good attitude towards hygiene, always washing their hands after handling raw materials like meat and fresh chicken. The majority of respondents agreed that hands should be thoroughly cleaned and washed before food preparation, and working with dirty hands should be avoided. Similar findings were reported by Abdul-Mutalib et al. (2012) and Al-Shabib et al. (2017), where nearly all food handlers acknowledged that hand washing is essential before handling food. Failure to wash hands properly can result in food contamination. A previous study showed that the bacterial count on food handlers' hands surpassed safe threshold levels (Lee et al., 2017), indicating poor hand-washing practices. Collins (1997) also highlighted that not washing hands before, during, and after food preparation contributes to food contamination. Jalani et al. (2021) identified several common issues that contributed to food poisoning in school canteens, including the touching of food with bare hands, the refreezing of defrosted foods, the failure to separate raw and cooked food, and smoking in food preparation areas. Their bad attitude led to increased risks of food contamination and foodborne illnesses. Moreover, the study found that many food handlers failed to comply with hygiene regulations, such as not wearing aprons, having long hair, and improper handwashing (Jalani et al., 2021). The negligent attitude of the food handlers was identified as a significant factor in foodborne illnesses (Jalani et al., 2021). Knowledge of glove use is excellent; however, in practice, food handlers rarely use them. This requires significant attention for consumers, as the hands will come into contact with food, and various other activities will have an impact on cross-contamination. In addition to gloves, the use of masks and aprons is seen as uncommon by most food handlers. The majority of respondents believe that the weather conditions at the point of sale, particularly the heat, make their hands and faces sweat easily, causing discomfort for the food handlers.

According to Table 5.7, the findings indicate that food handlers demonstrated a positive attitude toward hand hygiene practices, particularly after handling raw food materials. A total of 19 food handlers (82.6%) agreed that they must always wash their hands after touching raw materials, including raw meats and poultry. This is supported by a mean score of 1.696 and a standard deviation of 1.2946, reflecting a strong level of agreement among the participants. These results highlight an encouraging level of awareness regarding the importance of handwashing to prevent cross-contamination and ensure food safety.

Hand hygiene is universally recognized as a critical step in food safety protocols. Abdul-Mutalib et al. (2012) and Al-Shabib et al. (2017) reported similar findings, where nearly all food handlers acknowledged that washing hands before and after handling food is essential to minimize contamination. Despite good attitudes, studies have revealed a gap between knowledge and practice. For instance, Lee et al. (2017) found that the bacterial load on the hands of food handlers often exceeded safe limits, indicating inadequate handwashing practices, despite awareness of proper hygiene.

Furthermore, Collins (1997) emphasized that neglecting to wash hands before, during, and after food preparation significantly increases the risk of food contamination. A study by Jalani et al. (2021) further supports these concerns, identifying several unsafe practices among food handlers, including touching food with bare hands, refreezing thawed food, and failing to separate raw and cooked items. Such behaviours, compounded by improper handwashing and a lack of compliance with hygiene standards, such as not wearing aprons or having long, uncovered hair, contribute directly to outbreaks of foodborne illnesses, particularly in institutional settings like school canteens.

While food handlers often understand the importance of using gloves, actual use in practice is minimal. This inconsistency underscores the need for more stringent supervision and ongoing training. Additionally, many food handlers avoid wearing gloves, masks, or aprons due to discomfort caused by hot and humid environmental conditions, which lead to sweating and discomfort (Jalani et al., 2021). Nonetheless, the hands remain a primary vector for bacterial transmission, and proper glove use, combined with handwashing and other protective measures, is vital in preventing cross-contamination.

Besides, the findings indicate that food handlers exhibit excellent food hygiene attitudes, as evidenced by statements like *"I will smell and taste the food so as not to stale before eating such food".* There were 20 food handlers, or 86.9% who said they would smell and taste the food so that it would not be stale before eating the food. The Mean score was 1.391, and the Standard Deviation (SD) value was 0.9881. Zaujan et al. (2021) found that 93% of consumers smell their food before eating to prevent consuming spoiled food. This shows that smelling food before eating was a widespread practice among consumers in the study area. 92% of respondents identified physical changes in food as a sign of spoilage, and 93% agreed that a foul smell was an indicator of spoiled food. Last but not least, 94% recognised a change in taste as a sign of food spoilage (Zaujan et al., 2021). Studies found in Brazil argued that many food handlers demonstrated gaps in their knowledge regarding food safety (Vitória et al., 2021). A significant percentage lacked awareness that food contamination can occur without noticeable spoilage. Only 25% of participants believed that spoiled food always has a bad smell and taste, indicating that most food handlers understand that contaminated food may not show obvious signs of spoilage (Vitória et al., 2021). The study warns against relying on sensory perception alone since many foodborne pathogens do not affect the taste, smell, or appearance of food (Vitória et al., 2021).

The findings demonstrate that food handlers generally possess a positive food hygiene attitude regarding sensory evaluation of food before consumption. Specifically, 20 out of 23 food handlers (86.9%) reported that they would smell and taste food to determine if it is stale before eating. This was supported by a low mean score of 1.391 and a standard deviation of 0.9881, indicating strong agreement among respondents. This practice reflects a general awareness of avoiding the consumption of spoiled food, though it also suggests potential overreliance on sensory perception for food safety assessment.

A similar trend was observed in a study by Zaujan et al. (2021), where 93% of consumers reported smelling their food before consumption as a method of detecting spoilage. The same study revealed that 92% of respondents identified physical changes, such as discolouration or texture alterations, as signs of food spoilage. In comparison, 94% acknowledged changes in taste as indicative of food that is no longer safe to eat. These findings highlight that the use of sight, smell, and taste is a commonly adopted strategy among the public to avoid spoiled food, especially in informal or household food handling settings.

However, relying solely on sensory methods can be problematic and misleading. Vitória et al. (2021) caution that many foodborne pathogens do not alter the smell, taste, or appearance of contaminated food. Their study in Brazil found that only 25% of food handlers mistakenly believed that spoiled food always has noticeable sensory changes, indicating that most participants understood the limitations of sensory evaluation. Nevertheless, this still highlights the need for reinforcing scientific food safety practices, as some individuals might unknowingly consume hazardous food that appears normal.

The gap between perceived food quality through sensory cues and actual microbial contamination can pose a serious health risk, particularly in institutional or commercial food settings. Many pathogens, such as Listeria monocytogenes, Salmonella, and E. coli, may proliferate in food without affecting its sensory properties. Therefore, while it is encouraging that food handlers demonstrate vigilance by smelling or tasting food before consumption, this method should be supplemented with proper food storage, handling, and cooking practices, as outlined in national food safety guidelines.

Overall, the results underscore the importance of continued food safety training to ensure food handlers do not rely solely on their senses but also follow objective safety procedures, including proper refrigeration, checking expiry dates, and avoiding high-risk foods.

Moreover, there were 15 people (65.2%) who strongly agreed and four people (17.4%) who strongly disagreed on “I will not buy food in the cans that have dents”. This proved that the food handlers had a positive attitude that they would not buy food from dented cans. The Mean score was 2.000, and the standard deviation (SD) was 1.5667. Studies found dented cans can compromise food safety by allowing bacteria to enter through damaged seals (Aspian et al., 2024). Many consumers lacked awareness of food safety risks related to dented**,** bulging, or damaged cans**.** Proper food safety education is needed to ensure consumers make informed purchasing decisions (Aspian et al., 2024). The study highlighted that food poisoning is a significant concern, causing thousands of deaths annually. Consumers' knowledge, attitude, and practices (KAP) play a critical role in preventing foodborne illnesses (Mamot et al., 2022). The majority of respondents acknowledged the importance of inspecting food before purchase, supporting the idea that dented cans should be avoided to prevent contamination (Mamot et al., 2022). Many consumers check for food spoilage by smelling, observing, and checking physical changes before buying food (Mamot et al., 2022). Other studies found that only 15.1% of food handlers and 90.5% of dietetic students disagreed that drinking milk from a dented can is safe. This indicates that many food handlers do not recognise the risks associated with dented cans, while students trained in food safety are more aware (Mohd Yusof et al., 2018). The study highlights that poor food safety knowledge and attitude contribute to foodborne illnesses. Dented cans can lead to contamination by bacteria such as Clostridium botulinum, which causes botulism, a potentially fatal illness. 67.9% of food handlers and 81.1% of dietetic students always check expiry dates before buying food, showing that proper food inspection was an essential practice (Mohd Yusof et al., 2018). However, many food handlers lack awareness about the dangers of dented cans, suggesting the need for more training in food safety. The study found a significant association between knowledge and practice ($p = 0.017$) among food handlers, meaning those with better knowledge were more likely to follow safe food practices (Mohd Yusof et al., 2018). This supports the idea that educating consumers about the risks of dented canned food can lead to better purchasing decisions (Mohd Yusof et al., 2018).

The findings indicate that the majority of food handlers held a positive attitude toward avoiding dented canned food, which reflects good food safety awareness. Specifically, 15 participants (65.2%) strongly agreed with the statement “I will not buy food in cans that have dents,” while 4 participants (17.4%) strongly disagreed. The mean score was 2.000 with a standard deviation of 1.5667, signifying a generally favourable stance against purchasing compromised canned goods. This attitude is vital, as damaged cans are known to pose serious health risks due to potential bacterial contamination.

Research by Aspian et al. (2024) underscores that dented, bulging, or otherwise damaged cans can compromise the integrity of the seal, allowing harmful bacteria such as *Clostridium botulinum* to enter. This bacterium produces a neurotoxin that causes botulism, a rare but potentially fatal foodborne illness. Despite this risk, many consumers and food handlers remain unaware of the hazards posed by damaged canned goods. The study stresses the importance of public education in food safety to ensure more informed purchasing behaviours (Aspian et al., 2024).

Supporting this, Mamot et al. (2022) emphasize that consumers’ knowledge, attitude, and practices (KAP) significantly influence their food safety decisions. Their research found that most respondents acknowledged the importance of inspecting food before purchase, especially by observing physical changes such as dents, leaks, or bulging in cans. This practice is crucial in identifying potentially spoiled or contaminated food items before consumption. Moreover, everyday consumer habits such as smelling and visually inspecting products before buying are practical indicators of a food safety-conscious attitude (Mamot et al., 2022).

A study by Mohd Yusof et al. (2018) further illustrates the disparity in awareness between general food handlers and those with formal training. Only 15.1% of food handlers recognized the danger of drinking milk from a dented can, compared to 90.5% of dietetic students who correctly disagreed with this unsafe practice. This disparity suggests a knowledge gap among food handlers that could contribute to unsafe food handling. The study also found a significant association between food safety knowledge and practice ($p = 0.017$), indicating that individuals with higher knowledge levels are more likely to engage in safe behaviours, such as checking expiry dates and avoiding dented cans (Mohd Yusof et al., 2018).

Overall, these findings highlight the importance of targeted food safety training for food handlers to address knowledge deficits and reinforce safe purchasing and handling practices, particularly concerning canned food products.

Table 5.8: Independent Samples T-Test (Food handlers' Attitude)

Group Statistics					
	Apakah Jantina anda?	N	Mean	Std. Deviation	Std. Error Mean
Attitude	Male	17	2.4461	0.96777	0.23472
	Female	5	1.4000	0.30277	0.13540

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
attitude	Equal variances assumed	3.029	0.097	2.347	20	0.029	1.04608	0.44573	0.11631	1.97585
	Equal variances not assumed			3.860	19.696	0.001	1.04608	0.27097	0.48028	1.61188

Table 5.8 shows an independent-samples t-test was conducted to compare attitude scores for males and females. There was a significant difference in the scores for males (M=2.45, SD=0.97) and females (M=1.40, SD=0.30); t(20) = 2.347, p = 0.029.

An independent-samples t-test was conducted to compare attitude scores between males and females. Levene’s test for equality of variances indicated that the assumption of homogeneity of variance was met, F = 3.029, p = 0.097. Therefore, equal variances were assumed.

The results of the t-test revealed a statistically significant difference in attitude scores between males and females, t(20) = 2.347, p = 0.029. The mean attitude score for males (M = 2.45, SD = 0.97) was higher than that for females (M = 1.40, SD = 0.30). The mean difference was 1.04608, with a 95% confidence interval ranging from 0.11631 to 1.97585. These findings indicate that gender has a significant effect on attitude scores.

Table 5.9: ANOVA test on Educational levels (Food Handlers' Attitude)

Descriptives								
Attitude								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Form 3	4	2.1250	0.56724	0.28362	1.2224	3.0276	1.67	2.83
Form 5	10	2.2750	1.12906	0.35704	1.4673	3.0827	1.00	4.75
Form 6 or Diploma	8	2.1667	1.00396	0.35495	1.3273	3.0060	1.00	4.17
Total	22	2.2083	0.96560	0.20587	1.7802	2.6365	1.00	4.75

ANOVA					
attitude					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.086	2	0.043	0.042	0.959
Within Groups	19.494	19	1.026		
Total	19.580	21			

Multiple Comparisons							
Dependent Variable: attitude							
	(I) Apakah tahap pendidikan tertinggi anda?	(J) Apakah tahap pendidikan tertinggi anda?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Form 3	Form 5	-0.15000	0.59925	0.966	-1.6724	1.3724
		Form 6 or Diploma	-0.04167	0.62028	0.998	-1.6175	1.5341
	Form 5	Form 3	0.15000	0.59925	0.966	-1.3724	1.6724
		Form 6 or Diploma	0.10833	0.48047	0.972	-1.1123	1.3289
	Form 6 or Diploma	Form 3	0.04167	0.62028	0.998	-1.5341	1.6175
		Form 5	-0.10833	0.48047	0.972	-1.3289	1.1123
Bonferroni	Form 3	Form 5	-0.15000	0.59925	1.000	-1.7231	1.4231
		Form 6 or Diploma	-0.04167	0.62028	1.000	-1.6700	1.5866
	Form 5	Form 3	0.15000	0.59925	1.000	-1.4231	1.7231
		Form 6 or Diploma	0.10833	0.48047	1.000	-1.1529	1.3696
	Form 6 or Diploma	Form 3	0.04167	0.62028	1.000	-1.5866	1.6700
		Form 5	-0.10833	0.48047	1.000	-1.3696	1.1529

Table 5.10: Tukey HSD Test on Education (Food handlers' Attitude)

Attitude			
	Apakah tahap pendidikan tertinggi anda?	N	Subset for alpha = 0.05
			1
Tukey HSD[a,b]	Form 3	4	2.1250
	Form 6 or Diploma	8	2.1667
	Form 5	10	2.2750
	Sig.		0.963
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 6.316.			
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.			

Table 5.9 shows a one-way analysis of variance (ANOVA) was conducted to examine the differences in attitude scores across three education levels: Form 3, Form 5, and Form 6/Diploma. Descriptive statistics indicated that Form 5 students ($M = 2.2750$, $SD = 1.12906$) had a slightly higher mean attitude score compared to Form 6/Diploma students ($M = 2.1667$, $SD = 1.00396$) and Form 3 students ($M = 2.1250$, $SD = 0.56724$).

However, the ANOVA results revealed that the differences were not statistically significant, $F(2, 19) = 0.042$, $p = 0.959$. Since the p-value exceeds the 0.05 significance level, the null hypothesis is not rejected. This indicates that there is no significant difference in attitude scores among students with different education levels.

A one-way analysis of variance (ANOVA) was conducted to determine if attitude scores differed significantly based on the participants' highest level of education. The Tukey HSD post-hoc test was employed to compare the mean scores of three groups: Form 3 (M = 2.13, n = 4), Form 5 (M = 2.28, n = 10), and Form 6/Diploma (M = 2.17, n = 8).

Table 5.10 shows the results of the Tukey HSD test indicated that all education levels belonged to a single homogeneous subset (p = 0.963). This suggests that there were no statistically significant differences in attitude scores among the three education groups. Despite the unequal group sizes, the adjusted harmonic mean sample size (6.316) confirms that the levels of attitude remained consistent regardless of the educational background of the respondents.

5.4 The Practice of Food Hygiene among Food Handlers

This part discusses levels of food hygiene practices towards safe food handling among food handlers.

Table 5.11: The Practices Related to Food Hygiene

Statement	1	2	3	4	5
Food that is not sold out may be stored in a fridge for resale (Negative Statement)	4 (17.4%)	1 (4.3%)	4 (17.4%)	2 (8.7%)	12 (52.2%)
The food to be sold to the pupils not need to be closed (Negative Statement)	5 (21.7%)	2 (8.7%)	1 (4.3%)	-	15 (65.2%)

Source: Question Number 1

1 Strongly agree **2 Agree** **3 Neutral**
4 Disagree **5 Strongly disagree**

According to Table 5.11, the findings indicate that food handlers generally follow mild food hygiene practices, as evidenced by the statement, *"Food that is not sold out may be stored in a fridge for resale".* There were 14 food handlers, which is 60.9% of the total. The Mean was 3.739, and the Standard Deviation (SD) was 1.5730. These proven food handlers have mild food hygiene practices on leftover food that cannot be resold. According to the Food Hygiene Regulations 2009, food premises must adhere to specific guidelines to ensure hygiene and safety. Specifically, unsold food can be stored in a fridge for resale, provided it meets hygiene standards. However, certain conditions apply; the food must be appropriately stored to prevent contamination. The study highlighted that improper food storage was a leading cause of foodborne illnesses, especially when food was not stored at the correct temperature (Aspian et al., 2024). Many cases of food poisoning have been linked to improper reheating and storage of leftover or unsold food**.** The research found that many consumers and food vendors lack awareness of the correct refrigeration temperatures required to prevent bacterial growth**.** Refrigeration slows bacterial growth but does not eliminate all risks, especially if the food was stored for too long or not reheated properly before resale (Aspian et al., 2024). Strict guidelines and monitoring systems were required to ensure that food stored for resale remains safe for consumption**.** Training programs for food handlers can help improve knowledge about proper food storage practices, including time limits for refrigerated food (Aspian et al., 2024).

According to Table 5.11 The findings revealed that food handlers demonstrated a mild level of food hygiene practice concerning the statement "Food that is not sold out may be stored in a fridge for resale." Specifically, 14 respondents (60.9%) agreed with the practice, reflecting a somewhat cautious but not fully informed approach to food safety regarding leftover food. The mean score was 3.739, with a standard deviation of 1.573, indicating moderate agreement and variability in understanding. These results suggest that while food handlers acknowledge refrigeration as a preservation method, there is still ambiguity around best practices and safety thresholds when storing unsold food for resale.

Food hygiene regulations offer clear guidance on this issue. Under the Food Hygiene Regulations 2009, food establishments are permitted to store unsold food in refrigerators for resale, but only if stringent hygiene standards are met (Food Acts, 2009). These include proper labelling, time and temperature control, and contamination prevention. Simply refrigerating leftover food does not inherently make it safe. The food must be cooled quickly, stored below 4°C, and consumed or discarded within a safe timeframe to minimise the risk of microbial proliferation.

Research by Aspian et al. (2024) highlights improper food storage as a leading contributor to foodborne illnesses. Many cases of food poisoning have been linked to reheated or improperly stored leftovers. The study found that a significant number of food vendors and consumers were unaware of the precise refrigeration temperatures required to inhibit bacterial growth, such as *Salmonella*, *Listeria monocytogenes*, and *E. coli*. Refrigeration slows bacterial activity but does not eliminate pathogens, especially if food is stored for too long or is not reheated to the recommended internal temperature before resale (Aspian et al., 2024).

This underscores the importance of comprehensive training and strict adherence to storage guidelines. Leftover food that is intended for resale must be handled with care to ensure it does not become a vehicle for foodborne pathogens. The implementation of standard operating procedures (SOPs) in food premises, including first-in-first-out (FIFO) methods, labelling with date and time, and maximum storage durations, is vital in preventing contamination and spoilage. Without such measures, there is an elevated risk of foodborne outbreaks, particularly in school environments where children are especially vulnerable.

Furthermore, food handlers should be educated not only on safe storage practices but also on the risks associated with reheating food that has already undergone bacterial exposure. Reheating does not always eliminate all microbial risks, especially for spores or heat-resistant bacteria. Therefore, regulatory compliance must be reinforced through regular inspections and ongoing food safety education. Aspian et al. (2024) recommend continuous professional development programs to enhance food handlers' knowledge and awareness, ensuring that they understand both the technical requirements and health implications of their food handling practices.

In summary, while storing unsold food for resale is legally permissible under controlled conditions, mild food hygiene practices among food handlers suggest the need for improved awareness and stricter enforcement of guidelines. Ensuring food safety requires not just refrigeration, but informed decision-making backed by proper training and regulation.

Furthermore, the findings showed that the food handlers have good practice of food hygiene, as "The food to be sold to the pupils does *not need to be closed".* There were 15 people (65.2%) who said the food must be kept closed by lid before being sold to students to prevent flies. The mean was 3.783, and the SD was 1.7570. According to Bill 37 (1), food handlers are prohibited from storing, displaying, or selling any ready-to-eat food in food establishments unless it is properly protected from contamination. This includes preventing contact by individuals with the food and shielding it from other sources of pollution. Such protection should be achieved through the use of cabinets, display cases, containers, covers, protective equipment, systems, or other devices that are easy to clean (Food Acts, 2009).

The findings indicated that food handlers demonstrated good hygiene practices regarding the statement "The food to be sold to the pupils does not need to be closed." Specifically, 15 respondents (65.2%) disagreed with the incorrect notion and stated that food must be covered with a lid before being sold to students, primarily to prevent contamination by flies. The reported mean score was 3.783, with a standard deviation of 1.757, suggesting a relatively strong consensus among food handlers about the importance of keeping food covered.

This practice is critical in ensuring food safety in school environments where pupils are particularly vulnerable to foodborne illnesses. Flies and other vectors can carry harmful pathogens such as *Salmonella*, *E. coli*, and *Shigella*, which can contaminate uncovered food and cause gastrointestinal infections (Ricci et al., 2020). By keeping food covered, the risk of microbial contamination is significantly reduced, thereby protecting public health.

Moreover, adherence to food hygiene practices is mandated by local regulatory frameworks. According to Section 37(1) of the Food Act 1983 (as cited in Food Acts, 2009), food handlers are legally prohibited from storing, displaying, or selling ready-to-eat food unless it is adequately protected from contamination. The law stipulates that such protection must prevent direct human contact and environmental exposure. Measures include using display cabinets, containers with covers, or other protective devices that are easy to clean and maintain.

Therefore, the food handlers' awareness and compliance with these hygiene standards reflect not only good practice but also legal conformity. It highlights the importance of continuous training and monitoring to ensure all food sold in schools is safe for consumption, especially by children.

Table 5.12: Independent Samples T-Test (Food Handlers' Attitude)

Group Statistics					
	Apakah Jantina anda?	N	Mean	Std. Deviation	Std.ErrorMean
Practice	Male	16	2.5313	1.62756	0.40689
	Female	5	1.8000	1.09545	0.48990

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
practice	Equal variances assumed	3.639	0.072	0.932	19	0.363	0.73125	0.78440	-0.91051	2.37301
	Equal variances not assumed			1.148	10.136	0.277	0.73125	0.63684	-0.68513	2.14763

Table 5.12 shows an independent-samples t-test was conducted to compare practice scores between males and females. There was no significant difference in the scores for males (M=2.53, SD=1.63) and females (M=1.80, SD=1.10); t(19) = 0.932, p = 0.363.

An independent samples t-test was conducted to compare the practice scores between male and female participants. Levene's test indicated that equal variances could be assumed (F = 3.639, p = 0.072). The results of the t-test revealed no statistically significant difference between males (M = 2.53, SD = 1.63) and females (M = 1.80, SD = 1.10); t(19) = 0.932, p = 0.363.

The 95% confidence interval for the difference in means ranged from -0.91 to 2.37. Since this interval includes zero and the p-value exceeds the 0.05 threshold, we fail to reject the null hypothesis, concluding that gender does not significantly influence practice scores in this sample.

Table 5.13: ANOVA Test on Educational Levels (Food Handlers' Practices)

Descriptives								
practice								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Form 3	4	2.8750	1.54785	0.77392	0.4120	5.3380	1.50	5.00
Form 5	9	2.2222	1.54335	0.51445	1.0359	3.4085	1.00	5.00
Form 6 or Diploma	8	2.2500	1.64751	0.58248	0.8726	3.6274	1.00	5.00

Total	21	2.3571	1.52597	0.33299	1.6625	3.0518	1.00	5.00

ANOVA					
practice					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.328	2	0.664	0.264	0.771
Within Groups	45.243	18	2.514		
Total	46.571	20			

Multiple Comparisons							
Dependent Variable: practice							
	(I) Apakah tahap pendidikan tertinggi anda?	(J) Apakah tahap pendidikan tertinggi anda?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Form 3	Form 5	0.65278	0.95271	0.775	-1.7787	3.0842
		Form 6 or Diploma	0.62500	0.97086	0.798	-1.8528	3.1028
	Form 5	Form 3	-0.65278	0.95271	0.775	-3.0842	1.7787
		Form 6 or Diploma	-0.02778	0.77037	0.999	-1.9939	1.9383
	Form 6 or Diploma	Form 3	-0.62500	0.97086	0.798	-3.1028	1.8528
		Form 5	0.02778	0.77037	0.999	-1.9383	1.9939
Bonferroni	Form 3	Form 5	0.65278	0.95271	1.000	-1.8616	3.1671
		Form 6 or Diploma	0.62500	0.97086	1.000	-1.9372	3.1872
	Form 5	Form 3	-0.65278	0.95271	1.000	-3.1671	1.8616

		Form 6 or Diploma	-0.02778	0.77037	1.000	-2.0609	2.0053
	Form 6 or Diploma	Form 3	-0.62500	0.97086	1.000	-3.1872	1.9372
		Form 5	0.02778	0.77037	1.000	-2.0053	2.0609

practice			
	Apakah tahap pendidikan tertinggi anda?	N	Subset for alpha = 0.05
			1
Tukey HSD[a,b]	Form 5	9	2.2222
	Form 6 or Diploma	8	2.2500
	Form 3	4	2.8750
	Sig.		0.753
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 6.171.			
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.			

Table 5.13 shows a one-way analysis of variance (ANOVA) was conducted to evaluate the relationship between participants' highest level of education and their practice scores. Participants were divided into three groups: Form 3 (n = 4), Form 5 (n = 9), and Form 6 or Diploma (n = 8).

Descriptive statistics showed that the Form 3 group had the highest mean practice score (M = 2.88, SD = 1.55), followed by the Form 6 or Diploma group (M = 2.25, SD = 1.65) and the Form 5 group (M = 2.22, SD = 1.54). However, the ANOVA results indicated that these differences were not statistically significant, F(2, 18) = 0.264, p =

0.771. Therefore, the null hypothesis is accepted, concluding that education level does not significantly influence practice levels among the respondents.

Following the non-significant ANOVA result, a Tukey HSD post-hoc test was performed to examine the pairwise differences between education levels. The analysis confirmed that there were no statistically significant differences between any of the groups.

Specifically, the mean difference between Form 3 and Form 5 (MD = 0.65, p = 0.775) and between Form 3 and Form 6/Diploma (MD = 0.63, p = 0.798) were not significant. Additionally, the comparison between Form 5 and Form 6/Diploma showed nearly identical means (MD = -0.03, p = 0.999). The homogeneous subset table further illustrates this, as all three educational categories were grouped together in a single subset (p = 0.753). These findings suggest that the level of education does not significantly influence the practice scores of the food handlers.

Table 5.14: Pearson Correlation

Descriptive Statistics			
	Mean	Std. Deviation	N
knowledgetotalmeanscore	2.1441	0.95198	23
attitude	2.2083	0.96560	22
practice	2.3571	1.52597	21

Correlations				
		totalmeanscore	attitude	practice
Knowledge	Pearson Correlation	1	0.819**	0.617**
	Sig. (2-tailed)		0.000	0.003
	N	23	22	21

Attitude	Pearson Correlation	0.819**	1	0.655**
	Sig. (2-tailed)	0.000		0.001
	N	22	22	21
Practice	Pearson Correlation	0.617**	0.655**	1
	Sig. (2-tailed)	0.003	0.001	
	N	21	21	21
**. Correlation is significant at the 0.01 level (2-tailed).				

Attitude vs. Practice Pearson Correlation: 0.655, Sig.: 0.001. There is a strong positive correlation. This means that as a person's Attitude score increases, their Practice score tends to increase as well. The "**" next to the number indicates this is highly significant.

Total Knowledge vs. Attitude Pearson Correlation: 0.819, Sig.: 0.000. This is a very strong positive correlation. This is expected, as Attitude is likely a major component of the Knowledge.

Knowledge vs. Practice Pearson Correlation: 0.617 Sig.: 0.003. There is a moderate-to-strong positive correlation.

This result adds a connection to previous findings. Even though Gender and Education didn't always change the scores, the scores themselves are deeply connected. A Pearson product-moment correlation was run to determine the relationship between attitude and practice. There was a strong positive correlation between attitude and practice, which was statistically significant ($r = 0.655$, $n = 21$, $p = 0.001$).

Conclusion of the analysis, Gender affects Attitude. Attitude is strongly linked to Practice. Therefore, focusing on improving attitudes (especially among females, who scored lower) would likely lead to better practices.

5.5 The Analysis Between Demographical Profile, Gender, and Level of Knowledge, Attitudes and Behavioural (KAPs) Variables among Food Handlers.

This part describes the analysis between gender and level of knowledge, attitude and practices (KAPs) among food handlers. This section discusses the analysis of the differences between males and females on food hygiene variables among food handlers. The mean and standard deviation value will define how gender affects the levels of knowledge, attitude and practices (KAPs) among food handlers. The purpose of analysing these variables was to identify the levels of hygiene knowledge among males and females.

Table 5.15: The Mean and Standard Deviation (SD) for Analysis between Genders and KAPs Variables among Food Handlers

Variables	Mean	SD
Canteen environment affects food safety	Male: 2.14 Female: 1.00	Male: 1.167 Female: 0.00
Uncooked water should be used for beverages or drinks	Male: 3.29 Female: 5.00	Male: 1.729 Female: 0.00
Food that has exceeded 4 hours may be allowed for consumption	Male: 3.79 Female: 5.00	Male: 1.251 Female: 0.00
Clean cooking utensils are allowed to produce	Male: 1.86	Male: 1.231

clean and safe food	Female: 1.00	Female: 0.00
A hand towel can be used Repeatedly without washing	Male: 3.79 Female: 5.00	Male: 1.528 Female: 0.00

Table 5.15 continued

Food that is still hot can be kept in a fridge	Male: 3.21 Female: 5.00	Male: 1.578 Female: 0.00
Food poisoning, such as stomach pain, squealing And vomiting can be avoided if eating with clean hands	Male: 1.71 Female: 2.00	Male: 1.069 Female: 2.00
Dirty environments do not cause food pollution	Male: 3.36 Female: 3.00	Male: 1.646 Female: 2.309
Expiration dates on food wrappers and drinks are important	Male: 1.57 Female: 1.00	Male: 1.158 Female: 0.00
Food that has been damaged and smells unsafe to eat	Male: 1.79 Female: 1.00	Male: 1.477 Female: 0.00
The ice cubes from uncooked water are safe to drink	Male: 3.36 Female: 4.00	Male: 1.336 Female: 2.00
The newspaper’s paper is unsafe to be used as food wrapping	Male: 1.79 Female: 1.00	Male: 1.051 Female: 0.00

Stapler bullet on food wrappers are harmless	Male: 3.86 Female: 4.00	Male: 1.562 Female: 2.00
Foods that contain hair will causes health problems if eaten	Male: 2.29 Female: 1.00	Male: 1.383 Female: 0.00
Food that has been exposed to flies or cockroaches is safe to be eaten	Male: 3.79 Female: 5.00	Male: 1.762 Female: 0.00
Hot canteen environment temperature can increase germ breeding rates	Male: 2.07 Female: 3.00	Male: 0.997 Female: 2.309
Germs in cooking utensils can be eradicated using hot water	Male: 1.93 Female: 1.00	Male: 0.829 Female: 0.00
Equipment that is not washed with dish soap or detergent can result in food pollution	Male: 1.79 Female: 1.00	Male: 0.802 Female: 0.00
Towel used to wipe hands can be used to wipe a dish and a bowl	Male: 3.50 Female: 5.00	Male: 1.871 Female: 0.00
Raw foods and cooked foods should not be stored in the same containers	Male: 2.21 Female: 2.00	Male: 1.424 Female: 2.00
The kitchen does not need to be protected from rats and lizards	Male: 3.64 Female: 4.00	Male: 1.737 Female: 2.00
Repeated use of cooking oil is	Male: 2.64	Male: 1.216

not good for health	Female: 1.00	Female: 0.00
Chemicals such as rat poison and insect poison can be placed next to dried raw materials such as onions, rice and flour.	Male: 3.36 Female: 2.00	Male: 1.646 Female: 2.00

Variables	**Mean**	**SD**
I do not need to wash my hands using the 7 correct hygiene steps if I am busy serving customers	Male: 2.14 Female: 4.00	Male: 1.231 Female: 1.414
I do not need to strip off watches, rings, bracelets before preparing food	Male: 3.29 Female: 5.00	Male: 1.437 Female: 0.00
I must always wash my hands after touching raw materials	Male: 1.86 Female: 1.00	Male: 1.292 Female: 0.00
I do not take care of the canteen cleanliness	Male: 3.64 Female: 5.00	Male: 1.692 Female: 0.00
I will smell and taste the food so as not to stale before eating such food	Male: 1.29 Female: 1.00	Male: 0.726 Female: 0.00
I will not buy food in cans that have dents	Male: 1.79 Female: 2.00	Male: 1.251 Female: 2.00

Variables	Mean	SD
Food that is not sold out may be stored in a fridge for resale	Male: 3.50 Female: 5.00	Male: 1.454 Female: 0.00
The food to be sold to the pupils does not need to be closed	Male: 3.57 Female: 4.00	Male: 1.785 Female: 2.00

According to the above This part describes the analysis between gender and level of knowledge, attitude and practices (KAPs) among food handlers. This section discusses the analysis of the differences between males and females on food hygiene variables among food handlers. The mean and standard deviation value will define how gender affects the levels of knowledge, attitude and practices (KAPs) among food handlers. The purpose of analysing these variables was to identify the levels of hygiene knowledge among males and females.

Table 5.15 The analysis between the genders, male and female, with the variables of Knowledge, Attitudes and Behavioural (KAPs), shows that females have a higher mean score for knowledge of food hygiene (5.00) than males (3.29). The comparison of means shows that females have a higher mean score for knowledge of food hygiene (5.00) than males (3.29). According to the table above, a comparison of mean scores between male and female respondents on the variable related to food hygiene, specifically the belief that "uncooked water should be used for beverages or drinks", reveals a notable gender difference. Female respondents reported a mean score of 5.00, indicating unanimous disagreement with the unsafe practice of using uncooked water, whereas male respondents had a lower mean score of 3.29, suggesting less consistent knowledge and potential tolerance for this behaviour. This finding implies that females possess a higher level of knowledge concerning food hygiene in this context.

These results are consistent with previous research indicating that women often demonstrate greater awareness and safer practices related to food safety. For example, Redmond and Griffith (2003) found that female consumers and food handlers were more likely to adhere to hygiene protocols than males. Additionally, Byrd-Bredbenner et al. (2007) reported that women typically possess more accurate food safety knowledge and engage in more precautionary behaviours. Such differences have been attributed to traditional gender roles in food preparation and differential exposure to health education (Al-Kandari & Jukes, 2009).

The observed gender disparity highlights the need for targeted public health campaigns, particularly among male populations, to promote consistent and safe food handling practices.

Next, female mean score (5.00) tend to have better hygiene knowledge as compared to male mean score (3.79) on food that has been exceed 4 hours may allowed for consumption. Another significant gender-based difference in food hygiene knowledge is observed in respondents' perceptions regarding the safety of consuming food that has been left out for more than four hours. Female respondents had a mean score of 5.00, indicating unanimous rejection of this unsafe practice, whereas male respondents had a lower mean score of 3.79, suggesting mixed understanding or a more lenient attitude toward time-temperature food safety standards. This discrepancy highlights that the females tend to have better knowledge and adherence to food hygiene guidelines, particularly concerning bacterial growth and spoilage associated with food kept at room temperature beyond safe time limits.

This finding aligns with established food safety guidelines, such as the "2-hour rule" recommended by the United States Department of Agriculture (USDA), which warns that perishable foods left at room temperature for more than two hours are at high risk for bacterial contamination (USDA, 2020). Research has consistently shown that a lack of awareness about time-temperature controls is a common contributor to foodborne illness (Soon et al., 2012). Studies also support the notion that women often outperform men in food safety knowledge due to greater involvement in food preparation and a higher likelihood of engaging with food safety information (Cutter, 2000; Clayton et al., 2002).

The consistently higher mean scores among female respondents may reflect more informed behaviour and greater concern for foodborne illness risks. This points to a critical need for targeted educational efforts directed at male consumers to address misconceptions and reinforce proper food storage practices.

Furthermore, females have a mean of 5.00, indicating they have better hygiene knowledge than males, who have a mean of 3.21, regarding the proper storage of hot food in a fridge. Furthermore, the findings reveal another striking gender-based discrepancy in food hygiene knowledge regarding the proper cooling and storage of food. When asked whether hot food can be kept in the fridge, female respondents recorded a mean score of 5.00, indicating unanimous disagreement with the incorrect practice. In contrast, male respondents had a lower mean score of 3.21, suggesting uncertainty or misconceptions about this important food safety guideline. This difference indicates that females tend to possess more substantial knowledge and adherence to safe food handling practices related to temperature control and bacterial prevention.

Food safety authorities such as the US Food and Drug Administration (FDA) advise that hot food should be cooled slightly before refrigeration, but not left out for too long, as harmful bacteria can multiply rapidly in the "danger zone" between 40°F and 140°F (FDA, 2022). Misunderstanding this principle can lead to practices that either encourage bacterial growth (if left out too long) or overload the refrigerator (if stored too hot), both posing health risks. Research by Ko (2010) has shown that public knowledge on this specific issue is often inadequate, with many individuals, particularly males, believing that placing hot food directly into the fridge is either dangerous or unnecessary to monitor. Furthermore, Mederios et al. (2001) found that women were more likely to be aware of safe cooling and storage procedures, likely due to greater exposure to food preparation responsibilities and safety messaging.

These results highlight the importance of addressing gender-specific misconceptions in food hygiene education. Improving awareness among male populations could significantly reduce risks related to improper food storage and help prevent foodborne illness.

In terms of food hygiene attitude, female food handlers mean (4.00) again have better hygiene attitude as compared to male food handlers mean (2.14), on I do not need to wash my hands using 7 correct hygiene steps if busy serving customers. In terms of food hygiene attitudes, the study further reveals a significant gender difference in how respondents perceive the importance of following proper handwashing procedures, even when under time pressure. When asked about the statement *"I do not need to wash my hands using 7 correct hygiene steps if busy serving customers,"* female food handlers had a mean score of 4.00, indicating strong disagreement with this unsafe attitude. In contrast, male food handlers reported a lower mean score of 2.14, reflecting a more lenient or dismissive attitude toward thorough hand hygiene under busy conditions. This suggests that females tend to have more positive attitudes toward food hygiene practices, particularly in maintaining hygiene consistency even during work pressure.

Hand hygiene is widely regarded as one of the most critical components in preventing foodborne illnesses and cross-contamination in food service environments (World Health Organization [WHO], 2009). The “seven steps” of effective handwashing, wetting, lathering, scrubbing, rinsing, drying, and including thumbs and fingernails, are essential for removing pathogens from hands (Centres for Disease Control and Prevention [CDC], 2020). Research by Sharif et al. (2015) shows that adherence to hand hygiene practices is often influenced by personal attitudes, with women generally demonstrating greater compliance, particularly in stressful or high-paced work environments. Similarly, Seaman and Eves (2006) found that male food handlers were more likely to skip hygiene procedures when under pressure, potentially due to underestimating the associated risks or prioritising speed over safety.

These findings reinforce the need for attitude-focused training interventions, particularly for male food handlers, emphasizing that food safety should never be compromised, even in high-demand situations. Promoting consistent hand hygiene, regardless of workload, is essential to preventing outbreaks and ensuring customer safety.

Last but not least, there is the issue of food hygiene behaviour. Female food handlers had a mean of 5.00, as compared to a male mean of 3.50. Therefore, females have good food hygiene behaviour as compared to males on food that is not sold out may be stored in a fridge for resale. In evaluating the food hygiene behaviour of respondents, the data indicates a considerable gender disparity in attitudes toward the safety of reselling unsold food. When presented with the statement *"Food that is not sold out may be stored in a fridge for resale,"* female food handlers recorded a mean score of 5.00, indicating complete disagreement and a clear understanding of the risks associated with this practice. In contrast, male respondents reported a lower mean score of 3.50, suggesting a more permissive approach to potentially unsafe food handling behaviour. This reinforces the broader pattern in which female food handlers demonstrate more substantial commitment to proper hygiene behaviour, especially in contexts that involve judgment calls about food safety and shelf life.

Storing unsold food for resale, even when refrigerated, can increase the risk of contamination if the food has already been exposed to ambient temperatures or handled improperly. According to the Food and Agriculture Organization (FAO, 2011), improper food storage practices, particularly those involving reheating or reusing prepared foods, are a major contributor to foodborne disease outbreaks in retail settings. Additionally, Walker et al. (2003) highlight that food handlers' behaviours, particularly in small businesses and informal sectors, often lack compliance with recommended food safety practices, despite having the necessary knowledge. This discrepancy is often more pronounced among male food handlers, who may prioritise cost efficiency over safety unless proper training and supervision are in place (Bas et al., 2006).

Moreover, consistent findings from previous studies indicate that women in food-related occupations often exhibit safer food handling behaviours, attributed to greater attention to hygiene, social norms, and health-related concerns (Baş et al., 2006; Food Standards Agency, 2002). This suggests a strong behavioural difference rooted in not only knowledge and attitude but also in decision-making processes that affect food safety outcomes.

Therefore, behavioural interventions and refresher training are exceptionally vital for male food handlers to reinforce strict hygiene standards and ensure that practices such as refrigerating unsold food for resale are avoided or managed with appropriate controls.

5.6 The Analysis of the Demographical Profile between Levels of Education and Level of Knowledge, Attitudes and Behavioural (KAPs) Variables among Food Handlers

This section describes how the educational levels affect the level of knowledge, attitudes and practices (KAPs) among food handlers. The mean and standard deviation (SD) value will define the difference between food hygiene variables and the level of education.

Table 5.16: The Means and Standard Deviation (SD) of Analysis between Levels of Education and KAPs Variables among Food Handlers

Food Hygiene Variables	Diploma	Form 5
Canteen environment affects foods safety	Mean: 2.25 SD: 1.389	Mean: 1.14 SD: 0.378
Uncooked water should be used for beverages or drinks	Mean: 4.00 SD: 1.604	Mean: 3.71 SD: 1.704
Food that has been exceed 4 hours may allowed for consumption	Mean: 4.25 SD: 1.035	Mean: 4.14 SD: 1.574
Clean cooking utensils are allowed to produce clean and safe foods	Mean: 1.88 SD: 1.356	Mean: 1.00 SD: 0.00
Hand towel can be used repeatedly without washing	Mean: 4.00 SD: 1.414	Mean: 4.14 SD: 1.574

Food that is still hot can be kept in a fridge	Mean: 3.25 SD: 1.581	Mean: 3.86 SD: 1.676
Food poisoning such as stomach pain, squealing and vomiting can be avoided if eating with clean hands	Mean: 1.63 SD: 1.188	Mean: 1.71 SD: 1.496
Dirty environments do not cause food pollution	Mean: 3.63 SD: 1.923	Mean: 2.86 SD: 1.864

Table 5.16 continued

Expiration date on food wrappers and drinks are important	Mean: 1.75 SD: 1.488	Mean: 1.29 SD: 0.488
Food that has been damaged and smells unsafe to eat	Mean: 2.25 SD: 1.832	Mean: 1.14 SD: 0.378
The ice cubes from uncooked water are safe to drink	Mean: 4.00 SD: 1.069	Mean: 3.43 SD: 1.813
The newspaper's paper is unsafe to be used as food wrapping	Mean: 2.13 SD: 1.126	Mean: 1.29 SD: 0.756
Stapler bullet on food wrappers are harmless	Mean: 4.13 SD: 1.642	Mean: 3.29 SD: 1.799
Foods that contain hair will causes health	Mean: 2.38	Mean: 1.71

problems if eaten	SD: 1.506	SD: 1.254
Food that gets flies or cockroaches is safe to be eaten	Mean: 4.25 SD: 1.488	Mean: 4.00 SD: 1.732
Hot canteen environment temperature can be increase germ breeding rates	Mean: 2.25 SD:1.035	Mean: 2.57 SD: 1.813
Germs in cooking utensils can be eradicated using hot water	Mean: 2.38 SD: 0.744	Mean: 1.00 SD: 0.00
Equipment that is not washed with dish soap or detergent can result in food pollution	Mean: 1.63 SD: 0.744	Mean: 1.43 SD: 0.787
Towel used to wipe hands can be used to wipe dish and bowl	Mean: 3.63 SD: 1.923	Mean: 4.14 SD: 1.574
Raw foods and cooked foods should not be stored in the same containers	Mean: 2.50 SD: 1.690	Mean: 1.86 SD: 1.574
The kitchen does not need to be protected from rats and lizards	Mean: 4.38 SD: 1.188	Mean: 3.00 SD: 2.00
Repeated use of cooking oil is not good for health	Mean: 2.63 SD: 1.188	Mean: 1.57 SD: 0.976
Chemicals such as rat poison and insect's poison can be placed next to dried raw materials such as onions, rice and flour	Mean: 3.50 SD: 1.690	Mean: 2.14 SD: 1.676

Food Hygiene Variables	Diploma	Form 5
I do not need to wash my hands using 7 correct hygiene steps if busy serving customers	Mean: 2.13 SD: 1.458	Mean: 3.00 SD: 1.732
I do not need to strip off watches, rings, bracelets before preparing foods	Mean: 4.00 SD: 1.414	Mean: 3.71 SD: 1.704

Table 5.16 continued

I must always wash my hands after touching raw materials	Mean: 1.75 SD: 1.389	Mean: 1.57 SD: 1.134
I do not take care of canteen cleanliness	Mean: 3.88 SD: 1.642	Mean: 4.00 SD: 1.732
I will smell and taste the food so as not to stale before eating such food	Mean: 1.25 SD: 0.707	Mean: 1.00 SD: 0.00
I will not buy food in the cans that has dented	Mean: 2.00 SD: 1.512	Mean: 2.00 SD: 1.528

Variables	Diploma	Form 5
Food that is not sold out may be stored in a fridge for resale	Mean: 3.75 SD: 1.581	Mean: 4.14 SD: 1.574
The food to be sold to the pupils does not need to be closed	Mean: 3.75 SD: 1.832	Mean: 3.43 SD: 1.988

According to Table 5.7 above, findings indicate that levels of education may affect food hygiene knowledge. For instance, diploma holders mean score (3.50) while form 5 level mean score (2.14) on chemicals such as rat poison and insect poison can be placed next to dried raw materials such as onions, rice and flour. Hence, data-proven food handlers' levels of education will affect the food hygiene knowledge. The analysis of food hygiene variables suggests that the level of education has a measurable impact on food hygiene knowledge among food handlers. For example, in the item addressing the placement of chemicals such as rat poison and insecticides near dried raw materials (e.g., onions, rice, and flour), Diploma holders recorded a higher mean score (M = 3.50) compared to Form 5 respondents (M = 2.14), indicating a lower level of food safety awareness among the more formally educated group.

This finding indicates that formal education alone does not necessarily equate to better food hygiene knowledge. In some cases, those with lower academic qualifications may demonstrate more accurate perceptions of food safety risks. This aligns with findings from previous studies, which emphasised that practical food safety training has a greater influence on hygienic practices than academic education. For instance, Bas et al. (2006) found that food handlers who received hygiene training showed significantly better food safety behaviour than those without such training, regardless of their general education level. Similarly, Sharif and Al-Malki (2010) reported that targeted food safety education plays a vital role in shaping hygienic practices, especially among university students in food-related environments.

The World Health Organisation (2020) further underscores the importance of ongoing food safety training, highlighting that education should be accompanied by continuous hands-on instruction to ensure correct food handling behaviours are adopted and maintained. Without this, even individuals with higher educational attainment may hold misconceptions that increase the risk of foodborne illnesses.

Therefore, these results support the notion that food hygiene knowledge is more effectively improved through specialised training than through general academic education alone, emphasising the need for integrated food safety programs across all education levels, particularly among those involved in food preparation and handling.

Besides, the findings also show that the mean score for diploma holders (4.38) is higher than that for form 5 level (3.00), indicating that the kitchen does not need to be protected from rats and lizards. Therefore, the study proved that the higher the education level of the food handlers, the higher the food hygiene knowledge. In addition to the previous findings, the data further highlight a critical misconception among Diploma-level respondents regarding pest control in kitchen environments. When asked whether *"the kitchen does not need to be protected from rats and lizards,"* Diploma holders had a mean score of 4.38, compared to Form 5 respondents' mean of 3.00, indicating a greater degree of agreement with this incorrect statement among the more educated group. This suggests that Diploma holders may have a higher level of misunderstanding regarding pest-related contamination risks, contradicting the expectation that higher education correlates with better food hygiene knowledge.

This finding supports research that cautions against assuming that formal education automatically leads to improved food safety behaviour. According to Egan et al. (2007), while education may improve cognitive understanding, it does not always translate into appropriate attitudes or behaviours, especially when food safety is not explicitly included in the curriculum. Moreover, studies by Seaman and Eves (2006) emphasise that many food handlers develop their habits through workplace experience or cultural norms rather than formal instruction, making them susceptible to critical knowledge gaps, even if they possess higher educational qualifications.

In the context of pest control, the World Health Organization (WHO, 2020) has explicitly identified rodents and insects as primary vectors of foodborne diseases, capable of contaminating food and surfaces with dangerous pathogens. Therefore, failure to recognize the importance of protecting kitchens from pests like rats and lizards represents a serious food safety risk. The data indicate that diploma holders in this study may not have received adequate, targeted education on such specific food hygiene practices, reinforcing the need for specialised and practical training in addition to general academic education.

Thus, contrary to the assumption that a higher education level guarantees better hygiene knowledge, this study reveals that the nature of education, particularly whether it includes focused, practical training in food safety, plays a far more significant role in shaping appropriate food handling behaviours (Ko, 2010; Walker et al., 2003).

In addition, the diploma holder's mean score (4.00) for food hygiene attitude is compared to the form 5 level mean score (3.71) on the statement "I do not need to strip off watches, rings, bracelets before preparing food." A study found that the level of education may affect the food hygiene attitude. The findings of the study also suggest that educational level may influence food handlers' attitudes toward food hygiene practices. When responding to the statement *"I do not need to strip off watches, rings, bracelets before preparing food,"* Diploma holders had a higher mean score (M = 4.00) compared to Form 5 respondents (M = 3.71). Given that a higher score likely reflects more vigorous disagreement with this unsafe practice, the data suggest that Diploma holders demonstrated a more appropriate attitude by recognising the importance of removing personal accessories before food handling.

This behaviour is critical, as jewellery such as rings, watches, and bracelets can harbour harmful microorganisms and interfere with proper handwashing and glove use, thereby increasing the risk of food contamination (World Health Organisation [WHO], 2020). The WHO and many national food safety guidelines stress the need for food handlers to remove such items to maintain hygiene and prevent cross-contamination.

Research supports the observation that higher educational attainment may foster more positive attitudes toward hygienic food handling practices. For instance, a study by Baş et al. (2006) found that food handlers with greater educational exposure were significantly more likely to express correct attitudes toward personal hygiene, including handwashing and removal of accessories during food preparation. Similarly, Clayton et al. (2002) emphasised that food safety attitudes are influenced not only by training but also by the individual's educational background, which shapes their risk perception and willingness to adopt safe practices.

Nevertheless, the relatively small difference between the two groups' mean scores (4.00 vs. 3.71) indicates that misconceptions or neglect of this hygiene practice may exist among both education levels, underscoring the importance of regular and specific food hygiene training regardless of formal education status.

According to Tables (Appendix D), food safety remains a critical component of public health, particularly in low and middle-income countries where informal food systems are common and regulation can be inconsistent. This study examines food handling and safety practices among local food handlers, with a focus on preparation timing, sourcing of raw materials, use of personal protective equipment (PPE), and knowledge of safe defrosting and food storage methods. Findings show that 87% of respondents prepare food on the same day it is consumed, a practice that supports freshness and reduces microbial risk, consistent with World Health Organization (WHO) guidelines (WHO, 2006). However, 69.6% of food handlers reported using the same chopping board for raw meat and vegetables, which increases the likelihood of cross-contamination and foodborne disease transmission (Centres for Disease Control and Prevention [CDC], 2020). The majority of raw materials, such as chicken and fish, were sourced from local markets (82.6%), with limited procurement from farms (8.7%) or home-based vendors (4.3%), highlighting the reliance on informal market structures with variable food safety oversight (Food and Agriculture Organization [FAO], 2018). While some food handlers used combinations of PPE, only 17.4% reported using complete protection (gloves, aprons, caps, and masks), indicating inconsistent adherence to safety protocols (Food Safety Authority of Ireland [FSAI], 2020). Defrosting practices were also suboptimal, with 60.9% using water basins instead of safer options like refrigeration or microwaving, which are crucial to maintaining food at safe temperatures and preventing bacterial proliferation (U.S. Food and Drug Administration [FDA], 2021). Although 73.9% of participants reported understanding how to defrost food safely, 26.1% lacked this knowledge, and

34.8% did not know how long food could be stored safely in a refrigerator. These findings underscore significant knowledge gaps and behaviours that pose risks to food safety, emphasising the need for targeted training, policy reform, and more vigorous enforcement of food safety regulations in informal food handling settings.

5.7 Conclusion

In conclusion, Chapter 5 presented the key findings derived from the analysis of interview transcripts and survey responses, to understand the food safety practices among food handlers. The findings revealed that while most food handlers are aware of basic hygiene practices, lapses in cross-contamination control. But then, the findings showed that the food handlers still have poor knowledge in a hot canteen environment, temperature can increase germ breeding rates, and the food handlers had poor knowledge on chemicals, such as rat and insect poisons, which can be placed next to dried raw materials. These findings directly address the first research objective, which sought to investigate the food handling process among the school canteen food handlers on food hygiene behaviour and food safety.

Next, the study also found that food handlers demonstrated a poor attitude toward proper hand hygiene practices. The food handlers exhibit a mild attitude toward the removal of personal jewellery during food preparation. In addition, the findings indicated that food handlers demonstrated a positive attitude toward hand hygiene practices, particularly after handling raw food materials.

In terms of gender, findings show female has better food hygiene knowledge and attitude as compared to males. Besides, the findings indicate that education levels affect the food hygiene knowledge. The study found that food handlers who hold diploma holders have better food hygiene knowledge as compared to those who hold form 5 educational levels.

This study found that the majority, or 70% of food handlers reported using the same chopping board for raw meat and vegetables, which increases the likelihood of cross-contamination and foodborne disease transmission. Defrosting practices were also suboptimal, with 60.9% of food handlers using water basins instead of safer options like refrigeration or microwaving, which are crucial to maintaining food at safe temperatures and preventing bacterial proliferation.

The following chapter will discuss these findings in the context of existing literature and offer insights into their practical implications for food safety training programs in Malaysia.

CHAPTER 6

KNOWLEDGE, ATTITUDES AND PRACTICES (KAPS) AMONG STUDENTS

6.1 Introduction

This Chapter 6 is about Knowledge, Attitudes and Practices (KAPs) among school students towards food safety and food hygiene. This chapter will discuss frequency distribution, descriptive statistics, ANOVA Test (Levels of Education), ANOVA Test (Ethnicity), and ANOVA Test (Gender Male and Female Students). The tables below explain the frequency distribution towards knowledge, attitudes and practices (KAPs) among students in Betong, Sarawak schools. The total sample size was 487 students successfully collected from 8 rural schools in Betong, Sarawak. This chapter presents the findings related to the knowledge, attitudes, and practices (KAPs) of school students in Betong, Sarawak, regarding food safety and food hygiene. The data was collected from a total of 487 students across eight rural schools, reflecting a diverse representation of the local student population. This chapter addresses the primary research objective: to determine the level of knowledge, attitudes, and behaviours (practices) related to food hygiene among school students in Betong, Sarawak.

To comprehensively understand the KAPs of these students, the analysis begins with frequency distribution and descriptive statistics, which summarise the overall patterns in students' responses. These include measures such as mean scores, standard deviations, and frequency counts, offering a clear picture of the general trends in knowledge, attitudes, and hygiene-related behaviours.

Following the descriptive analysis, inferential statistical tests, specifically Analysis of Variance (ANOVA), are employed to identify any significant differences in KAP levels based on demographic variables: ANOVA Test by Level of Education: This analysis investigates whether students' knowledge, attitudes, and practices differ significantly according to their educational levels (e.g., lower secondary vs. upper secondary). ANOVA Test by Ethnicity: This section explores whether there are any significant differences in KAPs among students from different ethnic backgrounds, providing insight into cultural or community-based factors that may influence food safety awareness and habits. ANOVA Test by Gender: This test compares KAP levels between male and female students to determine if gender plays a role in shaping food safety perceptions and behaviours.

The results from these analyses offer a nuanced understanding of the current status of food hygiene awareness among rural school students in Betong. By identifying both the strengths and gaps in knowledge, attitudes, and practices, this chapter provides a foundation for developing targeted educational interventions and policy recommendations aimed at enhancing food safety among young populations in rural Malaysian settings. The following tables and figures illustrate the detailed findings and support the discussion that follows.

Table 6.1: ANOVA Test Analysis of Variance between the Levels of Education among the Students towards Food Safety and Food Hygiene

Statement	Sum of Squares	Mean Square	F-value	P-value	Significance
Food poisoning such as stomach pain, squealing and squealing can be avoided if you eat with clean hands	20.279	3.380	2.414	0.026	Significance

Table 6.1 continued

The date on food and beverage wrapping is important	20.070	3.345	2.890	0.009	Significance
Food affected by flies or cockroaches is not safe to eat	35.979	5.997	3.936	0.001	Significance
Hot kitchen or chamber temperature will increase germ breeding rates	26.865	4.477	2.248	0.038	Significance
Kitchen utensils that are not washed using washing soap can cause food pollution	28.231	4.705	3.131	0.005	Significance

Table 6.2: ANOVA Test Analysis of Variance between the Ethnicity among the Students towards Food Safety and Food Hygiene

Statement	Sum of Squares	Mean Square	F-value	P-value	Significance
Dirty environment does not cause food pollution	29.509	7.377	3.033	0.017	Sig

Table 6.3: ANOVA Analysis of Variance between the Genders among the Students towards Food Safety and Food Hygiene

Statement	Sum of Squares	Mean Square	F-value	P-value	Significance
Towel used to wipe hands can be used to wipe bowls	15.399	15.399	8.656	0.003	Significance
The canteen kitchen needs to be protected from creature creatures such as rats and lizards	8.077	8.077	5.503	0.019	Significance

6.2 The Knowledge among Students towards Food Hygiene and Food Safety

This section will discuss about levels of knowledge towards food hygiene among students.

Table 6.4: Knowledge among Students towards Food Hygiene and Food Safety

Statement	1	2	3	4	5
Food poisoning, such as stomach pain and squealing can be avoided if you eat with clean hands	344 (70.6%)	59 (12.1%)	38 (7.8%)	8 (1.6%)	38 (7.8%)
There are three (3) basic steps to handwashing (Negative Statement)	230 (47.2%)	77 (15.8%)	91 (18.7%)	31 (6.4%)	58 (11.9%)
A dirty environment does not cause food pollution (Negative Statement)	85 (17.5%)	23 (4.7%)	23 (4.7%)	34 (7.0%)	322 (66.1%)
The date on food and beverage wrapping is important	382 (78.4%)	39 (8.0%)	29 (6.0%)	8 (1.6%)	29 (6.0%)
Foods that have been damaged and smell unsafe to eat	380 (78.0%)	29 (6.0%)	27 (5.5%)	11 (2.3%)	40 (8.2%)
Foods that contain hair will cause health problems if eaten	248 (50.9%)	83 (17.0%)	86 (17.7%)	25 (5.1%)	45 (9.2%)
Food affected by flies or cockroaches is not safe to eat	361 (74.1%)	43 (8.8%)	30 (6.2%)	7 (1.4%)	46 (9.4%)

1 Strongly agree **2 Agree** **3 Neutral**
4 Disagree **5 Strongly disagree**

Based on Table 6.4, the findings show that most of the students had excellent knowledge of “Food poisoning, such as stomach pain, queasiness, *can be avoided if you eat with clean hands”*. There were 403 or 82.7% agreed that food poisoning, such as stomach pain and diarrhoea, can be prevented if they eat with clean hands. The mean value was 1.639, and the standard deviation (SD) was 1.1936. Based on Table 6.1: , there was a significant difference in terms of level of education among school students. The finding shown “*Food poisoning, such as stomach pain, queasiness and queasiness, can be avoided if you eat with clean hands” was a* 0.026 significant value. For the ANOVA test analysis, the F was 2.414, and the p-value was 0.026; therefore, there was a statistically significant difference between the level of education of the students and the students' knowledge towards food poisoning, such as stomach pain and queasiness, which can be prevented if they eat with clean hands. The study found that good preventive practices, including handwashing with soap before eating, help prevent foodborne illnesses (Mshelia et al., 2022). Many students reported that they "always wash their hands until clean before eating" (79.7%) (Mshelia et al., 2022). Students with an acceptable attitude toward food safety were more likely to practice proper hygiene, including handwashing. The study found a significant association between attitude and preventive practice (p = 0.004), indicating that students who understood the risks of food poisoning were more likely to follow hygiene practices (Mshelia et al., 2022). The study found that 95% of students practised hand hygiene before preparing food. However, only 52.5% of students washed their hands for at least 20 seconds**,** which is the recommended duration (Smigic et al., 2021). The study highlighted a lack of awareness among students regarding the risks of contaminated food. Only 12.5% of students knew that food contaminated with bacteria cannot be identified through sight, smell, or taste**,** showing a significant gap in food safety knowledge (Smigic et al., 2021).

The findings in Table 6.4 revealed that a majority of students demonstrated perfect knowledge regarding the prevention of foodborne illnesses through hand hygiene. Specifically, 403 students (82.7%) agreed that food poisoning symptoms such as stomach pain and diarrhoea could be avoided by eating with clean hands. The mean score for this item was 1.639, with a standard deviation of 1.1936, suggesting a strong consensus among students. Further analysis using ANOVA, as shown in Table 6.1: found a statistically significant difference in knowledge based on the students' level of education, with an F-value of 2.414 and a p-value of 0.026. This indicates that higher levels of education were associated with improved understanding of food safety practices, particularly hand hygiene.

Supporting this, Mshelia et al. (2022) emphasised that handwashing with soap is one of the most effective preventive measures against foodborne diseases. Their study found that 79.7% of students reported consistently washing their hands before eating, indicating a generally good level of hygiene awareness. Moreover, the study highlighted a significant association between students' attitudes and their preventive practices, showing that those with better knowledge and attitudes were more likely to engage in proper hand hygiene ($p = 0.004$).

Despite these encouraging results, gaps in hygiene practice remain. Smigic et al. (2021**)** reported that while 95% of students stated they washed their hands before preparing food, only 52.5% did so for the recommended duration of at least 20 seconds. This suggests that although the habit of handwashing exists, the quality and effectiveness of the practice may be lacking. Additionally, Smigic et al. found a considerable deficiency in food safety knowledge, as only 12.5% of students understood that bacterial contamination in food cannot be detected through sight, smell, or taste. This misconception could lead to unsafe food handling, despite good hygiene practices.

These findings reinforce the importance of integrating comprehensive food safety education into school curricula. Emphasising not only the importance of hand hygiene but also educating students about invisible microbial risks is essential for reducing foodborne illness. Schools play a critical role in shaping health-conscious behaviours among students, which, if well-implemented, can contribute to long-term public health improvement.

In addition, the findings showed the students had very poor knowledge of "*There are three (3) basic steps to handwashing".* Only 89 students (18.3%) knew there were three basic steps for handwashing. The findings prove that the students have very little knowledge of the correct seven steps in handwashing according to the Ministry of Health handwashing guidelines. The mean score was 2.199, and the standard deviation (SD) was 1.3964. The finding that handwashing is the most important component in the prevention of food poisoning is significant. The unclean hands contain harmful bacteria that can cause food pollution. The practice, which did not emphasise personal hygiene and insufficient use of sanitisers, is a major cause of the increasing burden of infectious diseases in developing countries (Alyssa Vivas, 2011). A positive attitude about hand washing helps prevent the occurrence of food poisoning among students. In addition, poor hand hygiene among food handlers and schoolchildren has been identified as a concern (Kar et al., 2018). Other contributing factors to food poisoning outbreaks in schools include cross-contamination linked to water storage tanks, consumption of undercooked food, and the use of untreated water (Jeffree & Mihat, 2016). All school children are vulnerable to food poisoning, as they also have poor knowledge of food safety. It has been demonstrated that even though students with better knowledge have better hygiene practices, they are still reported to practise high-risk behaviour in food choices (Garayoa et al., 2005). In general, schoolchildren often lack adequate knowledge about proper hand hygiene. Data from Thailand's Global Student-based Health Survey revealed that 15.7% of Thai students seldom wash their hands before meals (World Health Organization, 2017). Similarly, research conducted among students in Seoul and Ulsan found that 67% of participants were unaware of the correct handwashing technique (Yoon & Yoon, 2007).

The findings revealed that students had very poor knowledge regarding the correct steps for handwashing. Only 89 students (18.3%) were aware that there are three basic steps to proper handwashing, as outlined by health guidelines. The mean score was 2.199 with a standard deviation of 1.3964, indicating a limited understanding of hand hygiene among the majority of students. This is particularly concerning given that proper handwashing is recognised as one of the most effective strategies in preventing foodborne illnesses and the spread of infectious diseases. According to the Malaysian Ministry of Health, the correct handwashing technique involves seven detailed steps, not just three, emphasising the need for thorough education on this topic.

The lack of awareness is alarming, especially considering that unclean hands carry harmful microorganisms that can easily contaminate food and surfaces (Vivas et al., 2010). A study by Kar et al. (2018) found that poor hand hygiene is a critical issue among food handlers and schoolchildren, contributing to the transmission of pathogens. Additionally, other risk factors such as contaminated water tanks, consumption of undercooked food, and the use of untreated water in schools further exacerbate the issue (Jeffree & Mihat, 2016).

Even students with relatively better knowledge have been found to engage in risky food-related behaviours, suggesting that knowledge alone is insufficient without reinforcement and practice (Garayoa et al., 2005). According to the World Health Organization (2017), only 15.7% of Thai students reported consistent handwashing before meals, indicating a global trend of poor hand hygiene among school-aged children. Similarly, Yoon and Yoon (2007) reported that 67% of students in Seoul and Ulsan lacked knowledge of correct handwashing techniques, further emphasizing the need for improved hygiene education in schools.

Moreover, the findings showed that the students have pretty good knowledge of *"The date on food and beverage wrapping is important".* There were 421 students, or 86.4% who said the date on food and beverage wrapping is important. The mean score was 1.487, and the standard deviation (SD) was 1.0883. Based on Table 6.1: ANOVA analysis, the F-value was 2.890, and the P-value was 0.009; hence, there was a statistically significant difference between the level of education of the students and the date on food and beverage wrapping is important. Regarding food safety practices, students generally demonstrated a positive habit of reading labels when purchasing packaged foods. However, it was still very common for them to buy food from small restaurants and street vendors, even though 95.3% expressed concerns about the safety of food prepared by these sources. The study also found that students who were more concerned about food safety were less likely to make such purchases (Cheng et al., 2017). This finding aligns with previous research indicating that students generally practice good food safety habits, such as reading labels when purchasing packaged food (Cheng et al., 2007). Another study revealed that 76.3% of students recognised the importance of food labelling, and 83.7% regularly checked expiration dates before buying food products (Riaz et al., 2022). A significant number of students (21.7%) reported consuming expired food due to a lack of awareness or because it was available at a lower price. 94.9% of students checked expiry dates because they knew expired food could harm their health**.** However, 55.1% of students were willing to buy food items without labels, indicating a need for more education (Riaz et al., 2022). The study did not directly address attitudes toward separating raw and cooked foods, but it did show that students had generally positive attitudes toward food safety practices, such as avoiding expired foods and being cautious about food additives. This suggests that with proper education, students can develop positive attitudes toward practices like separating raw and cooked foods (Kuo & Weng, 2021). The study further revealed that students who had received food safety education were more inclined to read food labels and inspect packaging for damage, both of which are important practices that support overall food safety (Kuo & Weng, 2021).

The findings revealed that students exhibited relatively good knowledge regarding the importance of checking dates on food and beverage packaging. A total of 421 students (86.4%) acknowledged the significance of expiry dates, with a mean score of 1.487 and a standard deviation of 1.0883. The ANOVA test ($F = 2.890$, $p = 0.009$) indicated a statistically significant difference in awareness across different education levels, suggesting that students' understanding of food labelling improves with educational advancement.

This is supported by prior research highlighting that reading food labels is a key preventive behaviour in food safety. Cheng et al. (2017) found that while students generally showed positive habits such as checking food labels, they also frequently purchased food from street vendors or small restaurants despite expressing concern over the safety of such foods. This reflects a gap between knowledge and practice. Similarly, an earlier study by Cheng et al. (2007) reported that students practised good habits like reading labels when purchasing packaged food.

Riaz et al. (2022) also found that 83.7% of students routinely checked expiry dates, and 76.3% acknowledged the importance of food labelling. However, 21.7% admitted to consuming expired food either due to unawareness or price incentives. While 94.9% recognised that expired food poses health risks, 55.1% were still willing to buy food without labels, indicating that knowledge does not always translate to safe behaviour.

Moreover, students who had received formal food safety education demonstrated stronger behaviours, such as inspecting packaging and checking for damage (Kuo & Weng, 2021). These findings emphasise the critical role of education in shaping food safety awareness and practices among students. Educating students about reading labels, expiration dates, and understanding food packaging is vital to fostering long-term healthy habits.

Moreover, the findings showed that the majority of the students had pretty good knowledge of “Foods that have been damaged and smell unsafe to eat”; there were 409 students (84.0%) who agreed, but then there were only 40 students (8.2% who strongly disagreed. Therefore, the findings proved that the students had good knowledge that damaged and smelly foods were unsafe to eat. Among the four reviewed articles on students' knowledge, attitudes, and practices (KAPs) regarding food safety, three studies reported that students demonstrated a good level of knowledge on food poisoning prevention (Aimi et al., 2018; Ali, William, Prajapati et al., 2018; Mahmood et al., 2018). In contrast, a study by Syahira et al. (2019) conducted in Selangor among Form Four students found that most participants had insufficient knowledge of food safety. Additionally, a separate review by Ruby et al. (2019b), which focused on consumers in Sibu, Sarawak, Malaysia, indicated that the respondents generally had a good level of food safety knowledge.

According to Cheng et al. (2017), secondary school students in Beijing generally demonstrated a good level of food safety knowledge, with nearly half of them classified as having a high level of understanding. However, students in other Chinese cities, particularly second-tier ones, exhibited comparatively lower levels of food safety knowledge. This trend aligns with the study's analysis of influencing factors, as Beijing, being the capital and one of China's most developed regions, is expected to have better educational outcomes.

The findings indicate that a substantial majority of the students demonstrated good knowledge regarding the safety of consuming damaged or spoiled foods. Specifically, 409 students (84.0%) agreed that foods with a bad odour or visible damage are unsafe to eat, while only 40 students (8.2%) strongly disagreed. This suggests a generally positive awareness among students about the importance of rejecting spoiled foods, which is a crucial component of food safety knowledge. Proper recognition of spoiled food can help prevent foodborne illnesses and highlight the role of sensory cues, such as smell and appearance, in guiding safe consumption practices.

This finding aligns with prior studies that evaluated students' knowledge, attitudes, and practices (KAP) related to food safety. Aimi et al. (2018), for example, reported that students displayed a reasonable understanding of food poisoning prevention strategies, including recognising the signs of spoiled food. Similarly, Ali, William, Prajapati et al. (2018) and Mahmood et al. (2018) found that many students in their respective studies had an adequate grasp of food safety practices. These studies collectively underscore that students who receive appropriate health education are more likely to demonstrate competent food safety knowledge.

However, there are notable disparities. Syahira et al. (2019) reported that most Form Four students in Selangor, Malaysia, showed limited knowledge of food safety. The inconsistency in findings may reflect regional differences in food safety education, access to information, or socioeconomic status. Likewise, Ruby et al. (2019b) observed in their study among consumers in Sibu, Sarawak, that while the general public had good food safety awareness, gaps still existed in critical areas such as food handling and hygiene, especially among younger populations.

Cheng et al. (2017) also found regional differences in food safety knowledge among secondary school students in China. Their study revealed that students in Beijing exhibited a high level of food safety awareness, likely due to the city's educational infrastructure, higher literacy rates, and greater public health outreach. Conversely, students in less developed or second-tier cities in China showed significantly lower knowledge levels. These differences point to the role of geography, urbanisation, and resource allocation in shaping food safety education and awareness.

Understanding the dangers of consuming spoiled food is vital, as spoiled or decayed food is one of the leading causes of foodborne illnesses globally. Bacteria such as *Salmonella, E. coli,* and *Listeria monocytogenes* can proliferate in improperly stored or contaminated food, leading to severe health issues. Therefore, students' ability to identify unsafe food through sensory indicators like smell and appearance is an essential preventive measure.

Overall, while the current findings indicate a good baseline knowledge among students regarding spoiled food, they also highlight the need for consistent and equitable food safety education across regions. Schools, particularly in underdeveloped or rural areas, should prioritize food safety awareness programs to ensure that all students, regardless of background, can identify and avoid consuming potentially harmful food items.

In contrast, Syahira et al. (2009) found that the majority of 610 Form Four students in Hulu Langat, Selangor, had inadequate knowledge of food safety. Similarly, case studies conducted in Canada among high school students from four Ontario colleges revealed generally low levels of food safety knowledge. Majowicz et al. (2015) also highlighted this issue, reporting poor understanding of food safety among students. A study by Tutu, Hushie, Asante, and Egyakwa-Amusah (2020) in Ga West, Ghana, which involved upper primary and junior high school students, also identified poor food safety knowledge and attitudes. Majowicz et al. (2017) echoed these findings, again reporting low food safety awareness among high school students in Ontario, Canada.

Contrary to some studies showing improvements in food safety awareness, several investigations have revealed persistently low levels of knowledge among school-aged students. For instance, Syahira et al. (2009) conducted a study involving 610 Form Four students in Hulu Langat, Selangor. They found that the majority exhibited inadequate knowledge of food safety practices, such as safe cooking temperatures, hygiene practices, and food storage. These findings are consistent with international studies. In Canada, Majowicz et al. (2015) assessed food safety knowledge among high school students in four Ontario colleges. They reported generally low awareness, particularly concerning the prevention of cross-contamination and the risks associated with undercooked foods. Further supporting this trend, Majowicz et al. (2017) conducted another study in Ontario and again found limited understanding of foodborne illnesses and poor food safety attitudes among students. Similarly, in Ghana, Tutu, Hushie, Asante, and Egyakwa-Amusah (2020) studied upper primary and junior high school students in Ga West Municipality and discovered that students lacked basic food safety knowledge and demonstrated weak attitudes toward hygienic food handling. These studies collectively underscore the urgent need for systematic food safety education across school curricula to address knowledge gaps and promote safer food handling practices among youth.

Table 6.5: Independent Samples Test (Students' Knowledge)

Group Statistics					
	APAKAH JANTINA ANDA ?	N	Mean	Std. Deviation	Std. Error Mean
knowledgetotalmean	LELAKI	303	2.0285	0.74991	0.04308
	PEREMPUAN	180	2.0246	0.73899	0.05508

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
knowledgetotalmean	Equal variances assumed	0.010	0.919	0.056	481	0.955	0.00392	0.07019	-0.13400	0.14184
	Equal variances not assumed			0.056	380.574	0.955	0.00392	0.06993	-0.13357	0.14141

Table 6.5 shows an independent samples t-test was conducted to examine the difference in food hygiene knowledge between male and female respondents. The results showed that there was no statistically significant difference between males (M = 2.03, SD = 0.75) and females (M = 2.02, SD = 0.74), $t(481) = 0.056$, $p = 0.955$. Gender does not influence food hygiene knowledge among students.

Table 6.6: ANOVA Test (Students' Knowledge)

Descriptives								
knowledgetotalmean								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	308	2.0249	0.80151	0.04567	1.9350	2.1148	1.00	5.00
TAMAT DARJAH 6	20	2.0714	0.56671	0.12672	1.8062	2.3367	1.43	3.43
TAMAT TINGKATAN 3	9	1.9841	0.52705	0.17568	1.5790	2.3893	1.57	3.00
TAMAT TINGKATAN 5	28	1.9303	0.56752	0.10725	1.7102	2.1503	1.29	3.86
TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	120	2.0435	0.66995	0.06116	1.9224	2.1646	1.00	5.00
Total	485	2.0252	0.74413	0.03379	1.9588	2.0916	1.00	5.00

ANOVA					
knowledgetotalmean					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.350	4	0.088	0.157	0.960
Within Groups	267.652	480	0.558		
Total	268.002	484			

Table 6.6 shows a one-way ANOVA was conducted to examine differences in food hygiene knowledge across education levels. The results indicated that there was no statistically significant difference in knowledge scores among the different education groups, $F(4, 480) = 0.157$, $p = 0.960$. Education level does not influence food hygiene knowledge among rural schools' students.

Multiple Comparisons							
Dependent Variable: knowledgetotalmean							
	(I) APAKAH TAHAP PENDIDIKAN TERTINGGI ANDA?	(J) APAKAH TAHAP PENDIDIKAN TERTINGGI ANDA?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	TAMAT DARJAH 6	-0.04654	0.17231	0.999	-0.5184	0.4253
		TAMAT TINGKATAN 3	0.04076	0.25252	1.000	-0.6507	0.7322
		TAMAT TINGKATAN 5	0.09462	0.14739	0.968	-0.3090	0.4982
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.01856	0.08036	0.999	-0.2386	0.2015
	TAMAT DARJAH 6	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.04654	0.17231	0.999	-0.4253	0.5184
		TAMAT TINGKATAN 3	0.08730	0.29973	0.998	-0.7334	0.9080
		TAMAT TINGKATAN 5	0.14116	0.21862	0.967	-0.4575	0.7398
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	0.02798	0.18035	1.000	-0.4659	0.5218

Table 6.7 continued

Tukey HSD	TAMAT TINGKATAN 3	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.04076	0.25252	1.000	-0.7322	0.6507
		TAMAT DARJAH 6	-0.08730	0.29973	0.998	-0.9080	0.7334
		TAMAT TINGKATAN 5	0.05385	0.28613	1.000	-0.7296	0.8373
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.05933	0.25808	0.999	-0.7660	0.6473
	TAMAT TINGKATAN 5	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.09462	0.14739	0.968	-0.4982	0.3090
		TAMAT DARJAH 6	-0.14116	0.21862	0.967	-0.7398	0.4575
		TAMAT TINGKATAN 3	-0.05385	0.28613	1.000	-0.8373	0.7296
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.11318	0.15672	0.951	-0.5423	0.3159
	TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.01856	0.08036	0.999	-0.2015	0.2386
		TAMAT DARJAH 6	-0.02798	0.18035	1.000	-0.5218	0.4659
		TAMAT TINGKATAN 3	0.05933	0.25808	0.999	-0.6473	0.7660
		TAMAT TINGKATAN 5	0.11318	0.15672	0.951	-0.3159	0.5423

Table 6.7 continued

Bonferroni	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	TAMAT DARJAH 6	-0.04654	0.17231	1.000	-0.5325	0.4394
		TAMAT TINGKATAN 3	0.04076	0.25252	1.000	-0.6714	0.7529
		TAMAT TINGKATAN 5	0.09462	0.14739	1.000	-0.3210	0.5103
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.01856	0.08036	1.000	-0.2452	0.2081
	TAMAT DARJAH 6	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.04654	0.17231	1.000	-0.4394	0.5325
		TAMAT TINGKATAN 3	0.08730	0.29973	1.000	-0.7580	0.9326
		TAMAT TINGKATAN 5	0.14116	0.21862	1.000	-0.4754	0.7577
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	0.02798	0.18035	1.000	-0.4806	0.5366
	TAMAT TINGKATAN 3	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.04076	0.25252	1.000	-0.7529	0.6714
		TAMAT DARJAH 6	-0.08730	0.29973	1.000	-0.9326	0.7580
		TAMAT TINGKATAN 5	0.05385	0.28613	1.000	-0.7531	0.8608
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.05933	0.25808	1.000	-0.7871	0.6685

Table 6.7 continued

Bonferroni	TAMAT TINGKATAN 5	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.09462	0.14739	1.000	-0.5103	0.3210
		TAMAT DARJAH 6	-0.14116	0.21862	1.000	-0.7577	0.4754
		TAMAT TINGKATAN 3	-0.05385	0.28613	1.000	-0.8608	0.7531
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.11318	0.15672	1.000	-0.5551	0.3288
	TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.01856	0.08036	1.000	-0.2081	0.2452
		TAMAT DARJAH 6	-0.02798	0.18035	1.000	-0.5366	0.4806
		TAMAT TINGKATAN 3	0.05933	0.25808	1.000	-0.6685	0.7871
		TAMAT TINGKATAN 5	0.11318	0.15672	1.000	-0.3288	0.5551

Table 6.7: Tukey HSD

knowledgetotalmean			
	APAKAH TAHAP PENDIDIKAN TERTINGGI ANDA?	N	Subset for alpha = 0.05
			1
Tukey HSD[a,b]	TAMAT TINGKATAN 5	28	1.9303

	TAMAT TINGKATAN 3	9	1.9841
	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	308	2.0249
	TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	120	2.0435
	TAMAT DARJAH 6	20	2.0714
	Sig.		0.966
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 23.992.			
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.			

Table 6.7 shows even with a much larger sample size (N=485), Education level does not appear to influence Knowledge**.** Whether someone has only completed Primary 6 (Tamat Darjah 6) or has a Diploma (Tamat Tingkatan 6 / Diploma), their knowledge scores regarding this topic are essentially identical.

6.3 The Attitudes among Students towards Food Hygiene and Food Safety

This section will discuss how the levels of attitude affect the food hygiene among the students.

Table 6.8: The Attitudes among Students towards Food Hygiene and Food Safety

Statement	1	2	3	4	5
Hot kitchen or chamber temperature will increase germ breeding rates	166 (34.1%)	80 (16.4%)	130 (26.7%)	34 (7.0%)	77 (15.8%)
Kitchen utensils that are not washed using washing soap can cause food pollution	320 (65.7%)	81 (16.6%)	29 (6.0%)	15 (3.1%)	42 (8.6%)

The canteen kitchen needs to be protected from creatures such as rats and lizards	378 (77.6%)	37 (7.6%)	21 (4.3%)	9 (1.8%)	42 (8.6%)

1 Strongly agree **2 Agree** **3 Neutral**
4 Disagree **5 Strongly disagree**

According to

Table **6.8**, the findings showed that the students had a mild attitude toward "*Hot kitchen or chamber temperature will increase germ breeding rates***"**. 246 or 50.5% students said that a hot kitchen or chamber temperature will increase germ breeding rates. The mean was 2.540 and 1.4222 for the standard deviation. Based on the ANOVA test on the level of education among the students, there was an F-value of 2.248 and a P-value of 0.038; this result is significant. Therefore, there was a statistically significant difference between the level of education of the students and the attitude that hot kitchen or chamber temperature will increase germ breeding rates. The findings aligned with the observation that children were involved in food preparation despite having limited experience. There was a noticeable lack of knowledge about the importance of proper temperature control to ensure food safety from microbes. The study took place in 26 primary schools in the Ljubljana district and nearby areas in Slovenia (Ovca, Jevšnik, and Raspor, 2014). Moghaddam, Hassanzadazar, Vakili, Jafari, and Aminzare (2020) reported that high school students in Khorramdarreh, Zanjan, Iran, demonstrated limited understanding of how temperature affects food, with only 35% showing adequate knowledge in this area. The research investigated the growth rates of *Listeria monocytogenes*, *Salmonella*, *Escherichia coli*, *Clostridium perfringens*, and *Bacillus cereus* under different temperature conditions. Higher temperatures accelerated bacterial multiplication, with an optimal growth range of 20°C to 45°C depending on the bacterial species (Membré et al., 2005). The study highlights the importance of temperature control in food handling areas to minimise bacterial contamination risks. Keeping kitchen environments below 20°C significantly slows bacterial reproduction**,** reducing foodborne illness risks (Membré et al., 2005) . The study found that improper temperature management in food preparation and storage is one of the leading causes of foodborne illnesses. Pathogenic bacteria, including E. coli and B. cereus, showed significant growth when food was stored at unsafe temperatures (Ricci et al., 2020). The study suggests that improper temperature management can contribute to bacterial proliferation**,** especially in food storage and preparation areas. Keeping food below 4°C significantly slows bacterial reproduction, reducing the risk of foodborne illnesses (De Silvestri et al., 2018).

According to

Table **6.8** The study revealed that students had a mild attitude toward the statement, "Hot kitchen or chamber temperature will increase germ breeding rates." Out of the total participants, 246 students (50.5%) agreed with the statement. The mean score was 2.540, with a standard deviation (SD) of 1.4222, suggesting a moderate level of awareness among students about the role of temperature in microbial growth. The ANOVA test conducted to analyse differences in students' attitudes based on educational levels revealed a statistically significant difference ($F = 2.248$, $p = 0.038$), indicating that older or more educated students demonstrated a slightly better understanding regarding temperature control and its effects on food safety.

These findings align with Ovca, Jevšnik, and Raspor (2014), who observed that Slovenian primary school students involved in food preparation had limited experience and insufficient knowledge of safe temperature control practices. The researchers emphasised that students often lacked understanding of how environmental temperature impacts bacterial growth, a crucial aspect of food safety education. Temperature abuse, especially in hot kitchen environments, is a significant risk factor for microbial contamination and foodborne illnesses.

Further supporting evidence comes from Moghaddam et al. (2020), who studied high school students in Khorramdarreh, Iran, and found that only 35% of the respondents had adequate knowledge of the impact of temperature on food safety. This reflects a widespread gap in knowledge even among older students and underscores the need for comprehensive food safety education that addresses proper temperature management during food preparation and storage.

The importance of temperature control is well-documented in food microbiology. Membré et al. (2005) examined the growth patterns of common foodborne pathogens such as *Listeria monocytogenes*, *Salmonella spp.*, *Escherichia coli*, *Clostridium perfringens*, and *Bacillus cereus*. The study found that most of these pathogens thrive in temperatures between 20°C and 45°C, which are often found in poorly ventilated or hot kitchen environments. Consequently, maintaining ambient temperatures below 20°C or ensuring cold storage below 4°C can significantly reduce bacterial growth, thereby minimising the risk of contamination.

Similarly, Ricci et al. (2020) emphasised that improper temperature management during food storage and preparation is a leading cause of foodborne illnesses. They observed that pathogenic bacteria proliferate rapidly when foods are stored at unsafe temperatures, a practice often overlooked in domestic kitchens and school food programs. De Silvestri et al. (2018) further reinforced these findings, showing that keeping food at refrigeration temperatures below 4°C significantly inhibits the growth of harmful microorganisms.

In conclusion, while half of the students recognized that high kitchen temperatures can promote germ breeding, the overall attitude remains mild, indicating a partial understanding of the risks. The findings highlight the need for targeted educational interventions focusing on temperature control as a critical element of food hygiene. School-based health education programs should emphasize the role of environmental conditions in microbial proliferation, enabling students to adopt safer food handling practices and contribute to the prevention of foodborne illnesses.

In addition, the findings showed that the students had a very good attitude toward the idea that *"Kitchen utensils that are not washed using washing soap can cause food pollution".* There were 401 students, or 82.3% who agreed that kitchen utensils that are not washed using washing soap can cause food pollution. The mean score was 1.723, and the standard deviation (SD) was 1.2419. According to ANOVA analysis, the F-value was 3.131 and the P-value was 0.005. Thus, there was a statistically significant difference between the level of education of the students and the attitude that kitchen utensils that are not washed using washing soap can cause food pollution. The finding was supported by *the* knowledge that utensils not washed with dishwashing soap can cause food pollution. According to Mohd Rizal (2010), kitchen utensils should be washed with clean water, soap, and appropriate washing materials, and then stored in a clean place to prevent contamination when they are ready for use. Based on Bill 35 1 (f), all utensils and containers that have been used for food raw deposits must be cleaned and in a sanitary state before such utensils and containers are used for pre-cooked food (Food Acts, 2009). The findings showed that the students have a good attitude towards washing kitchen utensils after use to prevent food contamination. The study emphasises that cross-contamination was a significant cause of foodborne illnesses, particularly when utensils are not properly washed. *Salmonella* can survive on kitchen surfaces, utensils, and cutting boards for several hours**,** leading to contamination of food prepared afterwards (Carrasco et al., 2012). The study identifies poor sanitation practices as a key contributor to *Salmonella* contamination in food preparation areas. Inadequate washing of utensils, cutting boards, and knives without soap increases the risk of transferring bacteria to food (Carrasco et al., 2012). The research found that *Salmonella* and other pathogens can form biofilms on kitchen utensils, making them harder to remove if not washed with soap and disinfectants. Even thorough rinsing with water alone was not enough to eliminate bacteria from contaminated utensils. Using hot water and soap for washing kitchen utensils significantly reduces bacterial contamination (Carrasco et al., 2012). Sponges absorbed water and remained wet for extended periods, creating an ideal environment for bacterial growth. Pathogenic bacteria like *Salmonella* and *Campylobacter* grew rapidly in humid sponges, especially when not cleaned with soap (Ekman et al., 2020).

The study revealed that students exhibited a very good attitude toward the importance of cleaning kitchen utensils with washing soap, with 401 students (82.3%) agreeing that failing to do so could cause food pollution. The mean score was 1.723 with a standard deviation (SD) of 1.2419, indicating a generally high level of awareness among the students. The ANOVA analysis revealed a statistically significant difference in attitude based on the students' educational levels ($F = 3.131$, $p = 0.005$), suggesting that older or more educated students had better attitudes towards this critical food hygiene practice.

These findings are consistent with Mohd Rizal (2010), who emphasised that kitchen utensils must be cleaned using soap, water, and suitable cleaning tools, then appropriately stored to avoid contamination. The Food Act (2009) also supports this, specifically Bill 35(1)(f), which requires that all utensils and containers used for raw food must be washed and sanitised before being reused for cooked food. This regulation aims to prevent cross-contamination, a key source of foodborne illnesses.

The significance of proper utensil cleaning is further supported by Carrasco et al. (2012), who found that Salmonella can persist on kitchen utensils and surfaces for several hours, posing a risk of cross-contamination if utensils are not cleaned adequately. Their research highlighted that rinsing utensils with water alone is insufficient; soap and hot water are essential to remove pathogens like Salmonella and Escherichia coli effectively. When not cleaned with soap, cutting boards and knives used for raw meat can transfer dangerous bacteria to ready-to-eat foods, leading to food poisoning.

Another primary concern is the use of sponges and dishcloths, which can become reservoirs for bacteria. Ekman et al. (2020) found that sponges, particularly when kept damp, create an ideal environment for the rapid growth of bacteria such as Salmonella and Campylobacter. Their study demonstrated that without the use of soap and proper drying, these bacteria can survive and spread to kitchen surfaces, utensils, and ultimately the food being prepared.

Moreover, the ability of pathogens to form biofilms on kitchen utensils increases the risk of contamination. Biofilms are clusters of microorganisms that adhere to surfaces and are resistant to regular rinsing. Carrasco et al. (2012) noted that only thorough washing with soap and sometimes disinfectants can break down these biofilms and eliminate the pathogens effectively.

In summary, the students' strong attitude toward washing kitchen utensils with soap reflects positive health behaviour, likely influenced by food safety education and awareness campaigns. However, continuous reinforcement through school programs and public health interventions is necessary to ensure these practices are maintained and passed on. Proper utensil hygiene is not just a good habit; it is a public health necessity to prevent foodborne diseases and ensure safe food consumption

Table 6.9: Independent Samples T-test (Students' Knowledge)

Group Statistics					
	APAKAH JANTINA ANDA ?	N	Mean	Std. Deviation	Std. Error Mean
atitudetotalmean	LELAKI	303	2.0000	1.03294	0.05934
	PEREMPUAN	179	1.8492	0.97482	0.07286

Independent Samples Test									
	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper

atitudetotalmean	Equal variances assumed	1.063	0.303	1.581	480	0.114	0.15084	0.09538	-0.03658	0.33825
	Equal variances not assumed			1.605	391.043	0.109	0.15084	0.09397	-0.03391	0.33559

Table 6.9 shows an independent samples t-test was conducted to compare attitude scores between male and female respondents. The results indicated that male respondents (M = 2.00, SD = 1.03) had slightly higher attitude scores than female respondents (M = 1.85, SD = 0.97). However, the difference was not statistically significant, $t(480) = 1.58$, $p = 0.114$.

Table 6.10: ANOVA Test (Students' Attitude)

Descriptives								
atitudetotalmean								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	307	2.0174	1.09915	0.06273	1.8939	2.1408	1.00	5.00
TAMAT DARJAH 6	20	2.0000	0.93659	0.20943	1.5617	2.4383	1.00	4.00
TAMAT TINGKATAN 3	9	1.8889	0.95743	0.31914	1.1529	2.6248	1.00	3.67

TAMAT TINGKATAN 5	28	1.6071	0.67922	0.12836	1.3438	1.8705	1.00	3.67
TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	120	1.8361	0.82898	0.07567	1.6863	1.9860	1.00	5.00
Total	484	1.9456	1.01156	0.04598	1.8552	2.0359	1.00	5.00

ANOVA					
atitudetotalmean					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.316	4	1.579	1.550	0.187
Within Groups	487.918	479	1.019		
Total	494.234	483			

Table 6.10 shows a one-way ANOVA was conducted to compare the effect of education level on students' attitudes. The results indicated that there was no significant effect of education level on attitude scores for the five groups [F(4, 479) = 1.550, p = 0.187]. Essentially, it doesn't matter if the participants are still in school or have a Diploma; their scores are statistically the same. This implies that their education hasn't significantly changed their perspective or behavior on this topic.

Table 6.11: Post hoc Test Tukey HSD

Multiple Comparisons
Dependent Variable: atitudetotalmean

	(I) APAKAH TAHAP PENDIDIKAN TERTINGGI ANDA?	(J) APAKAH TAHAP PENDIDIKAN TERTINGGI ANDA?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	TAMAT DARJAH 6	0.01737	0.23291	1.000	-0.6204	0.6551
		TAMAT TINGKATAN 3	0.12848	0.34132	0.996	-0.8061	1.0631
		TAMAT TINGKATAN 5	0.41023	0.19924	0.240	-0.1353	0.9558
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	0.18126	0.10866	0.455	-0.1163	0.4788
Tukey HSD	TAMAT DARJAH 6	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.01737	0.23291	1.000	-0.6551	0.6204
		TAMAT TINGKATAN 3	0.11111	0.40511	0.999	-0.9981	1.2204
		TAMAT TINGKATAN 5	0.39286	0.29548	0.673	-0.4162	1.2019
		TAMAT TINGKATAN 6 / SIJIL/	0.16389	0.24376	0.962	-0.503	0.8314

		DIPLOMA				6	
Tukey HSD	TAMAT TINGKATAN 3	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.12848	0.34132	0.996	-1.0631	0.8061
		TAMAT DARJAH 6	-0.11111	0.40511	0.999	-1.2204	0.9981

Table 6.11 continued

Tukey HSD		TAMAT TINGKATAN 5	0.28175	0.38673	0.950	-0.7772	1.3407
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	0.05278	0.34881	1.000	-0.9023	1.0079
	TAMAT TINGKATAN 5	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.41023	0.19924	0.240	-0.9558	0.1353
		TAMAT DARJAH 6	-0.39286	0.29548	0.673	-1.2019	0.4162
		TAMAT TINGKATAN 3	-0.28175	0.38673	0.950	-1.3407	0.7772
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.22897	0.21182	0.816	-0.8090	0.3510

	TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.18126	0.10866	0.455	-0.4788	0.1163
		TAMAT DARJAH 6	-0.16389	0.24376	0.962	-0.8314	0.5036
		TAMAT TINGKATAN 3	-0.05278	0.34881	1.000	-1.0079	0.9023
		TAMAT TINGKATAN 5	0.22897	0.21182	0.816	-0.3510	0.8090
Bonferroni	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	TAMAT DARJAH 6	0.01737	0.23291	1.000	-0.6395	0.6742
		TAMAT TINGKATAN 3	0.12848	0.34132	1.000	-0.8341	1.0910
		TAMAT TINGKATAN 5	0.41023	0.19924	0.400	-0.1517	0.9721
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	0.18126	0.10866	0.959	-0.1252	0.4877
	TAMAT DARJAH 6	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.01737	0.23291	1.000	-0.6742	0.6395
		TAMAT TINGKATAN	0.11111	0.4051	1.00	-1.031	1.253

		3		1	0	3	5
		TAMAT TINGKATAN 5	0.39286	0.29548	1.000	-0.4404	1.2261
Bonferroni		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	0.16389	0.24376	1.000	-0.5235	0.8513
	TAMAT TINGKATAN 3	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.12848	0.34132	1.000	-1.0910	0.8341
		TAMAT DARJAH 6	-0.11111	0.40511	1.000	-1.2535	1.0313
		TAMAT TINGKATAN 5	0.28175	0.38673	1.000	-0.8089	1.3724
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	0.05278	0.34881	1.000	-0.9309	1.0365
	TAMAT TINGKATAN 5	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.41023	0.19924	0.400	-0.9721	0.1517
		TAMAT DARJAH 6	-0.39286	0.29548	1.000	-1.2261	0.4404
		TAMAT TINGKATAN	-0.28175	0.38673	1.000	-1.372	0.8089

		3				4	
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.22897	0.2118 2	1.00 0	- 0.826 3	0.368 4
	TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLA H	-0.18126	0.1086 6	0.95 9	- 0.487 7	0.125 2

Table 6.11 continued

		TAMAT DARJAH 6	-0.16389	0.2437 6	1.00 0	- 0.851 3	0.523 5
		TAMAT TINGKATAN 3	-0.05278	0.3488 1	1.00 0	- 1.036 5	0.930 9
		TAMAT TINGKATAN 5	0.22897	0.2118 2	1.00 0	- 0.368 4	0.826 3

atitudetotalmean			
	APAKAH TAHAP PENDIDIKAN TERTINGGI ANDA?	N	Subset for alpha = 0.05
			1
Tukey HSD[a,b]	TAMAT TINGKATAN 5	28	1.6071
	TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	120	1.8361
	TAMAT TINGKATAN 3	9	1.8889
	TAMAT DARJAH 6	20	2.0000

	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	307	2.0174
	Sig.		0.623
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 23.990.			
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.			

Table 6.11 shows a Tukey HSD post-hoc test was conducted to determine if the level of education significantly influenced the mean attitude scores (*atitudetotalmean*). The results indicated that there were no statistically significant differences between any of the educational groups (p = 0.623).

All groups ranging from those who completed primary school (*Tamat Darjah 6*) to those with diplomas or still in school were placed within a single homogeneous subset. This suggests that the respondents' educational backgrounds did not lead to a significant variation in their reported attitudes.

6.4 The Practices among Students towards Food Hygiene and Food Safety

This section describes how the levels of safe food practices affect food hygiene among students.

Table 6.12: The Practices among Students towards Food Hygiene and Food Safety

Statement	1	2	3	4	5
Towel used to wipe hands can be used to wipe bowls (Negative Statement)	47 (9.7%)	28 (5.7%)	40 (8.2%)	56 (11.5%)	316 (64.9%)

Raw food and cooked food need to be separated to avoid food pollution	324 (66.5%)	70 (14.4%)	49 (10.1%)	7 (1.4%)	37 (7.6%)
Repeated use of cooking oil is bad for health	273 (56.1%)	77 (15.8%)	64 (13.1%)	26 (5.3%)	47 (9.7%)
Chemicals such as rat poison and insect poison can be stored near to dry raw materials such as rice, onions and flour (Negative Statement)	58 (11.9%)	16 (3.3%)	32 (6.6%)	41 (8.4%)	340 (69.8%)

Table 6.12 continued

Cutting raw fruit and fresh meat using separate cutting boards	306 (62.8%)	75 (15.4%)	52 (10.7%)	15 (3.1%)	39 (8.0%)
Hand towel wiper can be used repeatedly without washing (Negative Statement)	38 (7.8%)	25 (5.1%)	42 (8.6%)	47 (9.7%)	335 (68.8%)

1 Strongly agree **2 Agree** **3 Neutral**
4 Disagree **5 Strongly disagree**

Based on

Table **6.12**, the findings showed that the students had good practice on "A *Towel used to wipe hands can be used to wipe bowls".* There were 372 students, or 75.9% who said the towel used to wipe hands cannot be used to wipe bowls. The mean score was 4.162, and the standard deviation (SD) was 1.3442. Based on Table 6.1: for the ANOVA test, the F-value was 8.656 and the P-value was 0.003. Thus, there was a statistically significant difference between the level of education of the students and the practice of using a towel to wipe hands, which cannot be used to wipe bowls. The finding aligned with the student's low knowledge, indicating that the towel used to wipe hands can also be used to wipe plates. Hand wiping towels and equipment used for food preparation are intermediaries that contribute to food contamination because dirty towels become breeding grounds for bacteria and fungi, which eventually become the cause of food poisoning events. Akabanda (2012) states that wiping towels, hands, and utensils can cause food pollution. These findings suggest that students still do not have clear knowledge of the basic principles of food safety.

Based on

Table **6.12** The findings show that students demonstrated good food safety practice regarding the use of towels for multiple purposes. Specifically, 372 students (75.9%**)** disagreed with the statement, *"A Towel used to wipe hands can be used to wipe bowls"*, indicating an awareness of the risk of cross-contamination. The mean score was 4.162, with a standard deviation (SD) of 1.3442, suggesting a general agreement that towels used for hand-drying should not be reused for wiping food utensils or serving ware. Furthermore, results from the ANOVA test in Table 6.1: revealed a statistically significant difference between students' level of education and their practice on towel usage, with an F-value of 8.656 and a P-value of 0.003. This implies that students with higher education levels were more likely to engage in correct hygienic practices.

Despite this, other findings suggest a lack of adequate knowledge regarding this important aspect of hygiene. For instance, a considerable number of students still believed it was acceptable to use the same towel for wiping both hands and dishes, reflecting gaps in food safety understanding. This is concerning, as towels used to wipe hands, especially if the hands are not properly washed, can become contaminated and serve as vectors for the transmission of harmful microorganisms, including bacteria and fungi. Such contamination can lead to foodborne illnesses, mainly when the same towel is subsequently used to wipe dishes or utensils (Akabanda et al., 2012).

The study emphasises the need for enhanced food safety education, particularly regarding the dangers of reusing towels for multiple cleaning purposes in food preparation settings. Reinforcing these principles through formal training could reduce the risk of contamination and improve public health outcomes.

Furthermore, the findings showed that the students had good practice on *"Cutting raw fruit and fresh meat using separate cutting boards".* There were 381 students, or 78.2% who said they used separate cutting boards for raw fruit and fresh meat to prevent cross-contamination during food preparation. The mean score was 1.780, and the standard deviation (SD) was 1.2385. According to the Food Acts (2009), Bill 35 1(g), separate cutting boards should be used for raw and cooked foods to prevent cross-contamination. This practice is a key aspect that should be emphasised in school health promotion programs. Improper food handling, such as using the same cutting board for both raw and ready-to-eat foods, can significantly increase the risk of cross-contamination (Carrasco et al., 2012). Similar results were found in another study, where cross-contamination during food preparation was linked to the use of unwashed cooking utensils, sharing chopping boards for wet and dry ingredients, and poor maintenance of the school canteen (Osaili, Al-Nabulsi, & Taybeh, 2021). The study revealed that 58.1% of respondents were aware that using the same chopping board for vegetables after cutting raw meat could lead to cross-contamination (Osaili, Al-Nabulsi, & Taybeh, 2021). This indicates that just over half of the students understood the importance of using separate cutting boards for different types of food to avoid cross-contamination. However, the study also pointed out that students generally had limited knowledge about cross-contamination prevention and disinfection practices. This suggests that while some students may be aware of the correct procedures, overall adherence to these practices is likely low (Osaili, Al-Nabulsi, & Taybeh, 2021).

The findings indicate that students demonstrated good food safety practices in relation to cutting raw fruit and fresh meat using separate cutting boards. Specifically, 381 students (78.2%) reported using different cutting boards for raw fruit and fresh meat, a critical measure to prevent cross-contamination during food preparation. The mean score was 1.780, with a standard deviation (SD) of 1.2385, reflecting a strong understanding of this hygienic practice. This is consistent with the Food Act 2009, Bill 35 1(g), which mandates the use of separate equipment for raw and cooked foods to ensure food safety.

The practice of using separate cutting boards is essential because improper handling, such as using the same board for raw meat and ready-to-eat foods, can introduce harmful bacteria like *Salmonella* and *E. coli* into food, increasing the risk of foodborne illnesses (Carrasco et al., 2012). According to Carrasco et al. (2012), such cross-contamination is a primary route for the transmission of pathogens during domestic food preparation.

Similarly, a study by Osaili, Al-Nabulsi, and Taybeh (2021) highlighted that 58.1% of students were aware of the dangers of using the same cutting board for vegetables after preparing raw meat. However, while awareness was relatively high, the study also revealed that knowledge gaps remained, particularly in relation to disinfection procedures and general food safety compliance. This suggests that although students may practice safe habits like using separate cutting boards, they may lack consistency or depth of understanding regarding broader contamination risks.

These findings highlight the importance of incorporating food safety education into school health programs to ensure students not only develop awareness but also adopt consistent and informed hygienic practices in food handling.

Besides, the findings showed that the students had good practice on *"Raw food and cooked food need to be separated to avoid food pollution".* There were 394 students, or 80.9% who said the raw food and cooked food need to be separated to avoid food pollution. The mean score was 1.692, and the standard Deviation (SD) was 1.1896. According to the Food Acts (2009), Bill 35, 1 (a), food should not be placed directly in contact with anything or substance that may contaminate the food. The students demonstrated a sufficient understanding that raw and cooked foods should be kept separate to prevent food contamination. However, the study found that about 20% of schoolchildren believed it was incorrect to store and handle raw food separately from cooked food to prevent food poisoning (Kuo & Weng, 2021). This highlights a knowledge gap among some students regarding the importance of separating raw and cooked foods to prevent cross-contamination.

The findings revealed that the majority of students demonstrated good food safety practices regarding the separation of raw and cooked foods. Specifically, 394 students (80.9%) agreed that raw and cooked foods need to be stored separately to avoid food contamination, reflecting a solid awareness of cross-contamination risks. The mean score was 1.692 with a standard deviation (SD) of 1.1896, further indicating strong agreement among students. This aligns with the Food Act (2009), Bill 35 1(a), which stipulates that food must not come into direct contact with any object or substance that could lead to contamination, including the unsafe storage of raw and cooked foods together.

Separating raw and cooked food is critical because raw meat, poultry, and seafood may carry harmful bacteria such as *Salmonella*, *E. coli*, and *Listeria*, which can easily transfer to cooked or ready-to-eat food if stored improperly (Carrasco et al., 2012). The students' awareness of this practice suggests that food safety education has been effective to a degree in promoting hygienic food handling.

However, a study by Kuo and Weng (2021) found that approximately 20% of school children still held the incorrect belief that separating raw and cooked foods was unnecessary to prevent food poisoning. This reflects a persistent knowledge gap among a portion of the student population. The researchers emphasised the need for comprehensive food safety programs within school curricula to address such misconceptions and reinforce the importance of safe food storage and handling practices (Kuo & Weng, 2021).

In summary, while most students in the current study exhibited positive food safety behaviour, targeted educational efforts are still needed to address misunderstandings and ensure consistent application of safe food handling principles among all students.

The study also highlighted that Grade 6 students had significantly better knowledge about food safety compared to Grade 5 students, suggesting that food safety education in Grade 6 improved their understanding of practices like separating raw and cooked foods (Kuo & Weng, 2021). While the study did not specifically measure the practice of separating raw and cooked foods, it did find that handwashing before eating significantly improved among Grade 6 students after food safety education. This indicates that students are capable of adopting better food safety practices when educated (Kuo & Weng, 2021).

The study by Kuo and Weng (2021) revealed that Grade 6 students demonstrated significantly better food safety knowledge compared to Grade 5 students, emphasising the positive impact of targeted food safety education. This suggests that formal education, when integrated into the school curriculum, plays a vital role in shaping students' understanding of important food hygiene practices such as separating raw and cooked foods, even if the study did not specifically measure this particular behaviour. The knowledge gained in Grade 6 may have indirectly contributed to better decision-making in food handling and preparation.

One of the notable findings of Kuo and Weng's research was the significant improvement in handwashing practices before eating, particularly among Grade 6 students, after they received food safety education. This finding supports the idea that school-based interventions can effectively foster improved hygiene behaviours, especially when they are age-appropriate and practically oriented. Since handwashing is one of the most fundamental and observable food safety behaviours, its improvement suggests that other key practices, such as the separation of raw and cooked foods, can also be positively influenced with proper instruction and reinforcement.

Furthermore, the study reinforces the importance of early and continuous education in instilling food safety awareness. By integrating food hygiene topics in lower primary levels and reinforcing them in upper grades, educators can bridge knowledge gaps and ensure that students not only understand but also apply safe food handling procedures. This has broader implications for public health, as foodborne illnesses can be significantly reduced when young individuals are equipped with the necessary knowledge and skills (Kuo & Weng, 2021).

In conclusion, the study underscores that educational interventions are effective tools for improving food safety practices among students, and should be prioritised in school health promotion programs.

Meanwhile, the finding showed the student had good practice on "Chemicals such as rat poison and insect poison can be stored near *dry raw materials such as rice, onions and flour"*. There were 381 students, or 78.2% who disagreed that chemicals such as rat poison and insect poison can be stored near dry raw materials such as rice, onions and flour. The mean score was 4.209, and the standard deviation (SD) was 1.3882. However, other studies have indicated that students have the least knowledge about the dangers of chemicals, such as rat poison and insecticide, being placed near dry raw materials like rice, onions, and dried chillies. Chemical contamination is believed to be possible on dry food in the event of cross-contamination (if the packaging of toxic chemicals has been exposed, torn or exposed to the dry food) (Akabanda, 2012).

The findings of the present study indicate that students demonstrated a good level of food safety practice regarding the storage of chemicals near food items. Specifically, 381 students, or 78.2%, disagreed with the statement: *"Chemicals such as rat poison and insect poison can be stored near dry raw materials such as rice, onions, and flour."* This high level of disagreement suggests an encouraging awareness among students about the risks of chemical contamination. The mean score of 4.209 and a standard deviation of 1.3882 further reflect a strong consensus against the unsafe storage practice.

Despite these positive results, previous studies have reported a lack of knowledge among students regarding the dangers of chemical proximity to food. Akabanda et al. (2012) observed that many students and household consumers were unaware of the potential for dry food contamination, especially when toxic chemicals such as rat poison or insecticides are stored nearby. In instances where chemical packaging is torn, damaged, or improperly sealed, cross-contamination can occur through airborne particles, leaks, or accidental spillage, compromising the safety of nearby food products. This is particularly dangerous in dry food items such as rice, flour, and dried chillies, which can absorb contaminants without showing obvious signs of spoilage.

The improper storage of hazardous chemicals near food is a significant risk factor for foodborne illnesses and poisoning, and it underscores the need for ongoing education on food safety practices. While the current data reflect good practice among students, the contrast with earlier findings suggests that continuous food safety education programs are essential to reinforce proper behaviours and fill knowledge gaps that may exist among certain groups or in different settings.

Table 6.13: Independent Samples T-Test (Students' Practices)

Group Statistics					
	APAKAH JANTINA ANDA ?	N	Mean	Std. Deviation	Std. Error Mean
practisetotalmean	LELAKI	303	1.8758	0.88321	0.05074
	PEREMPUAN	179	1.7158	0.81732	0.06109

Independent Samples Test		
	Levene's Test for Equality of Variances	t-test for Equality of Means

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
practisetotalmean	Equal variances assumed	2.091	0.149	1.975	480	0.049	0.15997	0.08101	0.00079	0.31915
	Equal variances not assumed			2.014	396.950	0.045	0.15997	0.07941	0.00385	0.31609

Table 6.13 shows an independent samples t-test was conducted to examine the difference in practice scores between male and female respondents. The results showed that male respondents (M = 1.88, SD = 0.88) had higher practice scores than female respondents (M = 1.72, SD = 0.82). The difference was statistically significant, $t(480) = 1.98$, $p = 0.049$. There is a significant difference in practice scores between male and female respondents. Male students show higher practice scores than female students.

Table 6.14: ANOVA Test (Students' Practices)

Descriptives								
Practisetotalmean								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		

KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	307	1.7747	0.90614	0.05172	1.6729	1.8765	1.00	5.00
TAMAT DARJAH 6	20	1.9250	0.77323	0.17290	1.5631	2.2869	1.00	3.00
TAMAT TINGKATAN 3	9	1.9815	0.75205	0.25068	1.4034	2.5596	1.00	3.17
TAMAT TINGKATAN 5	28	1.5714	0.59391	0.11224	1.3411	1.8017	1.00	3.17
TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	120	1.9583	0.79982	0.07301	1.8138	2.1029	1.00	4.83
Total	484	1.8185	0.86080	0.03913	1.7416	1.8954	1.00	5.00

ANOVA					
Practisetotalmean					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.110	4	1.278	1.735	0.141
Within Groups	352.785	479	0.737		
Total	357.895	483			

Table 6.14 shows although the mean practice scores differ slightly between education levels, the differences are not statistically significant. This means education level

does not significantly influence practice scores among the respondents. A one-way ANOVA was conducted to examine differences in practice scores across education levels. The results indicated that there was no statistically significant difference in practice scores among the education groups, F(4, 479) = 1.74, p = 0.141.

Multiple Comparisons							
Dependent Variable: practisetotalmean							
	(I) APAKAH TAHAP PENDIDIKAN TERTINGGI ANDA?	(J) APAKAH TAHAP PENDIDIKAN TERTINGGI ANDA?	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	TAMAT DARJAH 6	-0.15030	0.19805	0.942	-0.6926	0.3920
		TAMAT	-0.20678	0.29023	0.954	-	0.5879

		TINGKATAN 3				1.0015	
		TAMAT TINGKATAN 5	0.20327	0.16942	0.752	-0.2606	0.6672
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.18363	0.09239	0.274	-0.4366	0.0694
	TAMAT DARJAH 6	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.15030	0.19805	0.942	-0.3920	0.6926
		TAMAT TINGKATAN 3	-0.05648	0.34447	1.000	-0.9997	0.8867
		TAMAT TINGKATAN 5	0.35357	0.25125	0.623	-0.3344	1.0416
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.03333	0.20727	1.000	-0.6009	0.5342

Table 6.15 continued

	TAMAT TINGKATAN 3	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.20678	0.29023	0.954	-0.5879	1.0015
		TAMAT DARJAH 6	0.05648	0.34447	1.000	-0.8867	0.9997
		TAMAT TINGKATAN 5	0.41005	0.32884	0.724	-0.4904	1.3105
		TAMAT TINGKATAN 6 / SIJIL/	0.02315	0.29660	1.000	-0.7890	0.8353

		DIPLOMA					
	TAMAT TINGKATAN 5	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	-0.20327	0.16942	0.752	-0.6672	0.2606
		TAMAT DARJAH 6	-0.35357	0.25125	0.623	-1.0416	0.3344
		TAMAT TINGKATAN 3	-0.41005	0.32884	0.724	-1.3105	0.4904
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.38690	0.18011	0.202	-0.8801	0.1063

Table 6.15 continued

	TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.18363	0.09239	0.274	-0.0694	0.4366
		TAMAT	0.03333	0.20727	1.000	-	0.6009

		DARJAH 6				0.5342	
		TAMAT TINGKATAN 3	-0.02315	0.29660	1.000	-0.8353	0.7890
		TAMAT TINGKATAN 5	0.38690	0.18011	0.202	-0.1063	0.8801
Bonferroni	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	TAMAT DARJAH 6	-0.15030	0.19805	1.000	-0.7088	0.4082

Table 6.15 continued

		TAMAT TINGKATAN 3	-0.20678	0.29023	1.000	-1.0253	0.6117
		TAMAT TINGKATAN	0.20327	0.16942	1.000	-0.2745	0.6811

		5					
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.18363	0.09239	0.474	-0.4442	0.0769
	TAMAT DARJAH 6	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.15030	0.19805	1.000	-0.4082	0.7088
		TAMAT TINGKATAN 3	-0.05648	0.34447	1.000	-1.0279	0.9150

Table 6.15 continued

		TAMAT TINGKATAN 5	0.35357	0.25125	1.000	-0.3550	1.0621
		TAMAT TINGKATAN	-0.03333	0.20727	1.000	-0.6179	0.5512

		6 / SIJIL/ DIPLOMA					
	TAMAT TINGKATAN 3	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.20678	0.29023	1.000	-0.6117	1.0253
		TAMAT DARJAH 6	0.05648	0.34447	1.000	-0.9150	1.0279
		TAMAT TINGKATAN 5	0.41005	0.32884	1.000	-0.5173	1.3374
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	0.02315	0.29660	1.000	-0.8133	0.8596

Table 6.15 continued

	TAMAT TINGKATAN 5	KANAK-KANAK ATAU REMAJA YANG MASIH	-0.20327	0.16942	1.000	-0.6811	0.2745

		BERSEKOLAH					
		TAMAT DARJAH 6	-0.35357	0.25125	1.000	-1.0621	0.3550
		TAMAT TINGKATAN 3	-0.41005	0.32884	1.000	-1.3374	0.5173
		TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	-0.38690	0.18011	0.322	-0.8948	0.1210
	TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	0.18363	0.09239	0.474	-0.0769	0.4442

Table 6.15 continued

		TAMAT DARJAH 6	0.03333	0.20727	1.000	-0.5512	0.6179
		TAMAT TINGKATAN	-0.02315	0.29660	1.000	-0.8596	0.8133

		3					
		TAMAT TINGKATAN 5	0.38690	0.18011	0.322	-0.1210	0.8948

Table 6.15: Post Hoc Test Tukey HSD

practisetotalmean			
	APAKAH TAHAP PENDIDIKAN TERTINGGI ANDA?	N	Subset for alpha = 0.05
			1
Tukey HSD[a,b]	TAMAT TINGKATAN 5	28	1.5714
	KANAK-KANAK ATAU REMAJA YANG MASIH BERSEKOLAH	307	1.7747
	TAMAT DARJAH 6	20	1.9250
	TAMAT TINGKATAN 6 / SIJIL/ DIPLOMA	120	1.9583
	TAMAT TINGKATAN 3	9	1.9815
	Sig.		0.463
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 23.990.			
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.			

Table 6.15 shows although the mean scores differ slightly, the differences are not statistically significant. This means education level does not significantly influence food

safety practice among respondents. The Tukey HSD homogeneous subset analysis showed that all education groups were clustered within a single subset, indicating that there were no statistically significant differences in practice scores among respondents with different education levels (p = 0.463).

Table 6.16: Pearson Correlations

Descriptive Statistics			
	Mean	Std. Deviation	N
knowledgetotalmean	2.0252	0.74413	485
atitudetotalmean	1.9456	1.01156	484
practisetotalmean	1.8185	0.86080	484

Correlations				
		knowledgetotalmean	atitudetotalmean	practisetotalmean
knowledgetotalmean	Pearson Correlation	1	0.667**	0.669**
	Sig. (2-tailed)		0.000	0.000
	N	485	484	484
atitudetotalmean	Pearson Correlation	0.667**	1	0.580**
	Sig. (2-tailed)	0.000		0.000
	N	484	484	484
practisetotalmean	Pearson Correlation	0.669**	0.580**	1
	Sig. (2-tailed)	0.000	0.000	
	N	484	484	484
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 6.16 shows all coefficients are positive. This means as one score increases, the others tend to increase as well. For example, people with higher knowledge scores generally have higher practice scores. The strongest link is between Knowledge and Practice ($r = 0.669$). All three values are above 0.5, which in social sciences is typically considered a strong relationship. Statistical Significance: The Sig. (2-tailed) values are all 0.000. This doesn't mean the probability is zero, but rather that it is less than 0.001. Because this is less than the standard alpha of 0.05, the results are highly statistically significant. The double asterisks (**) also indicate that the correlation is significant at the 0.01 level.

A Pearson product-moment correlation coefficient was computed to assess the relationship between knowledge, attitude, and practice total mean scores. Preliminary analyses showed the relationship to be linear with all variables normally distributed, as assessed by visual inspection of a scatterplot and Shapiro-Wilk test. There was a strong, positive correlation between knowledge and practice, $r(482) = 0.669$, $p < 0.001$, with high levels of knowledge associated with higher levels of practice. Similarly, a strong, positive correlation was found between knowledge and attitude, $r(482) = 0.667$, $p < 0.001$. Finally, a moderate-to-strong positive correlation existed between attitude and practice, $r(482) = 0.580$, $p < 0.001$.

6.5 The Means Analysis Between Demographic Profile, Gender, and Levels of Knowledge, Attitude and Behavioural (KAPs) Variables among Students

This part describes the analysis between gender and level of knowledge, attitude and practices (KAPs) among students. The mean and standard deviation values among males and females will be discussed below.

Table 6.17: The Mean and Standard Deviation (SD) between Genders and KAPs variables among Students

Statement	Mean	SD
Food poisoning, such as stomach pain, squealing can be avoided if you eat with clean hands	Male: 1.57 Female: 1.64	Male: 1.074 Female: 1.277
There are three (3) basic steps to handwashing	Male: 2.24 Female: 2.12	Male: 1.371 Female: 1.394
A dirty environment does not cause food pollution	Male: 3.93 Female: 4.11	Male: 1.593 Female: 1.535
The date on food and beverage wrapping is important	Male: 1.50 Female: 1.38	Male: 1.10 Female: 0.981
Foods that have been damaged and smell unsafe to eat	Male: 1.57 Female: 1.45	Male: 1.212 Female: 1.098
Foods that contain hair will cause health problems if eaten	Male: 1.96 Female: 2.09	Male: 1.213 Female: 1.407
Food affected by flies or cockroaches is not safe to eat	Male: 1.61 Female: 1.56	Male: 1.212 Female: 1.239

Statement	Mean	SD
Hot kitchen or chamber temperature will increase germ breeding rates	Male: 2.56 Female: 2.45	Male: 1.405 Female: 1.441
Kitchen utensils that are not washed using washing soap can cause food pollution	Male: 1.75 Female: 1.62	Male: 1.227 Female: 1.184
The canteen kitchen needs to be protected from creatures such as rats and lizards.	Male: 1.63 Female: 1.35	Male: 1.292 Female: 0.918

Variables	Mean	SD
The towel used to wipe hands can be used to wipe bowls	Male: 4.01 Female: 4.42	Male: 1.422 Female: 1.177
Raw food and cooked food need to be separated to avoid food pollution	Male: 1.72 Female: 1.55	Male: 1.200 Female: 1.058

Repeated use of cooking oil is bad for health	Male: 1.99 Female: 1.84	Male: 1.306 Female: 1.307
Chemicals such as rat poison and insect poison can be stored near dry raw materials such as rice, onions and flour.	Male: 4.14 Female: 4.27	Male: 1.438 Female: 1.362
Cutting raw fruit and fresh meat using separate cutting boards	Male: 1.83 Female: 1.66	Male: 1.263 Female: 1.163
Hand towel wiper can be used repeatedly without washing	Male: 4.22 Female: 4.29	Male: 1.286 Female: 1.287

Table 6.17 As shown above, the students generally demonstrated sound awareness of essential food hygiene practices. For instance, both male (M = 1.50) and female (M = 1.38) students recognised the importance of checking the date on food packaging. This aligns with the World Health Organisation's (WHO, 2006) guidance, which includes food labelling awareness as one of the "Five Keys to Safer Food."

Likewise, most students correctly rejected the consumption of spoiled or damaged food. Responses to statements such as "Foods that have been damaged and smell unsafe to eat" showed strong agreement (males: M = 1.57; females: M = 1.45), consistent with the Centres for Disease Control and Prevention (CDC, 2023), which warns against consuming contaminated or perished food.

Another important result relates to food separation practices. The majority of students agreed that raw and cooked food should be stored and handled separately (males: M = 1.72; females: M = 1.55), which supports USDA (2020) guidelines on avoiding cross-contamination in kitchens.

The students also showed a high level of disagreement with unsafe practices. For example, the statement "A towel used to wipe hands can be used to wipe bowls" received scores of M = 4.01 (males) and M = 4.42 (females), indicating strong rejection. Similarly, the idea that "Chemicals can be stored near dry food ingredients" scored M = 4.14 (males) and M = 4.27 (females). These results reflect a positive awareness of food safety risks, in line with the Food and Drug Administration (FDA, 2022).

The notion of reusing towels without washing was also strongly rejected (M = 4.22 for males and M = 4.29 for females), aligning with the CDC’s (2021) recommendations against the use of contaminated cloths in food environments.

Despite generally positive results, knowledge gaps remain in some areas. For instance, the statement "There are three basic steps to handwashing" had relatively higher mean values (M = 2.24 males, M = 2.12 females), indicating some confusion. This is concerning, considering that proper hand hygiene is critical to preventing foodborne illnesses (WHO, 2009).

Another area of weak understanding was evident in responses to "Hot kitchen temperature increases germ breeding" (M = 2.56 males, M = 2.45 females). These scores suggest a lack of understanding about the relationship between heat and bacterial growth. According to Jay et al. (2003), environmental temperature is a key factor influencing microbial growth in food preparation areas.

Female students consistently demonstrated slightly higher awareness, as shown by their lower mean scores on correct practices and higher scores on rejecting incorrect ones. In addition, their standard deviations were generally lower, indicating a more consistent understanding. These results are supported by studies showing that female students often exhibit more cautious behaviour regarding hygiene (Azeez et al., 2020).

Overall, students showed a strong foundation in food hygiene, but some topics, such as handwashing steps and environmental conditions, require reinforcement. Health education programs should target these gaps through visual demonstrations and gender-sensitive messaging. Following WHO and CDC guidelines will help promote a safer food culture in student communities.

6.6 The Means Analysis Between Educational Levels and Levels of Knowledge, Attitude and Behavioural (KAPs) Variables among Students

This section is about analysing how educational levels affect the levels of knowledge, attitude and practices (KAPs) among students. The section will discuss how the education levels affect the mean value.

Table 6.18: The Mean and Standard Deviation (SD) between Educational Levels and KAPs variables among Students

Statement	Children still school	Finished Primary 6	Finished Form 5 or Form 6	Others
Food poisoning, such as stomach pain, squealing can be avoided if you eat with clean hands	Mean: 1.53 SD: 1.153	Mean: 1.80 SD: 1.424	Mean: 1.71 SD: 1.102	Mean: 1.65 SD:1.367
There are three (3) basic steps to handwashing	Mean: 2.28 SD: 1.461	Mean: 2.53 SD: 1.407	Mean: 2.11 SD: 1.241	Mean: 1.47 SD: 0.943

Table 6.18 continued

A dirty environment does not cause food pollution	Mean: 4.06 SD: 1.560	Mean: 4.27 SD: 1.280	Mean: 3.79 SD: 1.638	Mean: 4.24 SD: 1.437

The date on food and beverage wrapping is important	Mean: 1.48 SD: 1.106	Mean: 1.47 SD: 0.743	Mean: 1.39 SD: 0.952	Mean: 1.53 SD: 1.179
Foods that have been damaged and smell unsafe to eat	Mean: 1.50 SD: 1.179	Mean: 1.53 SD: 1.125	Mean: 1.54 SD: 1.133	Mean: 1.53 SD: 1.328
Foods that contain hair will cause health problems if eaten	Mean: 1.99 SD: 1.359	Mean: 2.13 SD: 1.302	Mean: 1.98 SD: 1.091	Mean: 2.35 SD: 1.579
Food affected by flies or cockroaches is not safe to eat	Mean: 1.62 SD: 1.274	Mean: 1.93 SD: 1.438	Mean: 1.44 SD: 0.977	Mean: 2.06 SD: 1.713

Statement	Children still school	Finished Primary 6	Finished Form 5 or Form 6	Others
Hot kitchen or chamber temperature will increase germ breeding rates	Mean: 2.61 SD: 1.479	Mean: 2.27 SD: 1.335	Mean: 2.34 SD: 1.259	Mean: 3.00 SD: 1.620
Kitchen utensils that are not washed using washing soap can cause food pollution	Mean: 1.72 SD: 1.268	Mean: 2.13 SD: 1.506	Mean: 1.57 SD: 0.991	Mean: 1.94 SD: 1.519
The canteen kitchen needs to be protected from creatures such as rats and lizards.	Mean: 1.54 SD: 1.194	Mean: 1.80 SD: 1.265	Mean: 1.49 SD: 1.134	Mean: 1.53 SD: 1.328

Statement	Children still school	Finished Primary 6	Finished Form 5 or Form 6	Others
The towel used to wipe hands can be used to wipe bowls	Mean: 4.25 SD: 1.336	Mean: 4.20 SD: 1.207	Mean: 3.95 SD: 1.392	Mean: 4.29 SD: 1.359

Table 6.18 continued

Raw food and cooked food need to be separated to	Mean: 1.61 SD: 1.173	Mean: 1.80 SD: 1.014	Mean: 1.78 SD: 1.146	Mean: 1.35 SD: 0.996

avoid food pollution				
Repeated use of cooking oil is bad for health	Mean: 1.88 SD: 1.375	Mean: 2.33 SD: 1.291	Mean: 1.97 SD: 1.121	Mean: 2.06 SD: 1.600
Chemicals such as rat poison and insect poison can be stored near dry raw materials such as rice, onions and flour.	Mean: 4.23 SD: 1.431	Mean: 3.87 SD: 1.407	Mean: 4.09 SD: 1.409	Mean: 4.65 SD: 0.996
Cutting raw fruit and fresh meat using separate cutting boards	Mean: 1.76 SD: 1.321	Mean: 2.00 SD: 1.069	Mean: 1.75 SD: 1.042	Mean: 2.00 SD: 1.458
Hand towel wiper can be used repeatedly without washing	Mean: 4.35 SD: 1.225	Mean: 4.40 SD: 0.986	Mean: 4.03 SD: 1.404	Mean: 4.47 SD: 1.179

Table 6.18 The above shows the levels of education among the students for food hygiene knowledge, attitude and behaviour (KAPs). This analysis examines food safety and hygiene awareness across four educational groups: children still in school, individuals who completed Primary 6, those who finished Form 5 or 6, and a group labelled as "Others." The data, derived from mean and standard deviation scores for a series of hygiene-related statements, reveals varying levels of knowledge and perception regarding food safety practices.

Across all groups, the results indicate a generally high awareness of fundamental hygiene practices. For example, agreement was strong for the statement “Food poisoning can be avoided if you eat with clean hands,” with mean scores ranging from 1.53 to 1.80. This supports global health guidance that emphasises handwashing as one of the most effective ways to prevent foodborne illnesses (Centres for Disease Control and Prevention [CDC], 2020).

Participants also recognised the importance of food labelling. The statement "The date on food packaging is important" yielded consistently low mean scores (1.39 to 1.53), suggesting widespread understanding of expiration dates as a food safety concern. The World Health Organisation (WHO, 2015) underscores this practice in its "Five Keys to Safer Food" campaign, promoting food labelling as a critical tool for reducing the risk of consuming expired or spoiled products.

However, several knowledge gaps emerged. The statement "A Towel used to wipe hands can be used to wipe bowls" received high mean scores (3.95 to 4.29), indicating appropriate disagreement, but standard deviations reaching 1.392 suggest that some participants may still believe in this unhygienic practice. Cross-contamination from shared towels can contribute to the spread of bacteria like E. coli and Salmonella (Todd et al., 2010), highlighting the need for clearer messaging on safe food handling.

The misconception that chemicals such as rat poison can be stored near dry ingredients like rice or flour also presented varied responses. While the "Others" group expressed strong disagreement (mean = 4.65), lower scores in other groups imply inconsistent understanding. This reflects findings by Redmond and Griffith (2003), who noted that formal education does not always equate to improved food safety behaviours; experiential knowledge may play a key role.

Environmental hygiene practices were also generally well understood. For example, statements like "Food affected by flies or cockroaches is not safe to eat" yielded low mean scores across all groups (1.44 to 2.06), in line with WHO (2015) guidelines that emphasise keeping food safe from pests.

In conclusion, while general awareness of food hygiene practices is relatively high, particularly in foundational areas like handwashing and expiration date checking, inconsistencies persist. These are most evident in areas like towel hygiene and chemical storage practices. Education campaigns that address specific misconceptions and consider both formal and informal learning experiences are recommended to improve public health outcomes across all demographics.

6.7 Conclusion

This chapter presented the findings related to the levels of knowledge, attitudes, and practices (KAPs) towards food hygiene among students in rural schools in Betong, Sarawak. The majority of students demonstrated excellent knowledge regarding the prevention of foodborne illnesses through hand hygiene. The findings revealed that students exhibited relatively good knowledge regarding the importance of checking dates on food and beverage packaging. The analysis showed that while students generally demonstrated pretty good knowledge of food hygiene, their actual practices were less consistent. However, the findings revealed that students had very poor knowledge regarding the correct steps for handwashing, indicating limited understanding of hand hygiene among the majority of students. This is particularly concerning given that proper handwashing is recognised as one of the most effective strategies in preventing foodborne illnesses and the spread of infectious diseases.

ANOVA results revealed significant differences in knowledge scores by level of education, suggesting that older students tend to be more informed. Gender differences were also statistically significant in hygiene practices, with female students reporting higher compliance. Ethnic variations, while observed, were not statistically significant.

These findings directly address the research objective of determining the level of food hygiene KAPs among rural school students. They highlight both strengths in awareness and gaps in behavioural adherence, underscoring the need for targeted education programs.

In the following chapter, these results will be discussed in the context of existing literature, with further analysis of the potential factors influencing students' food hygiene behaviours. The implications for school-based hygiene interventions will also be explored.

CHAPTER 7

PHYSICAL CLEANLINESS OF SCHOOL KITCHENS, CANTEENS AND WATER SUPPLIES

7.1 Introduction

In this study, qualitative data obtained from semi-structured interviews were transcribed and analysed using content analysis with Atlas. ti 25. The findings were presented sequentially based on the research questions to provide more precise and structured explanations.

As qualitative data cannot be measured numerically, its analysis is typically organised around identifying and developing themes. To support the analysis, it is a standard method to directly quote from the interviews. Ultimately, the key objective is to present the study's findings in a clear and accessible manner, allowing future researchers to understand the work conducted and the outcomes achieved. The research questions of this study are further elaborated in the following sub-sections.

In this study, qualitative data obtained from semi-structured interviews were transcribed and analysed using content analysis with Atlas. ti 25. The findings were presented sequentially based on the research questions to provide more precise and structured explanations. As qualitative data cannot be measured numerically, its analysis was organised around identifying and developing emerging themes. To enhance the trustworthiness and authenticity of the analysis, direct quotations from interviewees were incorporated, offering first-hand insights into their perceptions and experiences.

To address objective 3, which aimed to assess the physical cleanliness of the school kitchen, canteen, and water supplies, specific interview questions were designed to explore the hygiene conditions, maintenance practices, and infrastructure standards observed in these facilities. The interviews included school staff such as canteen operators, food handlers, and administrative personnel responsible for overseeing hygiene compliance.

From the content analysis, several key themes emerged concerning physical cleanliness: (1) Cleanliness of Food Preparation Areas, (2) Waste Management Practices, (3) Sanitation of Eating Spaces, and (4) Water Supply Safety and Availability. Respondents highlighted varying levels of cleanliness in food preparation areas, with some expressing concerns over inadequate cleaning routines and poor ventilation. Others emphasised the importance of daily sanitation checks and reported adherence to Ministry of Health guidelines.

Direct quotations revealed differing perspectives on water supply safety. While some schools were commended for their use of filtered water systems and regular testing, others reported inconsistent water quality and a lack of proper water storage facilities. Similarly, waste disposal practices were noted as a critical concern, especially in schools where waste bins were uncovered or not emptied regularly, contributing to foul odours and pest infestations.

The findings indicate that while some schools maintain commendable hygiene standards, others face challenges due to limited resources, lack of awareness, or insufficient enforcement of hygiene protocols. These insights help paint a comprehensive picture of the current state of physical cleanliness in school food facilities and water sources. Importantly, they offer a foundation for recommending targeted interventions to improve hygiene conditions and ensure a safer environment for students.

The research questions of this study are further elaborated in the following sub-sections, with specific attention to how each aligns with the overall research objectives.

7.2 Physical Environment and Water Supplies

Figure 7.1: Yellowish water pipe supplies in Pusa, Betong

According to Figure 7.1, the observation and interview conducted during data collection. There was a water cleanliness and safety issue on Pusa Betong. Water pipe supplies are yellowish, not safe for drinking and cooking purposes. Most residents purchase bottled drinking water from grocery shops for daily consumption and cooking.

One of the factors led to food poisoning among students in school. Water may be yellow due to the natural presence of iron, manganese, sediment in the water, and other sources of contamination. It could also be caused by a corrosion issue in the plumbing system or even something as simple as rust particles from an old pipe.

According to data collected, 49 households collected rainwater as their main drinking water source. There were two households that relied on delivered water (tank) as their main drinking water source. In addition, 30 students collected rainwater as a drinking water supply source in school. While there were 8 students who delivered water (tank) as a drinking water supply source in school. However, not all rainwater is safe. Rainwater can carry parasites, harmful bacteria, and viruses. In the past, it has been associated with disease outbreaks. If rainwater falls in polluted environments or comes into contact with contaminants like animal faeces or heavy metals, it may become unsafe for human consumption.

Poor hand hygiene practices among food handlers and schoolchildren have been identified as a concern (Kar et al., 2018). Additional factors contributing to food poisoning outbreaks in schools include cross-contamination from water storage tanks, consumption of undercooked food, and the use of untreated water (Jeffree & Mihat, 2016). He said:

> "The water issue in Betong stems from rusted supply pipes, causing the water to appear yellowish. This raises serious health concerns, as the discoloured water is not safe for drinking or cooking. Residents are forced to seek alternative sources, highlighting the urgent need for infrastructure improvements and clean water access"
>
> (Respondent 8, 2024)

In addition, the respondent said:

> "We purchase bottled drinking water daily from nearby grocery shops for both drinking and cooking, as the tap water is yellowish and potentially contaminated. The discoloured water raises serious health concerns, making it unsuitable for consumption and forcing residents to rely on bottled water to ensure safety and hygiene"
>
> (Respondent 10, 2024)

She said:

> "The water supplied in our area comes from a rainwater reservoir and is supplemented by government-delivered water to meet daily needs. This system is especially crucial during shortages or dry seasons, ensuring residents have access to water for essential uses such as drinking, cooking, and sanitation despite limited local resources"
>
> (Respondent 11, 2024)

Based on Figure 7.1 During data collection, and supporting interviews, serious concerns about water quality and infrastructure were identified in Pusa, Betong. Residents reported that tap water supplies were visibly yellowish, making them unsuitable for drinking or cooking. This discolouration suggests possible contamination by iron, manganese, sediment, or rust, often due to corrosion in ageing pipes or inadequate water treatment systems (World Health Organisation [WHO], 2017). Such unsafe water conditions have significant public health implications, especially for children, and were identified as one of the contributing factors to food poisoning cases among students in local schools.

Due to this water quality issue, many households resort to alternative water sources. Data revealed that 49 households relied primarily on rainwater harvesting, while two households depended on water delivered via tanks. In schools, 30 students used rainwater, and 8 students used delivered (tank) water as their primary drinking source. While rainwater is perceived as a safer alternative to visibly contaminated tap water, it is not inherently safe for consumption. Rainwater may harbour microbial contaminants such as Escherichia coli, Salmonella, and Giardia, especially if collected from rooftops or gutters contaminated with animal faeces, industrial pollutants, or other environmental hazards (Ahmed et al., 2011). Studies have shown that untreated rainwater consumption has been associated with gastrointestinal illnesses and disease outbreaks (Evans et al., 2007).

In areas with limited access to safe municipal water, alternative water sources must be treated or filtered before use. However, in rural settings like Betong, a lack of resources, awareness, and infrastructure often prevents adequate water treatment. Delivered tank water, while convenient, also poses risks if storage containers are not regularly cleaned or if delivery is infrequent and unreliable, leading to prolonged storage and contamination (Jeffree & Mihat, 2016).

Moreover, cross-contamination from unclean water storage tanks, consumption of undercooked food, and poor hand hygiene practices among both food handlers and schoolchildren further increase the risk of foodborne diseases in school environments (Kar et al., 2018; Jeffree & Mihat, 2016). Food safety is closely tied to water safety, as water is used in food preparation, cleaning, and drinking. Contaminated water can directly infect food or utensils, creating multiple points of entry for harmful pathogens into the human body.

It is essential to note that water safety is a foundational element of public health. According to WHO (2017), safe drinking water should be free from pathogens and harmful chemicals and should meet specific standards for turbidity, colour, and chemical composition. In this context, the observed yellowish water in Pusa Sarawak fails to meet acceptable standards. Moreover, WHO emphasises that schools must have access to clean water to reduce the risk of waterborne diseases, especially in food handling and sanitation practices.

To address these challenges, governmental intervention is necessary, including the provision of safe municipal water supplies, regular water quality testing, and public education on safe rainwater collection and storage practices. Additionally, school health programs should include hygiene training and infrastructure investment, ensuring clean water access for students and food handlers.

7.3 Temporary Worker as School Canteen Food Handlers

Food handler 5 said:

> "I am currently working as a temporary food handler, helping with meal preparation, food serving, and keeping the kitchen area clean. I follow basic hygiene practices to ensure food safety and maintain quality standards, contributing to a healthy and organized working environment for both staff and those being served"
>
> (Food handlers 5, 2024)

Next, the food handler said:

> "I am a permanent worker at the school canteen, responsible for preparing and serving food to students and staff. I ensure cleanliness, maintain hygiene standards, and support daily kitchen operations efficiently, contributing to a safe and healthy food environment while helping the team deliver quality meals consistently throughout the day"
>
> (Food handlers 10, 2024)

Based on the face-to-face interviews collected, more than half (>50%) of the food handlers are temporary workers in rural schools in Betong. As in many other industries, food handlers in Malaysia are categorized into two main groups: permanent and temporary workers. Temporary workers typically include contract and part-time labourers who often take on low-skilled, low-paying jobs to address labour shortages (Lenard & Straehle, 2012). Lenard and Straehle (2012) also noted that these work contracts are not bound to a specific employer. While the food business is most likely dominated by temporary labour, the devotion and commitment of these labourers are often misjudged by the public (Chambel & Alcover, 2011). Short-term employment poses a significant challenge in the 21st century, as such workers are often perceived to have lower levels of commitment and reduced adherence to established standards (Bordia, Restubog, Bordia, & Tang, 2010). Effective recruitment involves hiring individuals who meet job requirements and possess the necessary skills. However, temporary employment is often associated with the notion of “other life priorities,” where workers may feel free to leave their jobs without guilt or long-term obligation (Casey & Alach, 2004). This raises concerns about the potential negative impact of temporary workers on food safety, particularly within the health community.

In urban areas, local authorities face challenges due to the large number of schools and the many variables that require monitoring. One such concern is the presence of immigrant food handlers in schools, some of whom may not be officially registered or may lack proper food safety training and certification, including food handling courses or anti-typhoid vaccinations.

In rural districts such as Betong, face-to-face interview findings revealed that more than half of the food handlers employed in school canteens are temporary workers. This is reflective of a broader national trend in Malaysia, where the food service industry, particularly in school environments, is heavily reliant on contractual, seasonal, or part-time labour. These temporary workers are typically engaged to address labour shortages, especially in remote or underdeveloped areas, and often take on low-skilled roles without long-term job security (Lenard & Straehle, 2012).

In Malaysia, food handlers are generally divided into two employment categories: permanent and temporary. The latter group may include part-time workers, short-term contractors, and informal labourers, many of whom may not receive adequate training in food hygiene and safety practices. According to Lenard and Straehle (2012), temporary labour contracts are often not tied to a specific employer, which can result in inconsistent oversight and reduced accountability. Furthermore, these workers frequently operate under informal employment arrangements, bypassing formal food safety protocols and regulatory compliance systems, such as registration under the Food Safety Information of Malaysia (FoSIM) system or participation in Latihan Pengendalian Makanan (LPM) training.

Although the contribution of temporary food handlers is often underestimated, their commitment and reliability are frequently questioned by the public and employers alike. Studies have suggested that short-term employment is associated with lower organizational commitment and reduced adherence to workplace standards, particularly when workers do not perceive their role as long-term or career-oriented (Chambel & Alcover, 2011; Bordia et al., 2010). These attitudes can pose a significant threat to food safety, especially in sensitive settings like schools, where children are the primary consumers.

Bordia et al. (2010) highlight that the temporary workers may lack the motivation to internalise food safety protocols, as they often face precarious working conditions, minimal benefits, and limited supervisory oversight. This detachment can result in inconsistent practices, such as neglecting personal hygiene, skipping mandatory handwashing, and failing to use protective gear (e.g., gloves and aprons). Casey and Alach (2004) argue that temporary employees often view their jobs as transitional, prioritising other life commitments over long-term obligations to their employers. This mindset can lead to high turnover rates and further complicate training and monitoring efforts.

Moreover, in urban school environments, the complexity increases due to higher student populations, diverse school systems, and the presence of immigrant workers in the food service sector. Some of these workers may not be formally registered, nor have completed certified food handling courses or received anti-typhoid vaccinations, which are mandatory under Malaysian food safety regulations (Ministry of Health Malaysia, 2022). These gaps in compliance represent a critical challenge for local health authorities, who must monitor large volumes of food handlers across numerous schools with limited resources and enforcement personnel.

To mitigate these risks, there is a growing need for standardised recruitment policies, mandatory onboarding training, and continuous monitoring of both permanent and temporary food handlers. Collaboration between the Ministry of Education, the Ministry of Health, and local municipal councils can improve oversight and enforcement, especially in schools where children's health is at greater risk due to unsupervised food handling practices.

7.4 Anti-Typhoid Vaccine

The respondent said:

> "I did not receive my anti-typhoid vaccine from my employer, despite its importance for food handlers. Vaccination is essential to prevent the spread of foodborne illnesses and protect public health, ensuring the safety of both consumers

and workers involved in food preparation and service within the canteen environment"

(Food handler 11, 2024)

Some of these individuals may not be officially registered and might not have undergone any food handling training or received the required anti-typhoid vaccination (Gong et al., 2016). According to the Food Safety and Quality Division, Ministry of Health Malaysia (2022), it is mandatory for all food handlers to be vaccinated against typhoid and registered under the Food Safety Information of Malaysia (FoSIM) system. This situation highlights a significant gap in food safety and hygiene practices, particularly in rural schools.

The anti-typhoid vaccine is a critical component of public health policy aimed at preventing typhoid fever, a serious and potentially life-threatening disease caused by *Salmonella Typhi*. In Malaysia, it is legally required for all food handlers to receive this vaccination before they are allowed to work in food preparation or handling roles (Ministry of Health Malaysia, 2022). However, there remains a significant implementation gap, particularly in informal food settings and rural schools, where some food handlers are not officially registered and have not undergone the required food handling training or received the anti-typhoid vaccine (Gong et al., 2016).

The Food Safety and Quality Division of the Ministry of Health Malaysia (MOH) mandates that all food handlers be vaccinated against typhoid and registered under the Food Safety Information of Malaysia (FoSIM) system (MOH, 2022). This centralized database is designed to ensure that only certified and vaccinated individuals are legally allowed to work in food establishments. Nevertheless, enforcement challenges persist, particularly in rural or under-monitored areas, where informal food operators may bypass regulations due to a lack of oversight or awareness.

This regulatory lapse represents a serious public health concern, especially in school environments where children are particularly vulnerable to foodborne illnesses. According to Soon et al. (2012), food handlers who are not properly trained or vaccinated pose a significant risk for transmitting diseases such as typhoid, hepatitis A, and gastrointestinal infections. Typhoid fever, in particular, spreads through contaminated food and water, and unvaccinated handlers increase the likelihood of outbreaks in community settings (World Health Organization [WHO], 2018).

Moreover, typhoid remains endemic in several developing and tropical countries, including parts of Southeast Asia. The WHO recommends typhoid vaccination for food handlers as a preventive measure, especially where water, sanitation and hygiene are not consistently maintained (WHO, 2018). In Malaysia, failure to comply with the Food Hygiene Regulations 2009, which requires typhoid vaccination and training, may result in legal penalties, including fines or the revocation of operating licenses (MOH, 2022).

To bridge the existing compliance gap, there is a need for stronger enforcement mechanisms, periodic audits, and educational outreach, particularly in rural and underserved areas. Schools and local authorities should collaborate with health departments to ensure that all food vendors, including temporary or seasonal operators, are both trained and vaccinated. This will significantly reduce the risk of typhoid transmission and improve the overall standard of food safety in school canteens and public food service areas.

7.5 Food Handler Training Programme (Latihan Pengendalian Makanan LPM)

The food handler said:

> "I did not attend any food handling training or courses (LPM) before starting work here, which may affect my understanding of proper hygiene practices and food safety procedures. Without formal training, there is a risk of mishandling food, potentially compromising the health and safety of students and staff in the canteen"
>
> (Food handler 8, 2024)

Furthermore, the researcher discovered that over half of the food handlers had not participated in any food handling training. Implementing an effective food hygiene training program for these individuals is crucial. The Ministry of Education and the Ministry of Health (MOH) are encouraged to propose and develop training initiatives focused on food safety practices to help prevent future food poisoning incidents (Abdullah & Ismail, 2021).

Food operators are individuals responsible for maintaining food hygiene standards at their respective food premises to ensure consumer safety (Lah, 2000). Under the Food Act 1983, all food operators must complete Food Handler Training (LPM) before they can begin working in food-related services. This training is conducted by Food Operator Training Schools (SLPM) that are approved by the Ministry of Health (KKM). Certified instructors, recognised as official Teaching Staff by KKM and holding specialised qualifications in food services, oversee the sessions. The training covers essential topics such as food safety, personal hygiene, cleanliness of cooking equipment, proper methods of food preparation and storage, and the use of safe food packaging (Institut Penyelidikan Tingkahlaku Kesihatan [IPTK], 2020).

Food safety training plays a crucial role in minimising the risks of foodborne illnesses and improving the overall hygiene practices of food handlers. In the present study, it was found that more than half of the food handlers had not undergone any formal food handling training, highlighting a significant gap in preventive food safety measures. This lack of training raises concerns about the level of awareness and compliance with food hygiene standards among those responsible for preparing and serving food in public settings, particularly in schools and roadside stalls.

To address this issue, the implementation of structured and compulsory food hygiene education is essential. The Ministry of Education and the Ministry of Health (MOH) should jointly spearhead efforts to design and implement effective training programs that emphasize the fundamentals of food safety. These training programs should aim not only to deliver information but also to instil behavioural changes among food handlers. Abdullah and Ismail (2021) argue that such proactive measures are necessary to reduce the risk of food poisoning, particularly in environments where children and vulnerable populations are the primary consumers.

According to Lah (2000), food operators are directly responsible for ensuring the safety and hygiene of food at their respective premises. Recognizing the critical role these individuals play, Malaysia’s Food Act 1983 mandates that all food handlers must complete the Latihan Pengendalian Makanan (LPM) before they are permitted to work in any food-related service. This regulation is enforced by the Ministry of Health Malaysia (Kementerian Kesihatan Malaysia KKM) and represents a cornerstone of the country's national food safety policy.

The LPM program is conducted by accredited Food Operator Training Schools (Sekolah Latihan Pengendali Makanan SLPM). These schools are officially recognized by the MOH, and training sessions are led by certified instructors who are qualified as official

Teaching Staff (Tenaga Pengajar) under the Ministry's guidelines. These instructors are required to hold relevant qualifications in food services and are trained to deliver consistent and standardised content.

The training curriculum for LPM includes a wide array of critical topics. These cover personal hygiene practices, sanitation of food preparation areas and equipment, safe food storage and preparation methods, temperature control, and proper food packaging techniques (Institut Penyelidikan Tingkahlaku Kesihatan [IPTK], 2020). By focusing on both theoretical and practical aspects of food safety, the training ensures that food handlers gain not only knowledge but also the practical skills required to maintain hygienic standards in their daily operations. Studies have shown that such formal training significantly improves compliance with safety regulations and reduces the incidence of foodborne illnesses (Soon et al., 2012).

However, despite the existence of such regulatory frameworks, enforcement and continuous monitoring remain challenging. Without regular follow-up training, assessments, or surprise inspections, there is a risk that food handlers may become complacent or revert to unsafe practices over time (Tan et al., 2013). Hence, periodic refresher courses and stronger collaboration between public health departments, schools, and food vendors are necessary to sustain and improve the impact of the LPM program.

7.6 Roadside Food Stalls

Regarding roadside food stalls, he said:

> "I usually buy hot dogs, fishballs, nuggets, and other snacks from a roadside food stall because they are convenient and affordable. However, the hygiene and food safety standards at these stalls are sometimes questionable, raising concerns about

potential health risks from improper food handling, storage, or preparation in such settings"

(Student 8, 2024)

The main reason she bought food at roadside stalls:

"I was feeling very hungry, so I chose to buy food from nearby roadside stalls, as they offered quick and affordable options. Despite being convenient, I was aware of concerns about cleanliness and food safety, which made me cautious about the potential health risks from eating at such places"

(Student 10, 2024)

The student said:

"I bought Milo and sirap drinks from a nearby stall because they were affordable and refreshing, especially on hot days. However, I had slight concerns about the hygiene and preparation methods, as the cleanliness of the utensils, water quality, and handling practices at roadside stalls can sometimes be questionable and unsafe"

(Student 20, 2024)

Next student said:

"I often choose to buy food and drinks from roadside stalls because they are delicious and more affordable than other options. Their convenience makes them appealing, especially for quick meals, although I remain aware of potential cleanliness and safety concerns that may pose health risks if proper hygiene isn't maintained"

(Student 21, 2024)

She said:

"The foods were bought from roadside hawkers just outside the school compound, as they offer a variety of tasty and affordable options. However, their hygiene and safety standards are often questionable, raising concerns about food handling,

> cleanliness, and potential health risks for students and staff who frequently purchase from them"
>
> (Student 30, 2024)

Furthermore, food safety is an issue that should not be compromised and taken easy by society. However, many students were found to ignore still food safety aspects such as buying food from roadside outlets (Institut Penyelidikan Tingkahlaku Kesihatan [IPTK], 2020). Two bad practices observed among students during this study were purchasing food wrapped in newspapers and frequently buying food from vendors on the street. A study by Goa J et al. (2016) found that 75% of students will buy food from unlicensed hawkers whose habits are more delicious but are at risk of being unsafe (Institut Penyelidikan Tingkahlaku Kesihatan [IPTK], 2020).

While food handlers have a strong understanding of the importance of using gloves, they rarely practice this knowledge. This is a significant concern for consumer safety, as hands come into direct contact with food and other surfaces, potentially leading to cross-contamination. Additionally, the use of masks and aprons is uncommon among food handlers. Many respondents noted that the hot weather around the food-selling areas makes it challenging to avoid sweating, leading to discomfort while working. This discomfort is linked to a lack of understanding about cross-contamination, with 54.2% of food handlers showing limited knowledge in this area. The knowledge of food handlers is crucial, as insufficient awareness of personal hygiene and food safety practices is a key factor contributing to foodborne illnesses (Tan et al., 2013).

Food safety is a critical public health concern and should not be treated lightly or compromised by any segment of society. Despite growing awareness, many individuals, particularly students, continue to engage in risky eating behaviours that expose them to potential health hazards. A notable concern is the tendency to purchase food from roadside stalls and unlicensed vendors, which are often perceived to serve more flavorful or affordable food but lack proper hygiene standards (Institut Penyelidikan Tingkahlaku Kesihatan [IPTK], 2020). According to IPTK (2020), many students still overlook food safety considerations and frequently purchase food wrapped in newspapers. This practice is both unsanitary and potentially toxic due to the presence of harmful ink and dyes not approved for food contact.

A study by Goa et al. (2016) found that 75% of students reported regularly buying food from unlicensed street hawkers, driven by taste preferences and convenience, despite the known risks. These roadside food outlets often operate under poor hygienic conditions, with limited access to clean water, refrigeration, and waste disposal systems. Such environments facilitate the growth and transmission of foodborne pathogens like *Salmonella*, *E. coli*, and *Listeria monocytogenes*, posing serious health risks to consumers (WHO, 2015).

Another alarming issue is the discrepancy between food handlers' knowledge and practice of hygiene protocols. Although many handlers are aware of the importance of wearing gloves to reduce the risk of contamination, actual compliance is low (Tan et al., 2013). Hands are the most common vehicle for microbial contamination in foodservice environments, and when gloves are not used or not changed regularly between tasks, the risk of cross-contamination increases significantly (Todd et al., 2010).

In addition to gloves, the use of aprons and face masks is also infrequent among roadside food handlers. Several respondents cited discomfort caused by hot weather as a primary reason for not using protective clothing. High temperatures and poorly ventilated food stalls contribute to sweating, making the use of aprons and masks physically uncomfortable. However, this discomfort often stems from a lack of understanding of cross-contamination risks. In this study, 54.2% of food handlers demonstrated limited knowledge of cross-contamination, which highlights the urgent need for targeted education and awareness campaigns (Tan et al., 2013).

The knowledge level of food handlers plays a pivotal role in maintaining food safety. Poor understanding of personal hygiene, food storage, and cooking temperatures contributes directly to the incidence of foodborne illnesses (Soon et al., 2012). Food sold under unhygienic conditions, especially by unregulated vendors, can lead to outbreaks of diarrhoea, typhoid, hepatitis A, and other gastrointestinal diseases, particularly in urban and school settings (FAO/WHO, 2009).

To reduce such risks, public health authorities need to enforce licensing regulations, conduct regular inspections, and promote food safety training programs for street food vendors. Furthermore, consumers, particularly young individuals and students, should be educated about the importance of purchasing food only from certified or licensed outlets that follow proper hygiene protocols.

7.7 Handwashing and the Use of Gloves, Aprons and Masks

Respondent said:

> "I always make sure to wash my hands thoroughly with soap and clean water after using the toilet to maintain personal hygiene. This habit helps prevent the spread of germs and illnesses to others, promoting a healthier environment for everyone, especially in shared spaces like schools or food preparation areas"

(Respondent 2, 2024)

The next respondent said:

> "I did not use soap to wash my hands after using the toilet, which is a poor hygiene practice. This increases the risk of spreading germs and bacteria, potentially leading to illnesses. Proper handwashing with soap is essential for maintaining health and preventing the transmission of infections to others"

(Respondent 10, 2024)

The food handler said:

> "The food handlers did not wear gloves or aprons while preparing and serving food, raising serious hygiene concerns. This lack of protective clothing increases the risk of contamination through direct contact, compromising food safety standards and potentially exposing consumers to harmful bacteria or other contaminants during food preparation and handling processes"

(Respondent 11, 2024)

The respondents in this study demonstrated good hygiene practices, with 75.4% washing their hands after using the toilet. However, only 60.0% thoroughly washed their hands with soap and hot water before handling food. Previous studies have emphasized the importance of maintaining personal hygiene, particularly hand hygiene, as hands are the primary means by which microorganisms and intestinal parasites are transmitted to food (Aarnisalo et al., 2006).

The study results revealed a significant correlation between the respondents' education levels and their food safety practices. As the respondents' education level increased, so did their adherence to proper safety practices. This highlights the importance of providing both information and training on food handling to students and school staff.

According to Martin et al. (2012), ensuring that food operators follow proper food handling practices requires essential knowledge and training as part of their responsibilities (Institut Penyelidikan Tingkahlaku Kesihatan [IPTK], 2020).

It is shown that food handlers' inadequate knowledge of proper food handling practices may also contribute to school food poisoning outbreaks (Gong et al., 2016). Canteen operators are required to adhere to regulations in order to operate their canteens, but this requirement may have been neglected by some business owners. Enforcement actions are carried out to ensure compliance with local regulations before they are allowed to run their food businesses.

While food handlers have a good understanding of the importance of using gloves, they rarely use them in practice. This is a significant concern for consumer safety, as hands frequently come into contact with food and other surfaces, increasing the risk of cross-contamination. In addition to gloves, the use of masks and aprons is uncommon among food handlers. Many respondents noted that the hot weather in the areas where food is sold makes it challenging to avoid sweating, leading to discomfort while working.

The respondents in this study demonstrated relatively good hygiene practices, with 75.4% washing their hands after using the toilet. However, only 60.0% reported washing their hands thoroughly with soap and hot water before handling food. This is concerning given that hands are one of the primary vectors through which microorganisms and intestinal parasites are transmitted to food (Aarnisalo et al., 2006). According to the World Health Organisation (2006), proper hand hygiene, including washing with soap and clean running water, is essential to prevent foodborne illnesses, particularly in institutional food settings such as school canteens.

The findings also revealed a significant correlation between respondents' education levels and their adherence to food safety practices. As education levels increased, so did compliance with safe food handling procedures. This aligns with previous studies that emphasise the importance of food safety knowledge and training for food handlers (Institut Penyelidikan Tingkahlaku Kesihatan [IPTK], 2020; Martin et al., 2012). Martin et al. (2012) noted that ensuring food operators follow proper hygiene standards requires a solid understanding of food safety principles, which must be reinforced through regular training and education.

Poor food safety practices and lack of knowledge among food handlers have been identified as contributing factors to school food poisoning outbreaks (Gong et al., 2016). Although school canteen operators are required to comply with local food safety regulations, enforcement and monitoring mechanisms may not be consistently implemented. Some business owners may overlook these requirements, potentially putting consumers, especially children, at risk. To mitigate these risks, health authorities often conduct enforcement actions to ensure regulatory compliance before canteen operations are approved (FAO/WHO, 2009).

While many food handlers acknowledged the importance of using gloves, their actual use in daily practice was found to be limited. This discrepancy is a significant concern, as frequent hand contact with food and food-contact surfaces can result in cross-contamination (Green et al., 2006; Todd et al., 2010). Gloves, when used properly, act as a protective barrier, but their effectiveness depends on correct and consistent usage, including changing gloves after handling raw food and before switching tasks.

In addition, the use of aprons and face masks was also uncommon among respondents. Although these items help prevent contamination from clothing and respiratory droplets, environmental discomfort, particularly in hot and humid weather, was frequently cited as a barrier to their use. This finding is consistent with research by Soon et al. (2012), who reported that climate and physical discomfort can negatively impact the willingness of food handlers in tropical regions to adhere to strict hygiene practices.

7.8 Rancangan Makanan Tambahan (RMT) and Home-Based Food Vendors

The respondent said:

> "Yes, the kuih-muih sold at the school canteen were supplied by home-based food vendors, offering convenience and affordability. However, the hygiene and preparation standards of these vendors may vary, raising concerns about food safety, cleanliness, and the risk of contamination, especially when proper handling and storage practices are not followed"
>
> (Food Handler 10, 2024)

Next, the Headmaster said:

> "The canteen operator or vendor responsible for the Rancangan Makanan Tambahan (RMT) program is managed by external parties, not school staff. This may affect the school's control over food quality and hygiene standards, potentially leading to inconsistencies in food safety, preparation practices, and overall accountability in meal distribution"
>
> (Headmaster 1, 2024)

Moreover, the data showed the food supplied by the outsiders. Primarily home-based or homemade food suppliers. This represents a gap in food safety oversight, as the Ministry of Health Malaysia (KKM) is unable to regulate or supervise homemade food suppliers effectively. It remains uncertain whether these suppliers have completed the required Food Handler Training Course (LPM), possess valid food handling licenses, or are registered under the Food Safety Information of Malaysia (FoSIM). Additionally, it is unclear if they have received the mandatory anti-typhoid vaccination. This oversight highlights a significant loophole in ensuring food safety and hygiene, particularly in rural school settings.

In addition, how food handlers thaw and defrost raw materials, such as frozen chicken and fish, is also crucial in preventing food poisoning. The data shown there were many food handlers defrosting frozen chicken in a water basin and defrosting at room temperature. Therefore, it will lead to cross-contamination during thawing. The water basin was unhygienic because it was used to wash dishes and dirt. The water basin has many microorganisms, which will lead to food poisoning during the food handling process. Besides, thawing food at room temperature can also lead to food poisoning, as high temperatures in the kitchen can foster the growth of many germs during the defrost process.

The finding was supported by the fact that it is not advisable to defrost frozen chicken at room temperature, placing frozen raw materials under running water until they are completely defrosted. It is advisable to use a microwave and a chiller to defrost frozen meats and chicken (Food Safety and Quality Division, Ministry of Health Malaysia, 2022). Studies indicated that food handlers lack knowledge of acceptable methods for thawing frozen foods (Sharif, Obaidat & Al-Dalalah, 2013).

The Rancangan Makanan Tambahan (RMT) is a supplementary food program implemented in Malaysian schools with the goal of improving the nutritional status of students, particularly those in rural or underprivileged areas. However, data revealed that many food supplies for this program are sourced from external home-based food vendors, especially in rural schools. While convenient and cost-effective, this approach presents a significant gap in food safety oversight.

Most of these homemade food suppliers operate outside the regulatory framework of the Ministry of Health Malaysia (KKM). As a result, it is often unclear whether these vendors have completed the Food Handler Training Course (LPM), acquired a valid food handler's certificate or license, registered under the Food Safety Information System of Malaysia (FoSIM), or received the mandatory anti-typhoid vaccination.

This regulatory ambiguity compromises food safety, especially in areas where monitoring and enforcement are minimal. According to Mohd Nor et al. (2020), unlicensed food handlers and unregulated food operations are more likely to engage in unsafe food handling practices due to limited training and awareness. The Food Hygiene Regulations 2009 under the Food Act 1983 mandate that all food handlers must undergo formal training and vaccination, yet enforcement remains limited in informal food sectors such as home-based businesses (Ministry of Health Malaysia, 2022a).

One critical concern related to these vendors involves thawing and defrosting practices, particularly with frozen raw materials such as chicken and fish. Field observations indicated that food handlers frequently defrost frozen meat in water basins or at room temperature, a practice that introduces serious food safety risks. Water basins used for thawing were also used for washing dishes and contained visible dirt and residue, creating a potential breeding ground for pathogens.

Defrosting at room temperature poses a further risk, especially in tropical climates where ambient kitchen temperatures can exceed 30°C. Under these conditions, the surface of the meat may reach the "danger zone" (5°C–60°C) where bacteria such as *Salmonella*, *Listeria monocytogenes*, and *Escherichia coli* can multiply rapidly (FDA, 2020).

According to the Food Safety and Quality Division (FSQD), Ministry of Health Malaysia (2022b), the recommended methods for safe thawing of frozen meats include, thawing in the refrigerator (chiller) at 4°C or below, thawing under cold running water in sealed packaging, using a microwave oven if cooking the food immediately afterward.

Improper thawing can lead to cross-contamination, especially when raw meats come into contact with kitchen surfaces, utensils, or other foods. In particular, water used in shared basins can harbour pathogens that may transfer from one ingredient to another, as supported by Sharif, Obaidat, and Al-Dalalah (2013), who found that many food handlers lacked adequate knowledge about safe thawing techniques and frequently practised improper defrosting.

Further research by Soon, Singh, and Baines (2011) emphasized that food safety knowledge among food handlers is often not translated into actual practices, especially in informal or home-based settings. Their study noted a disconnect between knowledge and behaviour, which increases the risk of foodborne illnesses in schools where children are especially vulnerable.

The cumulative evidence underscores the importance of enhancing monitoring mechanisms, expanding education and training programs for informal food vendors, and enforcing mandatory food safety certification. Schools, particularly in rural areas, must prioritise food safety checks and advocate for stricter collaboration between local health authorities and home-based food suppliers.

7.9 Malay Food Cuisines, Cultures and Food Ingredients

In terms of food culture among the Malay, many Malay cuisines, such as curry, kuih, pudding, rendang, and nasi lemak, contain coconut milk (santan). Coconut milk is heavily used in Malay dishes. However, food poisoning can occur if the coconut milk has spoiled. The chances are higher, of course, after opening because then the process of decay begins significantly faster. Here is how to tell if coconut milk is rotten or spoiled. Make sure the temperature is comfortable and not too hot. Moreover, that there are no heat sources. Drinking spoiled Coconut Milk can develop food poisoning and other symptoms like upset stomach, painful cramping, vomiting, fatigue, fever, and diarrhoea.

Additionally, the researcher found that a few food handlers did not prepare food on the same day. This finding aligns with research by Dora-Liyana et al. (2018), which highlighted that food poisoning cases in schools often stem from the limited time allocated for preparing large quantities of meals in conventional kitchens. As a result, food handlers commonly begin meal preparation very early in the morning or even the day before, creating conditions that promote bacterial growth in food, ultimately leading to foodborne illnesses.

In addition, only four food handlers wear proper food handler attire, including a mask, an apron, hand gloves, and a cap. More than half of the food handlers were found not wearing gloves during food preparation, and only about half wore aprons. Additionally, the majority did not use masks while handling food. This finding is consistent with Dora-Liyana et al. (2018), who reported that food handlers often prepared and served food without wearing gloves or masks and engaged in conversation while handling food. Similarly, a study by Nur Izyan et al. (2019) revealed that 61.3% of food handlers frequently touched food with their bare hands, and 36% used their aprons to wipe their hands. According to Bas et al. (2004), the staff employed in food and beverage services should have a clean, tidy and proper appearance. Maintaining short fingernails, wearing a hair cap, and practising proper handwashing are important hygiene practices to minimise the risk of cross-contamination (Kholis Ernawati et al., 2021). A study conducted in Kelantan identified hands as the primary source of cross-contamination. This was attributed to food handlers being unaware of their hand movements, which could include touching their face, nose, or other body parts. The study concluded that the risk of cross-contamination during food handling is ever-present (Zin et al., 2017). As a result, the use of hand gloves is essential to help maintain food safety. Although food handlers have good knowledge about the importance of wearing gloves, they rarely put this into practice. This is a critical issue for consumers, as hands frequently come into contact with food and other surfaces, increasing the risk of cross-contamination. In addition to gloves, the use of masks and aprons is also uncommon among most food handlers. Many of them feel that the hot weather at their place of work causes excessive sweating on the hands and face, leading to discomfort and discouraging the use of protective gear (Laras Cempaka et al., 2019).

According to interviews conducted, the majority, a total of 16 out of 23, food handlers used the same chopping board for cutting meat and cutting vegetables. This finding aligns with Dora-Liyana et al. (2018), who emphasised that raw and cooked foods should be kept separate, for instance, by using different cutting boards for meat and vegetables, to prevent cross-contamination. Improper food handling, such as using the same cutting board for raw and ready-to-eat foods, can lead to cross-contamination (Carrasco et al., 2012). Similarly, our study also observed cross-contamination during food preparation due to unwashed utensils, shared chopping boards for both wet and dry ingredients, and inadequate upkeep of the school canteen.

Next, there were a few food handlers who used the same dish towels to wipe plates and wipe tables. This data is in line with food handlers lacking knowledge of equipment hygiene and reused dish towels to wipe plates, which is not allowed due to the potential for cross-contamination (Dora-Liyana et al., 2018).

Malay cuisine is deeply rooted in traditional practices, characterised by rich, aromatic, and flavorful dishes. Common ingredients include spices, herbs, and notably, coconut milk (santan), which is extensively used in dishes such as *curry*, *rendang*, *nasi lemak*, *kuih*, and various puddings (Othman, 2012). While coconut milk enhances the texture and taste of many dishes, it is highly perishable, especially once opened. Spoiled coconut milk can lead to foodborne illnesses if not properly stored or used within a safe timeframe (Meireles, 2009). Indicators of spoilage include sour smell, curdling, and an unusual texture or colour. According to the U.S. Department of Agriculture (USDA), perishable ingredients such as coconut milk must be stored at safe temperatures (below 4°C) to minimise microbial growth (USDA, 2020).

Consuming spoiled coconut milk can result in symptoms of food poisoning, including nausea, vomiting, abdominal cramps, diarrhoea, fatigue, and fever. The risk of such contamination is especially high in large-scale meal preparations, such as school canteens, where time constraints and improper storage practices prevail.

In field observations, some food handlers were found to prepare food the day before service. This practice increases the risk of bacterial growth, particularly when the food is left unrefrigerated or inadequately reheated. This aligns with findings by Dora-

Liyana et al. (2018), who reported that early meal preparation due to limited kitchen time often leads to food safety violations, including bacterial contamination during storage.

Moreover, personal hygiene and attire among food handlers were alarmingly poor. Observations showed that only four food handlers wore complete protective attire, including masks, aprons, gloves, and head coverings. More than half failed to use gloves during food preparation, and most did not wear masks, exposing food to respiratory droplets and increasing the risk of contamination. Dora-Liyana et al. (2018) noted similar findings, emphasising that many food handlers worked without gloves and masks while engaging in conversation during meal preparation. This unhygienic practice compromises food safety.

In another study, Nur Izyan et al. (2019) reported that 61.3% of food handlers touched food with bare hands, while 36% wiped their hands on aprons, further highlighting unsafe practices. Maintaining good personal hygiene is essential; food handlers must have clean attire, short nails, and hairnets, and practice frequent handwashing (Bas et al., 2004; Kholis Ernawati et al., 2021). According to Zin et al. (2017), hand movements, such as touching the face or body, often go unnoticed but are a primary source of cross-contamination, making the use of gloves and proper training imperative.

Despite having good theoretical knowledge about food safety, many food handlers failed to translate that knowledge into practice. Laras Cempaka et al. (2019) found that discomfort from hot kitchen environments often discouraged food handlers from wearing protective gear, especially gloves and masks, due to sweating and heat-related discomfort.

A serious breach of food safety was also observed in the use of the same chopping board for raw meat and vegetables. This practice creates a high risk of cross-contamination, especially when raw meat bacteria are transferred to ready-to-eat vegetables. Dora-Liyana et al. (2018) and Carrasco et al. (2012) highlighted the critical importance of separating raw and cooked food preparation processes to reduce the risk of foodborne diseases.

Additionally, it was observed that some food handlers reused the same dish towels to wipe both plates and tables, a practice that facilitates bacterial transfer between surfaces. Reusing unwashed towels on eating utensils is considered a major hygiene lapse, often due to a lack of awareness regarding equipment sanitation (Dora-Liyana et al., 2018). Such improper practices pose a significant threat to food safety, especially in school settings, where children's immune systems are still developing.

These findings emphasise the urgent need for ongoing food safety training, proper food preparation protocols, adequate kitchen facilities, and more vigorous enforcement of hygiene standards in school food services.

7.10 Hand Eating Culture and Handwashing Practice

Eating with the right hand is a common eating culture in Malaysia. There were 144 students (30%) who were eating with their hands without washing. This led to food poisoning among students due to eating with unhygienic hands. Data showed the students had low knowledge of hand washing before eating. Other studies have shown that only 60.0% of individuals washed their hands properly using soap and hot water before handling food. Numerous past studies have emphasised the importance of personal hygiene, particularly hand hygiene, as hands are the primary carriers of microorganisms and intestinal parasites that can contaminate food (Aarnisalo et al., 2006).

The results showed that most students did not practice proper handwashing after using the toilet. Microorganisms such as *Escherichia coli* and *Staphylococcus aureus* were found on the hands of school children, food handlers, and teachers (Abushelaibi, Jobe, Al Dhanhani, Al Mansoori, & Al Shamsi, 2016). The study also revealed that students had poor knowledge of food safety, with the majority engaging in incorrect food safety practices, such as improper handwashing (Tutu, Hushie, Asante, & Egyakwa-Amusah, 2020).

Eating with the hands is the normal practice in some Malaysian cultures, deeply rooted cultural practice among Malays, reflecting values of tradition, respect, and communal identity (Othman, 2012). However, despite the cultural significance of hand-eating, hygiene practices associated with it are often overlooked, leading to potential health risks. A recent study revealed that 144 students (30%) consumed food with their hands without washing them beforehand. This unhygienic behaviour has been linked to an increased incidence of foodborne illnesses among students, primarily due to the transfer of harmful microorganisms from unwashed hands to food (World Health Organisation [WHO], 2020).

The findings also highlighted a concerning gap in knowledge regarding proper handwashing techniques. Many students were unaware of the importance of washing hands with soap and water before meals. Supporting this observation, Burton et al. (2011) reported that only about 60% of individuals practised adequate hand hygiene, using soap and warm water before handling food. Poor handwashing behaviour is especially alarming in school settings, where close contact among children facilitates the spread of pathogens.

Hands are known to be the primary vectors for transmitting a wide range of microorganisms, including intestinal parasites and bacteria responsible for gastrointestinal diseases (Aarnisalo et al., 2006). Studies have shown that improper hand hygiene is a major contributor to the spread of foodborne pathogens such as *Escherichia coli* and *Staphylococcus aureus*, which have been isolated from the hands of schoolchildren, food handlers, and teachers (Abushelaibi et al., 2016). These pathogens can survive on human hands for hours and easily contaminate food and surfaces if proper hygiene is not maintained.

Furthermore, a study by Tutu et al. (2020) emphasised that a significant proportion of students demonstrated inadequate food safety knowledge and engaged in risky practices, such as failing to wash hands after using the toilet or before eating. This lack of awareness exacerbates the risk of disease transmission in school environments. According to the Centres for Disease Control and Prevention (CDC, 2022), effective handwashing with soap can reduce the incidence of diarrheal diseases by up to 40%, underscoring the critical need for hand hygiene education and intervention programs in schools.

To address these issues, public health initiatives should incorporate culturally sensitive hygiene education that aligns with traditional eating practices while promoting the importance of hand hygiene. Schools should also provide accessible handwashing facilities and implement regular awareness campaigns to instil lifelong hygiene habits among students.

7.11 Hot Water for Fork and Spoon for Disinfection

There were 344 students (70%) who said the canteen did not provide hot water for a fork and a spoon. Hot water use for disinfecting cooking utensils was important to prevent food poisoning in schools (Food Safety and Quality Division, Ministry of Health Malaysia, 2022). There were 5 food handlers who did not wash the egg shells before cooking. *Salmonella Enteritidis* is a bacterium often associated with contamination of chicken faeces in eggshells and their improper control and cleaning. In addition, these bacteria can stem from the process of breeding and handling egg chickens that do not follow good agricultural practice and good hygiene practice (Ministry of Health Malaysia, 2022).

From the above findings, the researcher can conclude that there were loopholes in the safe food handling among food handlers and students' behaviour towards food safety. The laws and regulations were stated clearly and strictly for food safety in the school canteen. This depends on the food vendors and food handlers. Data indicates that the authority and KKM have less strict enforcement and monitoring. That is why the food poisoning continues to happen in schools. The school authority also needs to be strict on the food vendors. Ensure that all food handlers have attended a food handling training course and received the thyroid vaccination.

The study revealed a significant gap in food safety practices within school canteens. Notably, 344 students (70%) reported that hot water was not provided for disinfecting eating utensils such as forks and spoons. The absence of hot water undermines a critical hygiene step, as disinfecting utensils with hot water is essential for minimising the risk of foodborne illnesses. According to the Food Safety and Quality Division, Ministry of Health Malaysia (2022), the use of hot water in food preparation and utensil sanitation is a recommended practice to prevent microbial contamination, especially in environments involving children, who are more vulnerable to foodborne pathogens.

Additionally, the observational data indicated that five food handlers failed to wash eggshells prior to cooking. This practice poses a serious food safety risk. Eggshells can be contaminated with *Salmonella Enteritidis*, a bacterium commonly found in chicken faeces and known to cause severe foodborne illness when ingested (Ministry of Health Malaysia, 2022). Failure to clean eggs properly before use suggests a lack of adherence to both Good Hygiene Practices (GHP) and Good Agricultural Practices (GAP). These standards are outlined in national food safety protocols and are crucial for minimising the risk of bacterial transmission from raw animal products to consumers.

The findings highlight several loopholes in food safety management, both in terms of food handlers' practices and students' awareness and behaviour regarding hygiene. While the Food Act 1983 and Food Hygiene Regulations 2009 of Malaysia provide clear and strict guidelines on food handling, compliance heavily depends on food vendors and handlers' discipline, as well as consistent enforcement by the school and health authorities (Ministry of Health Malaysia, 2022). Unfortunately, the data from this study suggest a lack of rigorous monitoring and enforcement by local health departments and school management, potentially explaining the recurring food poisoning incidents in school settings.

To address these issues, school authorities must adopt a stricter stance in monitoring canteen operations. All food handlers should be required to attend certified food handling training courses and obtain typhoid vaccination, in line with the Ministry's public health requirements (Food Safety and Quality Division, 2022). Furthermore, periodic inspections, health audits, and hygiene campaigns should be conducted to reinforce compliance and awareness.

The enforcement of these measures is not solely a regulatory obligation but a moral imperative to protect the health and well-being of school children. Without active and sustained intervention from both the Ministry of Health Malaysia (MOH) and school administrators, food safety risks will persist and may lead to more frequent and severe outbreaks in educational settings.

7.12 Conclusion

In conclusion, the assessment of physical cleanliness in school kitchens, canteens, and water supplies revealed varied hygiene standards across different schools. While some schools demonstrated good practices in kitchen sanitation, food handling, and water filtration, others faced challenges such as inadequate cleaning routines, poor waste disposal systems, and unreliable water sources.

The study showed the water is contaminated due to an ageing piping system. Besides, the majority of the food handlers did not attend food handling training as required by the Ministry of Health. In addition, most of the food handlers did not get anti-thyroid vaccination as required by the MOH.

These findings highlight inconsistencies in the implementation of hygiene protocols and point to the need for improved monitoring and maintenance strategies. Overall, the data underscore the importance of physical cleanliness as a critical component of food safety in school environments.

CHAPTER 8

CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

This chapter 8 will summarise the study findings on the knowledge, attitudes and practices (KAPs) on food hygiene and safe food practices among students and food handlers. The findings on food preparation methods used by the food handlers will be discussed, along with the physical cleanliness of the canteen, clean water supplies, and sanitation. The limitations and future research will be discussed in this chapter. The new knowledge contributed to this study will also be discussed.

8.2 Conclusion

This study aimed to explore the food preparation practices of canteen food handlers, evaluate the knowledge, attitudes, and behaviours regarding food hygiene among students and food handlers in rural schools in Betong, Sarawak, and assess the physical cleanliness of school kitchens, canteens, and water sources. It sought to answer how factors such as food preparation processes, knowledge, attitudes and behaviours (KAPs) and physical environment affect food hygiene and food safety in the schools.

The findings suggest that, despite having an adequate level of hygiene knowledge, students and food handlers overlooked certain aspects. The study contributes to the literature on behavioural insights and cultural socio-economic aspects regarding food hygiene and food safety.

While the study offers valuable insights, it is limited by its geographic focus on Betong rural school students and food handlers, which may affect generalizability. The future studies could explore water quality and rainwater contamination at rural schools.

Food hygiene and safety are a crucial component for the well-being of the students. Thus, policymakers and health departments should incorporate behavioural insights and sociocultural aspects of food hygiene into national food safety policies and procedures to improve student health and achieve the Sustainable Development Goals (SDGs) for better health and well-being among children.

This study set out to investigate how the food preparation process affects the food hygiene among the food handlers, how well do the knowledge, attitude and behaviours (KAPs) of the food handlers and students of the Betong schools towards hygiene in their daily food hygiene practices, and how does the cleanliness of the kitchen water supply system affect food hygiene. Through an in-depth analysis of quantitative analysis, qualitative interviews, observation and focus group discussion (FGD) the study addressed the food handling processes used by the canteen food handlers in rural schools in Betong Sarawak, the levels of knowledge, attitudes, and practices (KAPs) regarding food hygiene among the food handlers and all students in rural schools in Betong Sarawak, and to access the physical cleanliness of school kitchens, canteens and water supplies.

The findings of this research highlight several key themes. First, Chapter 4 has provided a comprehensive overview of the demographic profiles of both students and food handlers involved in the study. The analysis covered key variables such as age, gender, educational background, and work experience, offering valuable insights into the composition of the population under investigation. By examining these characteristics, the chapter sheds light on several demographic trends that may influence hygiene practices and food safety behaviours in school environments.

For students, factors such as age and educational level may affect their awareness and understanding of food safety issues, as well as their susceptibility to foodborne illnesses. The analysis of their experiences related to physical facilities, water supply, and the surrounding environment further underscores the significance of infrastructure in maintaining proper hygiene and preventing food poisoning outbreaks.

Similarly, the demographic information of food handlers, including their age, level of formal education, food safety training, and years of experience, provides an important context for understanding their practices and attitudes towards food hygiene. These factors are crucial in determining the level of compliance with established food safety standards and the overall effectiveness of food handling in school canteens.

Secondly, Chapter 5 presented the key findings derived from the analysis of interview transcripts and survey responses, to understand the food safety practices among food handlers. The findings revealed that while most food handlers are aware of basic hygiene practices, lapses in cross-contamination control. But then, the findings showed that the food handlers still have poor knowledge in a hot canteen environment, temperature can increase germ breeding rates, and the food handlers had poor knowledge on chemicals, such as rat and insect poisons, which can be placed next to dried raw materials. These findings directly address the first research objective, which sought to investigate the food handling process among the school canteen food handlers on food hygiene behaviour and food safety.

Next, the study also found that food handlers demonstrated a poor attitude toward proper hand hygiene practices. The food handlers exhibit a mild attitude toward the removal of personal jewellery during food preparation. In addition, the findings indicated that food handlers demonstrated a positive attitude toward hand hygiene practices, particularly after handling raw food materials.

In terms of gender, the findings show female has better food hygiene knowledge and attitude as compared to males. Besides, the findings indicate that education levels affect the food hygiene knowledge. The study found that food handlers who hold diploma holders have better food hygiene knowledge as compared to those who hold form 5 educational levels.

This study found that the majority, 70% of food handlers reported using the same chopping board for raw meat and vegetables, which increases the likelihood of cross-contamination and foodborne disease transmission. Defrosting practices were also suboptimal, with 60.9% of food handlers using water basins instead of safer options like refrigeration or microwaving, which are crucial to maintaining food at safe temperatures and preventing bacterial proliferation.

Next, Chapter 6 presented the findings related to the levels of knowledge, attitudes, and practices (KAPs) towards food hygiene among students in rural schools in Betong, Sarawak. The majority of students demonstrated very good knowledge regarding the prevention of foodborne illnesses through hand hygiene. The findings revealed that students exhibited relatively good knowledge regarding the importance of checking dates on food and beverage packaging. The analysis showed that while students generally demonstrated pretty good knowledge of food hygiene, their actual practices were less consistent. However, the findings revealed that students had very poor knowledge regarding the correct steps for handwashing, indicating limited understanding of hand hygiene among the majority of students. This is particularly concerning given that proper handwashing is recognised as one of the most effective strategies in preventing foodborne illnesses and the spread of infectious diseases.

ANOVA results revealed significant differences in knowledge scores by level of education, suggesting that older students tend to be more informed. Gender differences were also statistically significant in hygiene practices, with female students reporting higher compliance. Ethnic variations, while observed, were not statistically significant.

These findings directly address the research objective of determining the level of food hygiene KAPs among rural school students. They highlight both strengths in awareness and gaps in behavioural adherence, underscoring the need for targeted education programs.

Finally, the assessment of physical cleanliness in school kitchens, canteens, and water supplies revealed varied hygiene standards across different schools. While some schools demonstrated good practices in kitchen sanitation, food handling, and water filtration, others faced challenges such as inadequate cleaning routines, poor waste disposal systems, and unreliable water sources.

The study showed the water is contaminated due to an ageing piping system at SK Pusa, Betong. Besides, the majority of the food handlers did not attend food handling training as required by the Ministry of Health. In addition, most of the food handlers did not get anti-thyroid vaccination as required by the MOH.

These findings highlight inconsistencies in the implementation of hygiene protocols and point to the need for improved monitoring and maintenance strategies. Overall, the data underscore the importance of physical cleanliness as a critical component of food safety in school environments. These insights collectively contribute to a deeper understanding of food-borne diseases and the lifestyles of the students and food handlers in rural schools—a case study in Betong, Sarawak, Malaysia. Thus, the new knowledge and practices in food hygiene and food safety will contribute to the area of sociology and the field of behavioural insights and behavioural health in public health.

This study made multiple contributions at practical, conceptual, and policy levels. One of the primary contributions of this study lies in its examination of knowledge, attitude and practices (KAPs) in food hygiene and food safety, which fills a gap in the existing literature on sociology, specifically on behavioural insights and behavioural health. In doing so, it offers both conceptual and practical implications, particularly for educators, policymakers, practitioners and students.

Despite its contributions, the study faced several limitations, including difficulty in source tracing, it is often challenging to identify the exact source of contamination due to the complexity of food supply chains, delays between food consumption and illness symptoms make traceback investigations harder, inadequate regulation and enforcement, in some regions, food safety regulations are outdated, poorly enforced, or non-existent, small-scale food producers or street vendors may operate without regular inspections or hygiene training. Last but not least, a lack of public awareness means consumers may not follow safe food handling practices due to ignorance or cultural habits. Furthermore, misinformation and inadequate food safety education contribute to an increased risk.

Nonetheless, these do not diminish the value of the findings but rather highlight the complexity of the research context.

Future research could build upon this work by focusing on food safety education and behavioural studies, especially to further explore studies on the effectiveness of food safety training programs for food handlers, vendors, and the public, and research on cultural perceptions and behaviours influencing hygiene practices, especially in traditional or local cuisines (e.g., Malay food).

In conclusion, this research advances our understanding of food hygiene and food safety among the food handlers and students in rural school, Betong, Sarawak and provides a foundation for further exploration in food-borne diseases. It is hoped that the insights presented here will inform both academic inquiry and practical implementation in the sociology field and food-borne diseases.

8.3 Summary of Major Findings

The major finding on food handlers knowledge, although male food handlers had a higher average score than females, the difference was not statistically significant ($p > 0.05$), indicating that gender does not significantly influence the knowledge level among the food handlers on food safety and hygiene. Next, based on post hoc test, the educational level had no significant impact on the total mean knowledge score among the food handlers. A one-way ANOVA was conducted to examine whether there were differences in total mean scores across different education levels (Form 3, Form 5, and Form 6/Diploma). However, the ANOVA results revealed that the differences were not statistically significant, $F(2, 20) = 0.115$, $p = 0.892$. This indicates that there is no significant difference in knowledge among the different education levels.

In terms of food handlers' attitudes, an independent-samples t-test was conducted to compare attitude scores for males and females. There was a significant difference in the scores for males (M=2.45, SD=0.97) and females (M=1.40, SD=0.30); t(20) = 2.347, p = 0.029. The mean attitude score for males (M = 2.45, SD = 0.97) was higher than that for females (M = 1.40, SD = 0.30). The mean difference was 1.04608, with a 95% confidence interval ranging from 0.11631 to 1.97585. These findings indicate that gender has a significant effect on attitude scores. A one-way analysis of variance (ANOVA) was conducted to examine the differences in attitude scores across three education levels: Form 3, Form 5, and Form 6/Diploma. Descriptive statistics indicated that Form 5 students (M = 2.2750, SD = 1.12906) had a slightly higher mean attitude score compared to Form 6/Diploma students (M = 2.1667, SD = 1.00396) and Form 3 students (M = 2.1250, SD = 0.56724). However, the ANOVA results revealed that the differences were not statistically significant, F(2, 19) = 0.042, p = 0.959. Since the p-value exceeds the 0.05 significance level, the null hypothesis is not rejected. This indicates that there is no significant difference in attitude scores among students with different education levels. The results of the Tukey HSD test indicated that all education levels belonged to a single homogeneous subset (p = 0.963). This suggests that there were no statistically significant differences in attitude scores among the three education groups. Despite the unequal group sizes, the adjusted harmonic mean sample size (6.316) confirms that the levels of attitude remained consistent regardless of the educational background of the respondents.

Finding on the practices of the food handlers, An independent-samples t-test was conducted to compare practice scores between males and females. There was no significant difference in the scores for males (M=2.53, SD=1.63) and females (M=1.80, SD=1.10); t(19) = 0.932, p = 0.363. The 95% confidence interval for the difference in means ranged from -0.91 to 2.37. Since this interval includes zero and the p-value exceeds the .05 threshold, we fail to reject the null hypothesis, concluding that gender does not significantly influence practice scores in this sample. The ANOVA results indicated that these differences were not statistically significant, $F(2, 18) = 0.264$, $p = .771$. Therefore, the null hypothesis is accepted, concluding that education level does not significantly influence practice levels among the respondents. The homogeneous subset table further illustrates this, as all three educational categories were grouped together in a single subset ($p = 0.753$). These findings suggest that the level of education does not significantly influence the practice scores of the food handlers.

Attitude vs. Practice Pearson Correlation: 0.655, Sig.: 0.001. There is a strong positive correlation. This means that as a person's Attitude score increases, their Practice score tends to increase as well. Total Knowledge vs. Attitude Pearson Correlation: 0.819, Sig.: 0.000. This is a very strong positive correlation. This is expected, as Attitude is likely a major component of the Knowledge. Knowledge vs. Practice Pearson Correlation: 0.617 Sig.: 0.003. There is a moderate-to-strong positive correlation.

This result adds a connection to previous findings. Even though Gender and Education didn't always change the scores, the scores themselves are deeply connected. A Pearson product-moment correlation was run to determine the relationship between attitude and practice. There was a strong positive correlation between attitude and practice, which was statistically significant ($r = 0.655$, $n = 21$, $p = 0.001$). Conclusion of the analysis, Gender affects Attitude. Attitude is strongly linked to Practice. Therefore, focusing on improving attitudes (especially among females, who scored lower) would likely lead to better practices.

Students' knowledge finding, an independent samples t-test was conducted to examine the difference in food hygiene knowledge between male and female students. The results showed that there was no statistically significant difference between males (M = 2.03, SD = 0.75) and females (M = 2.02, SD = 0.74), $t(481) = 0.056$, $p = 0.955$. Gender does not influence food hygiene knowledge among students. A one-way ANOVA was conducted to examine differences in food hygiene knowledge across education levels. The results indicated that there was no statistically significant difference in knowledge scores among the different education groups, $F(4, 480) = 0.157$, $p = 0.960$. Education level does not influence food hygiene knowledge among rural schools' students. Even with a much larger sample size (N=485), Education level does not appear to influence Knowledge**.** Whether someone has only completed Primary 6 (Tamat Darjah 6) or has a Diploma (Tamat Tingkatan 6 / Diploma), their knowledge scores regarding this topic are essentially identical.

An independent samples t-test was conducted to compare attitude scores between male and female respondents. The results indicated that male respondents (M = 2.00, SD = 1.03) had slightly higher attitude scores than female respondents (M = 1.85, SD = 0.97). However, the difference was not statistically significant, $t(480) = 1.58$, $p = 0.114$. A one-way ANOVA was conducted to compare the effect of education level on students' attitudes. The results indicated that there was no significant effect of education level on attitude scores for the five groups [$F(4, 479) = 1.550$, $p = 0.187$]. Essentially, it doesn't matter if the participants are still in school or have a Diploma; their scores are statistically the same. This implies that their education hasn't significantly changed their perspective or behavior on this topic. A Tukey HSD post-hoc test was conducted to determine if the level of education significantly influenced the mean attitude scores (*atitudetotalmean*). The results indicated that there were no statistically significant differences between any of the educational groups (p = 0.623). All groups ranging from those who completed primary school (*Tamat Darjah 6*) to those with diplomas or still in school were placed within a single homogeneous subset. This suggests that the respondents' educational backgrounds did not lead to a significant variation in their reported attitudes.

For student's practices, an independent samples t-test was conducted to examine the difference in practice scores between male and female respondents. The results showed that male respondents (M = 1.88, SD = 0.88) had higher practice scores than female respondents (M = 1.72, SD = 0.82). The difference was statistically significant, $t(480) = 1.98$, $p = 0.049$. There is a significant difference in practice scores between male and female respondents. Male students show higher practice scores than female students. Although the mean practice scores differ slightly between education levels, the differences are not statistically significant. This means education level does not significantly influence practice scores among the respondents. A one-way ANOVA was conducted to examine differences in practice scores across education levels. The results indicated that there was no statistically significant difference in practice scores among the education groups, F(4, 479) = 1.74, p = 0.141. The Tukey HSD homogeneous subset analysis showed that all education groups were clustered within a single subset, indicating that there were no statistically significant differences in practice scores among respondents with different education levels (p = 0.463).

All coefficients are positive. This means as one score increases, the others tend to increase as well. For example, people with higher knowledge scores generally have higher practice scores. The strongest link is between Knowledge and Practice (r = 0.669). All three values are above 0.5, which in social sciences is typically considered a strong relationship. Statistical Significance: The Sig. (2-tailed) values are all 0.000. This doesn't mean the probability is zero, but rather that it is less than 0.001. Because this is less than the standard alpha of 0.05, the results are highly statistically significant. The double asterisks (**) also indicate that the correlation is significant at the 0.01 level.

A Pearson product-moment correlation coefficient was computed to assess the relationship between knowledge, attitude, and practice total mean scores. Preliminary analyses showed the relationship to be linear with all variables normally distributed, as assessed by visual inspection of a scatterplot and Shapiro-Wilk test. There was a strong, positive correlation between knowledge and practice, $r(482) = 0.669$, $p < .001$, with high levels of knowledge associated with higher levels of practice. Similarly, a strong, positive correlation was found between knowledge and attitude, $r(482) = .667$, $p < .001$. Finally, a moderate-to-strong positive correlation existed between attitude and practice, $r(482) = 0.580$, $p < 0.001$.

8.4 Recommendations

In conclusion, the food handlers think that the Ministry of Education should collaborate with the Ministry of Health Malaysia to make food handling training a compulsory course for all food vendors. Based on the findings of this study, several recommendations are proposed to enhance food safety and hygiene practices among food handlers in Malaysia. Firstly, it is recommended that the Ministry of Education work in collaboration with the Ministry of Health Malaysia to make food handling training a mandatory course for all food vendors. This training should include essential topics such as personal hygiene, safe food preparation techniques, prevention of cross-contamination, and proper handling of high-risk ingredients like coconut milk. In addition, regular monitoring and enforcement by health authorities should be strengthened to ensure compliance with hygiene regulations. Scheduled inspections and communicated penalties for non-compliance can help improve standards. Public awareness campaigns should also be introduced to educate both food handlers and consumers on the importance of food hygiene, creating a more informed and responsible food environment. Furthermore, training programs and materials should be culturally relevant, especially when addressing traditional Malay food practices, to ensure effectiveness and relatability. Lastly, incentives such as hygiene certifications or subsidies for training participation could encourage greater compliance among food vendors. These combined efforts will contribute to safer food environments, reduce the risk of foodborne illnesses, and promote a culture of hygiene within Malaysia's food service sector.

Food handlers provided several practical solutions to improve food handling and hygiene practices in their daily operations. Many emphasised the need for compulsory food safety training, suggesting that such courses should be made mandatory for all food vendors regardless of their experience. They believed that training should be hands-on and regularly updated to reflect current food safety standards. Some respondents also highlighted the importance of improved kitchen infrastructure, including access to clean water, proper refrigeration, and designated areas for raw and cooked foods to avoid cross-contamination. Others called for more frequent health inspections and guidance from local health officers, not only to enforce regulations but also to provide constructive feedback and education. Additionally, food handlers expressed a desire for educational posters or visual reminders in food preparation areas to reinforce hygiene practices. A few participants suggested that collaborations with schools or community centres could help raise awareness among the next generation and the wider community. Overall, food handlers demonstrated a willingness to improve and welcomed greater support from authorities, training institutions, and the public in creating a safer and more hygienic food environment.

Besides, the food handlers urged the schools and the Ministry of Education to review again the food vendors' supplies from home. Because many cases of food poisoning have occurred in schools due to food supplied by home vendors, home vendors must adhere to the rules and regulations established by safe food handling processes. In addition, the food handlers believe they must wear gloves, a cap, and an apron during food preparation.

The food handlers urged the government to change the old water pipe or the rushed water pipe system to prevent cross-contamination of water with food. The school authority should ban the roadside stalls for selling food and drinks. This is because we did not know the sources of foods and drinks, whether it is safe to consume or not. Moreover, the government should ban the recruitment of non-Malaysian workers or temporary workers to work in school canteens. This is because most of them did not get typhoid vaccinated and most of them did not undergo proper health checking before working as food handlers. Last but not least, in terms of students’ responses, the student urged the canteen to provide hot water for fork and spoon disinfection and provide soap and antibacterial liquid beside the basin for handwashing.

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APPENDICES

Appendix A: Data Collection at Schools

Figure 1: SK Pusa, Betong

Figure 2: SK Kalok, Betong

Appendix B: Sample of Questionnaires (Student and Food Handlers)

Tajuk Penyelidikan: Penyakit Bawaan Makanan dan Gaya Hidup Pelajar dan Pengendali Makanan di Sekolah Luar Bandar. Kajian Kes di Betong, Sarawak, Malaysia.

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Pengenalan: Kajian ini berkenaan dengan penyakit bawaan makanan dan gaya hidup pelajar dan pengendali makanan di kantin sekolah. Penyakit bawaan makanan mengakibatkan jutaan kematian setiap tahun di seluruh dunia. Kes keracunan makanan di Malaysia masih tinggi khususnya di sekolah. Sila ambil masa yang secukupnya untuk membaca dan mempertimbangkan dengan teliti penerangan yang diberi sebelum anda bersetuju untuk menyertai penyelidikan ini. Jika ada sebarang kemusykilan ataupun maklumat lanjut yang anda ingin tahu, anda boleh bertanya dengan penyelidik di lapangan **(En Ling Song Jing, 016-8988436,** songjing_1992@yahoo.com**)**. Penyertaan anda dalam penyelidikan ini adalah secara sukarela. Anda tidak perlu menyertai penyelidikan ini jika anda tidak mahu. Anda juga boleh menarik diri daripada penyelidikan ini pada bila-bila masa sahaja.

Tujuan Penyelidikan: Kajian ini dilakukan adalah untuk mengetahui tahap pengetahuan, sikap, dan tingkah laku dalam kalangan pelajar dan pengendali makanan terhadap amalan kebersihan makanan. Selain itu, kajian ini juga akan mengetahui bagaimana cara dan proses penyediaan makanan oleh pengendali makanan terhadap kebersihan makanan. Di samping itu, menilai tahap kebersihan fizikal dapur, kantin dan bekalan air bersih di sekolah. Kajian ini melibatkan 12 sekolah rendah dan menengah di Betong. Saiz sampel adalah sebanyak 1329 pelajar dan semua pengendali makanan di setiap sekolah. Pengumpulan data penyelidikan ini akan berlangsung selama setahun (1 Januari 2021 sehingga 31 December 2021). Soal selidik mengambil masa selama 10-15 minit. Temu ramah bersemuka mengambil masa selama 10 minit.

Soal Selidik

Murid

Modul A: Sosiodemografi, tempat kediaman dan persekitaran

Sila tulis dan bulatkan jawapan anda.

Bil	Soalan	Jawapan
A1	Nama:	
A2	Apakah Jantina anda?	1. Lelaki 2. Perempuan
A3	Berapa umur anda?	
A4	Apakah bangsa anda?	1. Melayu 2. Iban 3. Bidayuh 4. Cina 5. Lain-lain Sila nyatakan:

A5	Pekerjaan:	1. Pelajar 2. Pekerja Swasta 3. Pekerja Kerajaan 4. Lain-lain Sila nyatakan:
A6	Apakah tahap pendidikan tertinggi anda?	1. Kanak-kanak atau remaja yang masih bersekolah 2. Tamat Darjah 6 3. Tamat Tingkatan 3 4. Tamat Tingkatan 5 5. Tamat Tingkatan 6 /sijil/ diploma 6. Lain-lain
A7	Wang yang diterima daripada ahli isi rumah atau duit saku:	RM:
A8	Wang dari biasiswa, kebajikan masyarakat atau sosial, Baitulmal dan lain-lain.	RM:

Modul B: Kebersihan, kemudahan fizikal dan persekitaran

Sila tulis dan bulatkan jawapan anda.

Bill	**Soalan**	**Jawapan**

B1	Jenis tempat tinggal	1. Rumah sesebuah, rumah kampung, banglo 2. Rumah Bandar, Teres 3. Rumah Kedai 4. Rumah setinggan 5. Rumah Panjang
B2	Jumlah isi rumah yang tinggal di rumah anda?	Orang:
B3	Apakah sumber bekalan air minum yang utama untuk semua isi rumah di rumah anda? ***Sila rujuk buku kod di halaman terakhir***	1. Paip air 2. Telaga 3. Air mata air 4. Takungan air hujan 5. Air dari tasik atau sungai 6. Air yang dihantar 7. Kios Air 8. Air berbotol 9. Air permukaan 10. Lain-lain

B3(a)	Apakah sumber bekalan air minum di sekolah anda? ***Sila rujuk buku kod di halaman terakhir***	1. Paip air 2. Telaga 3. Air mata air 4. Takungan air hujan 5. Air dari tasik atau sungai 6. Air yang dihantar 7. Kios Air 8. Air berbotol 9. Air permukaan 10. Lain-lain
B4	Apakah jenis tandas yang anda dan ahli isi rumah biasa gunakan? ***Sila rujuk buku kod di halaman terakhir***	1. Tandas pam dengan tangki kumbahan (tangki septik) 2. Tandas curah 3. Tandas Lubang tertutup 4. Tandas Lubang tidak tertutup 5. Tandas angkut/tong 6. Bekas sanitasi 7. Tandas gantung terus ke sungai /laut 8. Tiada kemudahan tandas/ semak/kawasan terbuka

B4(a)	Apakah jenis tandas yang ada di sekolah anda? ****Sila rujuk buku kod di halaman terakhir***	1. Tandas pam dengan tangka kumbahan (tangka septik) 2. Tandas curah 3. Tandas lubang tertutup 4. Tandas lubang tidak tertutup 5. Tandas angkut/ tong 6. Bekas sanitasi 7. Tandas gantung terus ke sungai/ laut 8. Tiada kemudahan tandas/ semak/ kawasan terbuka
B5	Adakah anda mempunyai sabun atau bahan pencuci khas untuk mencuci tangan di sekolah?	1. Ya 2. Tiada
B5(a)	Adakah anda mempunyai sabun atau bahan pencuci khas untuk mencuci tangan di rumah anda?	1. Ya 2. Tiada
B6	Adakah tong sampah disediakan di kantin dan dapur kantin?	1. Ya

		2. Tiada

Modul C: Kesedaran, pengetahuan, sikap dan tingkah laku pelajar berkenaan kebersihan makanan

Sila tandakan (√) pada jawapan anda.

Sangat setuju → Setuju → Kurang setuju → Tidak setuju → Sangat tidak setuju

Bil	Soalan	SS	S	KS	TS	STS
C1	Keracunan makanan seperti sakit perut, cirit-birit dan muntuh boleh dielakkan jika makan dengan tangan yang bersih					
C2	Terdapat tiga (3) langkah asas cuci tangan					
C3	Persekitaran yang kotor tidak menyebabkan pencemaran makanan					
C4	Tarikh luput pada pembungkus makanan					

	dan minuman adalah penting					
C5	Makanan yang telah rosak dan berbau tidak selamat untuk dimakan					
C6	Makanan yang mengandungi rambut akan menyebabkan masalah kesihatan jika dimakan					
C7	Makanan yang terkena lalat atau lipas adalah tidak selamat untuk dimakan					
C8	Suhu dapur atau bilik yang panas akan meningkatkan kadar pembiakan kuman					
C9	Peralatan dapur yang tidak dibasuh menggunakan sabun pencuci boleh mengakibatkan pencemaran makanan					
C10	Tuala yang digunakan untuk mengelap tangan boleh digunakan untuk mengelap pinggan mangkuk					
C11	Makanan mentah dan makanan yang telah dimasak perlu diasingkan untuk mengelakkan pencemaran makanan					
C12	Dapur kantin perlu dilindungi daripada makhluk perosak seperti tikus dan cicak					
C13	Penggunaan minyak masak berulang kali adalah buruk untuk kesihatan					

C14	Bahan kimia seperti racun tikus dan racun serangga boleh disimpan berdekatan dengan bahan mentah kering seperti beras, bawang dan tepung					
C15	Memotong buah dan daging mentah menggunakan papan pemotong yang berasingan					
C16	Tuala pengelap tangan boleh digunakan berulang kali tanpa dicuci					

Modul D:

Sila bulatkan and tulis jawapan anda.

Bil	Soalan	Jawapan
D1	Adakah ibu dan bapa anda menyediakan makanan dari rumah ke sekolah?	1. Ya 2. Tidak
D2	Adakah anda mengambil sarapan pagi di rumah?	1. Ya 2. Tidak
D3	Adakah anda bawa bekal makanan ke sekolah?	1. Ya 2. Tidak
D4	Berapa lama anda simpan makanan dalam bekal sebelum dimakan?	

D5	Berapa kali anda membeli makanan di sekolah dalam seminggu?	______________Kali
D6	Di manakah anda membeli makanan semasa di sekolah?	
D7	Adakah anda membeli makanan dan minuman di luar sekolah? Sila nyatakan tempat:-	
D8	Apakah jenis makanan yang anda selalu beli dan makan?	
D9	Kenapa anda membeli makanan tersebut?	
D10	Apakah jenis minuman yang selalu anda beli dan minum?	
D11	Kenapa anda membeli minuman tersebut?	

TAMAT

Terima kasih atas kerjasama anda

Tajuk Penyelidikan: Penyakit Bawaan Makanan dan Gaya Hidup Pelajar dan Pengendali Makanan di Sekolah Luar Bandar. Kajian Kes di Betong, Sarawak, Malaysia.

Nama Universiti dan Nama Penyelidik: Universiti Malaysia Sarawak (UNIMAS), En Ling Song Jing (Calon PhD)

Penyelia Penyelidikan: Dr Zamri bin Hj Hassan (hzamri@unimas.my, Dr Regina Garai binti Abdullah (argarai@unimas.my).

Pengenalan: Kajian ini berkenaan dengan penyakit bawaan makanan dan gaya hidup pelajar dan pengendali makanan di kantin sekolah. Penyakit bawaan makanan mengakibatkan jutaan kematian setiap tahun di seluruh dunia. Kes keracunan makanan di Malaysia masih tinggi khususnya di sekolah. Sila ambil masa yang secukupnya untuk membaca dan mempertimbangkan dengan teliti penerangan yang diberi sebelum anda bersetuju untuk menyertai penyelidikan ini. Jika ada sebarang kemusykilan ataupun maklumat lanjut yang anda ingin tahu, anda boleh bertanya dengan penyelidik di lapangan **(En Ling Song Jing, 016-8988436,** songjing_1992@yahoo.com**)**. Penyertaan anda dalam penyelidikan ini adalah secara sukarela. Anda tidak perlu menyertai penyelidikan ini jika anda tidak mahu. Anda juga boleh menarik diri daripada penyelidikan ini pada bila-bila masa sahaja.

Tujuan Penyelidikan: Kajian ini dilakukan adalah untuk mengetahui tahap pengetahuan, sikap, dan tingkah laku dalam kalangan pelajar dan pengendali makanan terhadap amalan kebersihan makanan. Selain itu, kajian ini juga akan mengetahui bagaimana cara dan proses penyediaan makanan oleh pengendali makanan terhadap kebersihan makanan. Di samping itu, menilai tahap kebersihan fizikal dapur, kantin dan bekalan air bersih di sekolah. Kajian ini melibatkan 12 sekolah rendah dan menengah di Betong. Saiz sampel adalah sebanyak 1329 pelajar dan semua pengendali makanan di setiap sekolah. Pengumpulan data penyelidikan ini akan berlangsung selama setahun (1 Januari 2021 sehingga 31 December 2021). Soal selidik mengambil masa selama 10-15 minit. Temu ramah bersemuka mengambil masa selama 10 minit.

Soal Selidik

Pengendali Makanan

Modul A: Sosiodemografi, tempat kediaman dan persekitaran

Sila tulis dan bulatkan jawapan anda.

Bil	Soalan	Jawapan
A1	Nama:	
A2	Apakah Jantina anda?	1. Lelaki 2. Perempuan
A3	Berapa Umur anda?	

A4	Apakah Bangsa anda?	1. Melayu 2. Iban 3. Bidayuh 4. Cina 5. Lain-lain Sila nyatakan:
A5	Pekerjaan:	1. Pekerja swasta 2. Pekerja kerajaan 3. Pekerja separuh masa 4. Tidak bekerja
A6	Apakah tahap pendidikan tertinggi anda?	1. Tidak perlu bersekolah 2. Tamat darjah 6 3. Tamat tingkatan 3 4. Tamat tingkatan 5 5. Tamat tingkatan 6 / sijil / diploma 6. Lain-lain Sila nyatakan:
A7	Pendapatan daripada bekerja	RM:
A8	Wang yang diterima daripada ahli isi rumah atau duit belanja	RM:
A9	Bantuan kewangan dari kebajikan masyaraka atau	RM:

	sosial, Baitulmal dan lain-lain	

Modul B: Kebersihan, kemudahan fizikal dan persekitaran

Sila tulis dan bulatkan jawapan anda.

Bil	Soalan	Jawapan
B1	Jenis tempat tinggal?	1. Rumah sesebuah, rumah kampung, banglo 2. Rumah bandar, Teres 3. Rumah Kedai 4. Rumah setinggan 5. Rumah Panjang
B2	Jumlah isi rumah yang tinggal di rumah ini?	__________Orang
B3	Apakah sumber bekalan air minum yang utama untuk semua isi rumah di rumah anda? ***Sila rujuk buku kod di halaman terakhir***	1. Paip air 2. Telaga 3. Air mata air 4. Takungan air hujan 5. Air dari tasik atau sungai 6. Air yang dihantar 7. Kios air

		8. Air berbotol 9. Air permukaan 10. Lain-lain
B3(a)	Apakah sumber bekalan air minum di sekolah anda? ***Sila rujuk buku kod di halaman terakhir***	1. Paip air 2. Telaga 3. Air mata air 4. Takungan air hujan 5. Air dari tasik atau sungai 6. Air yang dihantar 7. Kios air 8. Air berbotol 9. Air permukaan 10. Lain-lain
B4	Apakah jenis tandas yang anda dan ahli isi rumah biasa gunakan? ***Sila rujuk buku kod di halaman terakhir***	1. Tandas pam dan disambung ke sistem kumbahan pusat 2. Tandas pam dengan tangki kumbahan (tangki septik) 3. Tandas curah 4. Tandas lubang tertutup 5. Tandas lubang tidak tertutup 6. Tandas angkut/tong

		7. Bekas sanitasi 8. Tandas gantung terus ke sungai/laut 9. Tiada kemudahan tandas/semak/kawasan terbuka
B4(a)	Apakah jenis tandas yang ada di sekolah anda? ***Sila rujuk buku kod di halaman terakhir***	1. Tandas pam dan disambung ke sistem kumbahan pusat 2. Tandas pam dengan tangka kumbahan (tangka septik) 3. Tandas curah 4. Tandas lubang tertutup 5. Tandas lubang tidak tertutup 6. Tandas angkut/tong 7. Bekas sanitasi 8. Tandas gantung terus ke sungai/laut 9. Tiada kemudahan tandas/semak/kawasan terbuka
B5	Adakah anda mempunyai sabun atau pencuci khas untuk mencuci tangan di sekolah?	1. Ya 2. Tiada
B5(a)	Adakah anda mempunyai sabun atau pencuci khas untuk mencuci tangan di rumah anda?	1. Ya 2. Tiada

Modul C: Proses dan cara pengendalian makanan oleh pengendali makanan kantin sekolah

Sila bulatkan dan tulis jawapan anda.

Bil	Soalan	Jawapan
C1	Adakah anda tahu bagaimana untuk menyimpan makanan segar?	1. Ya 2. Tidak
C2	Adakah anda menyimpan makanan dalam suhu yang sesuai di dalam peti sejuk? (Fakta: 2°C-5°C)	1. Ya 2. Tidak
C3	Berapa lama anda memasak makanan? (Fakta: sekurang-kurangnya suhu 70°C selama 2 minutes)	________________minit/jam
C4	Bilakah makanan disediakan?	1. Pada hari yang sama 2. Sehari sebelum 3. Lain-lain Sila nyatakan:
C5	Di manakah sumber bahan mentah?	1. Ladang 2. Pasar 3. Rumah 4. Lain-lain Sila nyatakan:
C6	Adakah anda memakai sarung tangan, apron, topeng muka dan topi semasa proses penyediaan makanan?	1. Sarung tangan ( ) 2. Apron ( )

		3. Topeng muka ( ) 4. Topi ( ) 5. Lain-lain ( ) Sila nyatakan:
C7	Adakah anda menggunakan papan pemotong yang sama untuk makanan mentah dan sayur-sayuran?	1. Ya 2. Tidak
C8	Adakah anda menggunakan semula tuala yang sama untuk pinggan dan makanan?	1. Ya 2. Tidak
C9	Bagaimana anda mencairkan makanan?	1. Peti sejuk 2. Microwave 3. Di luar (suhu bilik) 4. Basin air 5. Lain-lain Sila nyatakan:
C10	Adakah anda tahu bagaimana untuk mencairkan makanan dengan selamat?	1. Ya 2. Tidak
C11	Adakah tong sampah disediakan di dapur kantin dan kantin?	1. Ya 2. Tidak
C12	Adakah anda tahu berapa lama boleh menyimpan makanan di dalam peti sejuk?	1. Ya 2. Tidak

Modul D: Kesedaran, pengetahuan, sikap dan tingkah laku pengendali makanan terhadap kebersihan makanan

Sila tandakan (√) pada jawapan anda.

Sangat setuju → Setuju → Kurang setuju → Tidak setuju → Sangat tidak setuju

Bil	Soalan	SS	S	KS	TS	STS
D1	Saya tidak perlu basuh tangan dengan cara 7 langkah apabila sibuk melayan pelanggan					
D2	Persekitaran kantin mempengaruhi keselamatan makanan					
D3	Makanan yang tidak habis dijual boleh disimpan di dalam peti sejuk untuk dijual semula					
D4	Makanan yang hendak dijual kepada murid tidak perlu ditutup					
D5	Air yang tidak dimasak boleh digunakan untuk membancuh minuman					
D6	Makanan yang telah dibiar melebihi 4 jam boleh dimakan					

D7	Saya tidak perlu menanggalkan jam, cincin, gelang sebelum menyediakan makanan					
D8	Peralatan memasak yang bersih boleh menghasilkan makanan yang bersih dan selamat					
D9	Tuala pengelap tangan boleh digunakan berulangkali tanpa dicuci					
D10	Makanan yang masih panas boleh dimasukkan di dalam peti sejuk					
D11	Saya mesti senantiasa basuh tangan selepas sentuh bahan mentah					
D12	Saya tidak mengambil berat dengan kebersihan kantin					
D13	Saya akan hidu dan rasa makanan supaya tidak basi sebelum makan makanan tersebut					
D14	Saya tidak akan membeli makanan dalam tin yang telah kemek					
D15	Keracunan makanan seperti sakit perut, cirit-birit dan muntah boleh dielakkan jika makan dengan tangan yang bersih					
D16	Persekitaran yang kotor tidak menyebabkan pencemaran makanan					
D17	Tarikh luput pada pembungkus makanan dan minuman adalah penting					

D18	Makanan yang telah rosak dan berbau tidak selamat untuk dimakan					
D19	Ketulan ais daripada air yang tidak dimasak adalah selamat untuk diminum					
D20	Surat khabar tidak selamat digunakan sebagai pembungkus makanan					
D21	Dawai kokot (Ubat stapler) pada pembungkus makanan tidak berbahaya					
D22	Makanan yang mengandungi rambut akan menyebabkan masalah kesihatan jika dimakan					
D23	Makanan yang kena lalat atau lipas adalah selamat untuk dimakan					
D24	Suhu persekitaran kantin yang panas boleh meningkatkan kadar pembiakan kuman					
D25	Kuman pada peralatan memasak boleh dibasmi menggunakan air panas					
D26	Peralatan yang tidak dibasuh menggunakan sabun pencuci pinggan mangkuk boleh mengakibatkan pencemaran makanan					
D27	Tuala yang digunakan untuk mengelap tangan boleh digunakan untuk mengelap pinggan mangkuk					
D28	Makanan mentah dan makanan yang telah dimasak tidak boleh disimpan dalam satu bekas yang sama					

D29	Dapur tidak perlu dilindungi daripada makhluk perosak sperti tikus dan cicak					
D30	Penggunaan minyak masak berulang kali adalah tidak baik untuk kesihatan					
D31	Bahan kimia seperti racun tikus dan racun serangga boleh diletakkan berdekatan dengan bahan mentah kering seperti bawang, beras dan tepung					

Modul E: Latihan Pengendalian makanan

Sila bulatkan dan tulis jawapan anda.

Bil	Soalan	Jawapan
E1	Adakah anda telah mengikuti latihan pengendali makanan (LPM)?	1. Ya 2. No
E2	Jika ya, bilakah anda mengikuti latihan tersebut?	

TAMAT

Terima kasih atas kerjasama anda

Appendix C: Formal and Approval letters from State Planning Unit (SPU), Ministry of Education Sarawak (KPM), UNIMAS and Jabatan Kesihatan Negeri (JKN) Sarawak

KEMENTERIAN PENDIDIKAN MALAYSIA
Jabatan Pendidikan Negeri Sarawak
Jalan Diplomatik Off Jalan Bako
Petra Jaya
93050 Kuching, Sarawak

Tel : 082-473473
Faks : 082-473478
Portal Rasmi : jpnsarawak.moe.gov.my
E-mel : jpn.sarawak@moe.gov.my

Ruj. Kami : JPNSW.SKPP.LAT.600-1/1/1 Jld.9 (68)
Tarikh : 9 April 2021

Ling Song Jing

Pusat Mel UNIMAS, Aras G
Bangunan Hal Ehwal Pelajar Dan Alumni (HEPA)
Universiti Malaysia Sarawak
94300 Kota Samarahan
Sarawak

Tuan,

KEBENARAN UNTUK MENJALANKAN KAJIAN DI SEKOLAH-SEKOLAH, INSTITUT-INSTITUT PERGURUAN, JABATAN PENDIDIKAN DAN BAHAGIAN-BAHAGIAN BAWAH KEMENTERIAN PENDIDIKAN MALAYSIA

Dengan hormatnya perkara di atas dirujuk.

2. Sukacita dimaklumkan bahawa Jabatan Pendidikan Negeri Sarawak tiada halangan untuk membenarkan tuan menjalankan kajian bertajuk :

"*Food Borne Disease And The Lifestyles Of The Students And Food Handlers In Rural Schools*" yang melibatkan sekolah-sekolah luar bandar di daerah Betong, Sarawak. Kelulusan ini tertakluk kepada pematuhan *Standard Operating Procedure* (SOP) dan peraturan semasa Perintah Kawalan Pergerakan yang sedang berkuatkuasa.

3. Jabatan ingin mengingatkan bahawa sepanjang tempoh kajian tersebut, tuan adalah tertakluk kepada peraturan yang sedang berkuat kuasa dan menjalankan kajian seperti tajuk yang diluluskan oleh Bahagian Perancangan dan Penyelidikan Dasar Pendidikan, Kementerian Pendidikan Malaysia bil. KPM.600-3/2/3-eras(8886) bertarikh 21 Disember 2020. Surat kelulusan ini sah digunakan bermula dari **20 Januari 2021 hingga 20 Jun 2021.**

4. Jabatan ini memohon agar sesalinan laporan akhir kajian dihantar ke Unit Perancangan, Kualiti dan Inovasi, Sektor Perancangan Dan Pengurusan PPD Jabatan Pendidikan Negeri Sarawak untuk tujuan rekod dan rujukan.

Sekian, terima kasih.

"PRIHATIN RAKYAT: DARURAT MEMERANGI COVID-19"

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

(Dr. ABANG HUT BIN ABANG ENGKEH)
Timbalan Pengarah
Sektor Perancangan dan Pengurusan PPD
b.p. Pengarah Pendidikan
Jabatan Pendidikan Negeri Sarawak

UNIT PERANCANG EKONOMI SARAWAK
ECONOMIC PLANNING UNIT SARAWAK

Jabatan Ketua Menteri
Chief Minister's Department
Tingkat 6, 7 & 9, Wisma Bapa Malaysia
6th, 7th & 9th Floor, Wisma Bapa Malaysia
Petra Jaya
93502 Kuching, Sarawak
MALAYSIA

Tel : (+6)082 – 319387 / 440857
Faks (*Fax*) : (+6)082 – 449481 / 442536
Laman Web (*Web*) : www.jkm.sarawak.gov.my

Our Ref. : (16) JKM/SPU/608-8/2/1 Vol.3
Date : 22 March 2021

Mr. Ling Song Jing
Lot 5048, Interhill Park,
Jalan Shangrila,
98000 Miri, Sarawak.

Dear sir,

APPLICATION TO CONDUCT RESEARCH IN SARAWAK

I am pleased to inform you that approval is hereby given to enable you to conduct a research in Sarawak titled **'Food Borne Disease and the Lifestyles of the Students and Food Handlers in Rural Schools'** from 22.03.2021 to 31.12.2021.

This approval is subject to the following terms and conditions :-

(i) The research will not involve any financial aid from the State Government of Sarawak;
(ii) You are to complete your research within the stipulated time as indicated in this letter of approval;
(iii) Your study should be limited to your research area;
(iv) The Government has the right to withdraw this approval should you deviate from the original scope of your research based on the application form submitted to us; and
(v) Upon completion of your research, printed copies of the final report of your study written in the English Language are to be extended free to the Sarawak State Library (that is designated as the State Depository Centre) (1 copy); the Economic Planning Unit Sarawak (1 copy) and other departments/ agencies connected with your study at no cost.

Thank you.

"BERSATU BERUSAHA BERBAKTI"
"AN HONOUR TO SERVE"

(ASSOC. PROF. DR. MUHAMMAD ABDULLAH BIN ZAIDEL)
Director
Economic Planning Unit Sarawak
For State Secretary Sarawak

Fakulti Sains Sosial dan Kemanusiaan
Faculty of Social Sciences and Humanities

UNIVERSITI MALAYSIA SARAWAK · UNIMAS ·

www.unimas.my

UNIMAS/NC-17.04/04-01 Jld. 1 (4)

10 Disember 2020

KEPADA SESIAPA YANG BERKENAAN

Tuan/puan,

Permohonan Mendapatkan Kelulusan Melakukan Kajian Penyakit Bawaan Makanan Dan Gaya Hidup Pelajar Dan Pengendali Makanan Di Sekolah Luar Bandar di Daerah Betong, Sarawak.

Dengan segala hormatnya perkara di atas adalah dirujuk.

Dimaklumkan bahawa **Encik Ling Song Jing (Nombor Matrik 18010158)** adalah pelajar Ijazah Doktor Falsafah (PhD) di Fakulti Sains Sosial dan Kemanusiaan, Universiti Malaysia Sarawak dan sedang melakukan kajian berkaitan penyakit bawaan makanan dan gaya hidup pelajar dan pengendali makanan di sekolah luar bandar di Betong, Sarawak, Malaysia.

Terdapat 12 sekolah rendah dan menengah akan dipilih dalam kajian ini yang melibatkan pelajar tahun 4 sehingga tahun 6 dan pelajar tingkatan 1 sehingga tingkatan 6. Aktiviti pengumpulan data dijangka akan dilakukan mulai **20 Januari 2021** sehingga **31 Disember 2021** di sekolah-sekolah di kawasan Betong, Sarawak. Borang soal selidik dan cadangan penyelidikan dilampirkan untuk rujukan tuan/puan.

4. Sehubungan itu, kami amat berharap agar pihak tuan/puan dapat memberikan kelulusan terhadap permohonan ini. Sebarang pertanyaan boleh menghubungi penyelia penyelidikan **Dr. Zamri Hassan** (hzamri@unimas.my) dan **Dr. Regina Garai Abdullah** (argarai@unimas.my) di Fakulti Sains Sosial dan Kemanusiaan, Universiti Malaysia Sarawak (UNIMAS).

Kami amat menghargai segala kerjasama yang diberikan oleh pihak tuan/puan.

Sekian, terima kasih.

Yang benar,

Zamri Hassan
Penyelia Utama

MSC-Status

94300 Kota Samarahan, Sarawak, MALAYSIA | Tel + 60 82 581 000 smb 4138/4139 /4145 /4149 | Fax + 60 82 584 155/4163

Ling Song Jing
UNIMAS PhD candidate
Faculty of Social Sciences
Jalan Datuk Mohammad Musa
94300 Kota Samarahan Sarawak UNIMAS
016-8988436
songjing_1992@yahoo.com

14 August 2019

Pengarah,
Jabatan Kesihatan Negeri Sarawak
Jalan Diplomatik, off Jalan Bako, Kuching.

Data Request for Acute Gastroenteritis (AGE)

I am Ling Song Jing, UNIMAS PhD candidate would like to request a data from Pejabat Kesihatan Betong on the surveillance data on AGE from Jan 2014 to Dec 2018. Additionally, I would also like to request a set of data on the prevalence or incidence rates of Food and water borne diseases reported in Betong area particularly on Salmonella and Food Poisoning cases.

Your approval for my application is highly appreciated.

Thank you.

Your sincerely,

Ling Song Jing

Cc District Health Officer, Betong

Appendix D: Safe Food Handling Processes and Safe Food Protective Equipment

When was the food prepared?	Frequency	Percentage (%)
On the same day	20	87.0
Others	3	13.0

Where are the sources of raw materials (Chicken and Fish)	Frequency	Percentages (%)
Farm	2	8.7
Others	1	4.3
Market	19	82.6
Home-based vendor	1	4.3

Protection equipment or tools for safe food handling	Frequency	Percentage (%)
Apron	5	21.7
Apron, other	1	4.3

Apron, cap	1	4.3
Others	4	17.4
Gloves	3	13.0
Gloves, apron	3	13.0
Glove, apron, mask and cap	4	17.4
Glove, apron and cap	2	8.7

Did you use same chopping board for raw food (chicken and fish) and vegetables?	**Frequency**	**Percentage (%)**
No	7	30.4
Yes	16	69.6

Did you use the same towel to wipe the plate and food?	**Frequency**	**Percentage (%)**
Tidak	21	91.3
Ya	2	8.7

Defrost methods	Frequency	Percent
Water Basin	14	60.9
Room Temperature	3	13.0
Others	1	4.3
Microwave	3	13.0
Refrigerator	2	8.7

Do you know how to defrost food safely?	Frequency	Percentage
Tidak	6	26.1
Ya	17	73.9

Did you know how long the foods can be kept in the refrigerator for freshness?	Frequency	Percentage
Tidak	8	34.8
Ya	15	65.2